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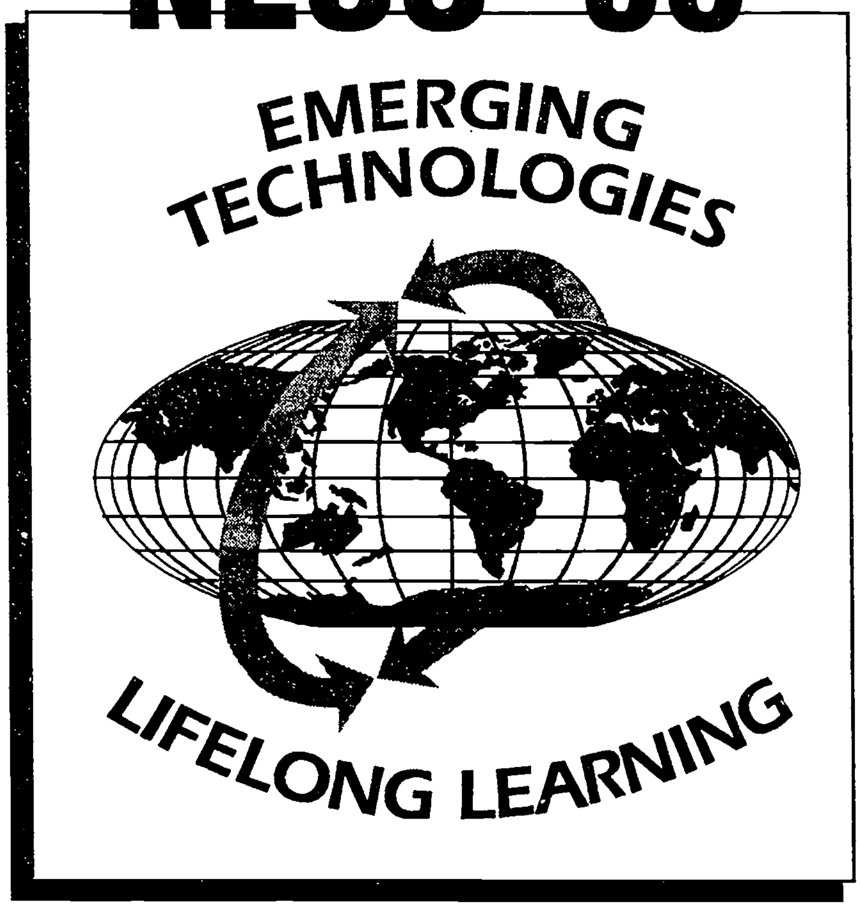
ABSTRACT

This volume of proceedings reports on innovations, trends, and research in computer uses in education across a broad range of disciplines. Papers, as well as summaries of presentations, classroom demonstrations, panel discussions, projects, and other sessions, are provided in chronological order. Topics covered include using technology to create written or multimedia products in the classroom; empowering and motivating teachers to use technology; integrating technology into the curriculum; the effects of technology on classroom techniques; assessing computer knowledge or literacy levels; alternative assessment; hypermedia and the Internet; technology planning; distance learning; gender and minority issues in computer science, and others. The conference committees are listed along with the National Educational Computing Conference (NECC) Board of Directors and Committee. The index is a combined author and key word index. (BEW)

Conference Proceedings

Baltimore Convention Center
Baltimore, Maryland
June 17-19, 1995

NECC '95



National Educational Computing Conference

Hosted by ***Towson State University,*** *in Cooperation with*
Maryland Instructional Computer Coordinators Association

National Educational Computing Conference

NECC '95 Proceedings

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Baltimore, Maryland
June 17-19, 1995

Diana Harris, Editor
Regenia Bailey, Assistant Editor

Hosted by ***Towson State University****, in Cooperation with*
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for the National Educational Computing Conference
June 1995

NECC '95 Proceedings Staff

Diana Harris, Editor
Regenia Bailey, Assistant Editor

FOREWORD

This volume of proceedings of the Sixteenth National Educational Computing Conference (NECC '95) reports on the innovations, trends, and research in the use of computers in education across a broad spectrum of disciplines and levels of education. The Proceedings reflect the breadth of the field of computing, the pervasiveness of technology in the curriculum, the impact of new technologies on education, and the importance of lifelong learning. The ideas expressed here and in the sessions are a manifestation of the vitality of this field.

This conference provides the attendees the opportunity to expand their expertise, benefit from the knowledge and experiences of others, share their mutual interests and develop contacts with other professionals. We believe that this conference will benefit all the participants and that these Proceedings will serve as a valuable reference in the future.

The conference and these Proceedings are the culmination of a great deal of effort by many individuals and groups. Particular thanks are due to

- Dennis Hinkle (Towson State University), who, in addition to his great support as Vice Chair of the conference, gave so generously of his time in working with many of our special and invited guests;
- Diana Harris (University of Iowa), who made this volume of proceedings possible, through her skills as an editor, her patience in dealing with the authors, and her ability to accomplish it all on schedule;
- All the people who submitted papers, panels, classroom demonstrations, posters, and Society Sessions;
- All the referees for their considerable efforts in reviewing the materials and making the frequently difficult decisions of whether to accept or reject them;
- Keith Miller (Sangamon State University), who so ably chaired the Program Committee including the immense task of coordinating all the review processes and putting together such an excellent program;
- Marie West (National Institutes of Health), who contributed much by serving as liaison between the Program Committee and the Local Committee
- The Program Committee, about thirty strong from all across the country, who worked with Keith Miller to provide an excellent, broad, well-refereed program;
- Ali Behforooz (Towson State University), who so ably handled the gigantic task of providing equipment and audio-visual support for the entire conference;
- Darlene Grantham (Montgomery County Public Schools) and John Davidson (Washington County Public Schools), who co-chaired the formidable task of organizing all aspects of the diverse and exciting workshops;
- Linda Rosenberg (Unisys Government Systems), who worked with the vendors to develop those win-win situations where sponsors gained exposure for their products and the conference benefited;
- Joan Morrison (Goucher College) and Edie Windsor (Roland Park Country School), who with energy and imagination arranged the wide variety of social events for conference attendees;
- Robert Wall (Towson State University), who effectively kept all our accounts in order;
- Ron Deitz (Towson State University), who was so impressive in arranging local publicity;
- Richard Austing (University of Maryland), who was of tremendous help with registration;
- Clarence Miller (Johns Hopkins University), J. Zeminski (Carroll County Public Schools, and the Maryland Association for Educational Uses of Computers (MAEUC) for organizing the Birds of a Feather Sessions;
- Ted Sjoerdsma (National Science Foundation) , who with humor and patience served as advisor to the Conference Chair and to the local committee;
- Zelda Schuman (Towson State University), who cheerfully and expeditiously handled all the administrative details of the local operation;
- Susan Taylor (Towson State University), who as programmer and office assistant for NECC '95 handled with a sunny disposition the many daily details;
- the National Educational Computing Association (NECA) for their guidance and support, especially those who advised and encouraged the conference committee;
- and most of all to all attendees, who made the efforts worthwhile.

Doris K. Lidtke
Chairperson, NECC '95
Towson State University
Baltimore, Maryland

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1994-1995 NECA Member Societies

The following descriptions describe the professional societies that belong to the National Educational Computing Association (NECA). Contact information for each society is given following the society's description.

AAHE – American Association for Higher Education

AAHE is a membership association of individuals interested in improving the effectiveness of the higher education enterprise as a whole and their own effectiveness in their particular setting. The Association's membership includes more than 8,000 administrators, faculty, and students from all sectors, as well as policy makers and leaders from foundations, business, and government.

AAHE is higher education's "citizen's organization," where individuals step beyond their special roles to address collectively the challenges higher education faces. Members share two convictions: that higher education should play a more central role in national life, and that each of our institutions can be more effective. AAHE helps members translate these convictions into action.

Through conferences, publications, and special- interest projects, members acquire both the "big picture" and the practical tools needed to increase their effectiveness in their own setting, and to improve the enterprise as a whole.

Contact: Louis Albert, AAHE, 1 Dupont Circle, Suite 360, Washington, DC 20036-1110, aahela@gwuvm.gwu.edu

SIGCAS – ACM Special Interest Group on Computers and Society

SIGCAS is the Association for Computing Machinery's Special Interest Group on Computers and Society. With a membership of nearly 1,200, this professional group seeks to identify social issues raised by computer technology and to provide a forum for discussion on how to approach these issues.

SIGCAS publishes a quarterly newsletter, *Computers and Society*, which is a primary source of material on this topic. As a vehicle of communication for the SIGCAS membership, it includes news, comments, and articles on any societal issues raised by computing technology. One of the few periodicals on this subject, it provides a flexible and timely forum for important, evolving topics, such as data quality, employment, and intellectual property rights.

According to a recent membership survey, about 40% of SIGCAS members teach course material on computers and society. In recent years SIGCAS has organized sessions at computer conferences on topics such as computer ethics and organizational impacts of computers.

Contact: C. Dianne Martin, EECS Department, George Washington University, 6th Floor, Academic Center, Washington, DC, 20052, diannem@seas.gwu.edu

SIGCSE – ACM Special Interest Group on Computer Science Education

SIGCSE became a special interest group of ACM in 1970. It currently consists of over 2000 members from the educational, industrial, and governmental communities interested in various aspects of computer science education. SIGCSE has goals of encouraging and assisting in the development of effective academic programs and courses in computer science and promoting research in computer science education.

The following are objectives of SIGCSE:

1. To provide a continuing forum for discussion of common problems among education and other computer scientists through organized meetings and symposia.
2. To publish a bulletin at least quarterly containing information aimed specifically at those interested in computer science education.
3. To work closely with the Education Board of ACM to insure implementation of effective education programs by the Association.

Contact: Harriet Taylor, Computer Science Department, Louisiana State University, Baton Rouge, LA 70803-4020, taylor@bit.csc.lsu.edu

SIGCUE – ACM Special Interest Group on Computer Uses in Education

SIGCUE provides a forum for the discussion of ideas, methods, and policies related to all aspects of computers in the educational process. Established in 1969 its membership (over 1,400 persons) comes from many countries and numerous, diverse institutions and businesses.

SIGCUE publishes a newsletter titled *The SIGCUE Outlook*. Recent topics have included Preservice Education in Educational Computing, International Reports on Educational Computing, and a Teacher Training Curriculum Project. SIGCUE also sponsors and organizes technical sessions at ACM annual meetings, the National Educational Computing Conference, and other national and regional meetings of interest to its members.

Among SIGCUE's goals are (1) helping to bring the technical expertise within ACM to bear upon educational computing generally, (2) cooperating with other special interest groups or educational societies to promote attention to educational computing issues, and (3) providing written and verbal forums for members and the educational community to exchange ideas concerning computer uses in education.

Contact: John Lawson, Special Education & Transition Programs, University of Oregon, College of Education, Room 175, Eugene, OR 97403-1211, john_lawson@ccmail.uoregon.edu

SIGUCCS – ACM Special Interest Group on University and College Computing Services

SIGUCCS provides a forum for those involved in providing computing services on a college or university campus. The topics addressed by SIGUCCS include managing campus computing, computing as it relates to the overall goals of the institution, and the state-of-the-art in various types of college and university computing services, and provides opportunities to discuss and share ideas and experiences with others.

Two annual conferences are regular activities of SIGUCCS. The Computing Center Management Symposium addresses the many aspects of managing computing on campus. This includes hardware, software, planning, finances, and personnel, to name few. The User Services Conference deals more directly with the delivery of particular services to the higher education community. Tutorials on relevant issues are held at both conferences.

In other projects, SIGUCCS offers a Peer Review of the university computing function. Upon request of the computer center director, members of SIGUCCS will formally analyze and comment on different areas of the campus computing function. SIGUCCS also publishes a quarterly newsletter. We consider the newsletter our most important form of communication as it reaches all members and is subscribed to by numerous university computing centers. Conference proceedings are published either as separate documents or as part of the newsletter itself.

Contact: Chuck Chulvick, Computing & Data Services, University of Scranton, 800 Linden Street, Scranton PA 18510, chulvickc1@lion.uofs.edu

AECT – Association for Educational Communications and Technology

The Association for Educational Communications and Technology (AECT) is an international professional association dedicated to the improvement of instruction at all levels through the appropriate use of instructional technology. Founded in 1923, AECT has evolved as an organization as the technology used in education has evolved, from the early use of traditional audiovisual media to today's interactive and multimedia technology platforms. AECT members can be found at all levels of public and private education, from elementary schools to colleges and universities, as well as in the corporate and government sectors.

Organizationally, AECT has nine special interest divisions, eight chapters, forty-six state affiliate organizations, and fourteen national and international affiliate organizations. With over 5000 members, AECT is the largest international association for professionals involved in the integration of instructional technology to the learning process. AECT is the United States representative to the International Council for Educational Media.

Tech Trends, in its 37th year of publication, is the Association's professional periodical. Published during the school year, *Tech Trends* features authoritative, practical articles about technology and its integration into the learning environment. *Educational Technology Research and Development*, the Association's research quarterly in its 40th year of publication, is the only refereed journal focusing entirely on research and instructional development in the rapidly changing field of educational technology. AECT also publishes reference books on a variety of topics, including practical applications of technology, research, copyright, and standards and guidelines for the field of special interest to instructional technologists.

The AECT national convention and exposition is held each year in January or February, drawing over 12,000 participants and exhibitors. Additionally, AECT sponsors an annual professional development seminar focusing on emerging technologies and a leadership development conference for leaders within AECT and its affiliates.

Contact: Stanley Zenor, AECT, 1025 Vermont Avenue, NW, Suite 820, Washington, DC 20005. 202/347-7834.

CAUSE

CAUSE is the association for managing and using information technology in higher education, with a focus on enhancing the administration and delivery of higher education through the effective management and use of information technology. Through its programs and services, CAUSE serves over 3,050 members on more than 1,100 college and university campuses around the world.

CAUSE member services include:

- Professional development, through the annual conference, seminars, the CAUSE Management Institute, workshops, constituent groups, and recognition programs, including the CAUSE ELITE (Exemplary Leadership and Information Technology Excellence) Award and the CAUSE Award for Excellence in Campus Networking.
- Publications, including the quarterly *CAUSE/EFFECT* magazine, several newsletters, the CAUSE Professional Paper Series, and other member publications.
- Information Exchange, through the Exchange Library with more than 2,500 items, including documents contributed by member campuses, *CAUSE/EFFECT* articles, conference papers, and videos, and the CAUSE Institution Database (ID) Service, a custom reporting service with data about computing environments on CAUSE member campuses.

Contact: Randy Richter, CAUSE, 4840 Pearl East Circle, Suite 302E, Boulder, CO 80301, (303)939-0314, rrichter@cause.colorado.edu

CCSC – Consortium for Computing in Small Colleges

CCSC is a not-for-profit organization focused on promoting effective use of computing in smaller institutions of higher education which are typically non-research in orientation. It supports activities which assist faculty in such institutions to make appropriate judgments concerning computing resources and educational applications of computer technology.

Because departments in smaller colleges and universities are usually small and not highly specialized, the Consortium encourages the sharing of expertise, effective curriculum patterns, and efficient technological applications. The Consortium is concerned with the advancement of major prog.. ns in both computer science and computer information systems, and with the use of computers in the liberal arts and sciences.

The Journal of Computing in Small Colleges is distributed to faculty in more than 200 colleges across the country. Now in its eighth volume, its five annual issues are averaging 500 pages with articles addressing the broad spectrum of curriculum and computer use in higher education.

Contact: Gail Miles, Lenoir-Rhyne College, Box 7482, Hickory, NC 28603, miles@alice.lrc.edu

ECMI – Educational Computing in Minority Institutions

ECMI is an organization run by a steering committee representing institutions whose student body reflects a large identifiable minority population. The objectives of ECMI are:

- Computer literary: To create among the faculty and administrators of the minority institutions an awareness and understanding of the strengths and weaknesses, uses and issues, advantages and disadvantages, feasibility, practicability and limitations of computer applications in all aspects of society, including education.
- Educational Computing: To narrow the gap which exists between the faculties in minority and non-minority institutions with respect to educational computing know-how and access.
- Research Computing: To improve the computing facilities available to faculty of minority institutions for research purposes, particularly in those institutions offering graduate programs.
- Technical assistance-consultants: To provide expert and impartial technical assistance to academic administrators of minority institutions on all phases of academic computing (Instruction and research).
- Education programs in the computer sciences: To improve the offerings of courses and degree programs in the computer sciences at minority institutions at all levels (e.g., introductory courses, minors, 2-year degree programs, 4-year degree programs, continuing education, graduate programs).
- Computing facilities: To improve both quality and quantity of computing facilities available in minority institutions, because experience in the non-minority institutions has shown that an adequately staffed and equipped computer center for academic computing is essential to the success of previously stated objectives.
- Direct student assistance: To increase the availability of minority staff for the computer centers and computer science education programs of minority institutions.
- The need for a comprehensive program: To facilitate coordination and equitable distribution of funded activities to qualified institutions, associations, etc.

Contact: Jesse Lewis, Academic Affairs, Norfolk State University, Norfolk, VA 23504, j_lewis@vger.nsu.edu

EDUCOM

EDUCOM is a nonprofit consortium of colleges, universities, and other organizations serving higher education. Founded in 1964, EDUCOM functions as an association dedicated to the transformation of higher education through the application of information technologies. Through direct services and cooperative efforts, EDUCOM assists its members and provides leadership for addressing critical issues about the role of information technology in higher education.

EDUCOM is committed to the fulfillment of the potential of information technology to realize education that is active and learner centered; free from traditional constraints of time and space; lifelong and collaborative; cost- effective; responsive, dynamic, and relevant; accessible; and outcomes oriented. EDUCOM has historically supported educational networking through computer and communications technology. It has, for nearly a decade, served as the contractor for the operation of BITNET. EDUCOM is committed to shaping the National Information Infrastructure and its uses to enable its effective use by higher education.

EDUCOM is completely self-supporting. Funds are generated from membership dues, conferences, publications, consultations, philanthropy, and collaborations with the National Science Foundation and other government agencies. EDUCOM's membership includes virtually every major research university in the country: four- year private and public institutions, along with a number of two-year colleges, overseas campuses, foundations, consortia, and research laboratories. Approximately 600 higher education institutions and 110 corporations participate in EDUCOM. Each institutional member appoints a voting representative, who serves as the link between EDUCOM and his or her institution.

The annual conference serves as a forum for sharing concepts, developments, and ideas amongst our community. EDUCOM Review is recognized as the premier source of information on information technology policy and its impact on higher education. EDUCOM also publishes electronic newsletters for the higher education community.

Contact: Carol Twigg, EDUCOM, 1112 16th Street, NW, Suite 600, Washington, DC 20036, inquiry@educom.edu

IEEE – The IEEE Computer Society

The Computer Society is the world's largest association of computing professionals, with a total membership of approximately 95,000 computer scientists, computer engineers, and interested professionals. Society membership is open to IEEE members, associate members, and student members and to non-IEEE members who qualify for affiliate membership. An affiliate member is a person who has achieved status in his or her chosen field of specialization and whose interests focus in the computing field.

Every Computer Society member receives *Computer*, a peer-reviewed monthly magazine of general interest to computing professionals which also covers society news and events. Nine specialized magazines and seven journals are also available to society members as optional subscriptions and to nonmembers, libraries, and organizations. Magazines published by the Computer Society include *IEEE Computer Graphics and Applications, IEEE Micro, IEEE Design and Test, IEEE Software, IEEE Expert, IEEE Annals of the History of Computing, IEEE Multimedia*, and *IEEE Parallel Distributed Technology*. Research-oriented journals include *IEEE Transactions on Computers, IEEE Transactions on Software Engineering, IEEE Transactions on Pattern Analysis and Machine Intelligence, IEEE Transactions on Knowledge and Database Engineering, IEEE Transactions on Parallel Distributed Systems*, and *IEEE Transactions on VLSI Systems*. The Computer Society Press publishes nonperiodical literature, including tutorial texts and conference records. The society's catalog contains approximately 900 titles which are available for purchase.

The society sponsors or cosponsors more than 100 conferences and meetings ranging from workshops and symposia with a few dozen participants to major conferences with many thousands of attendees. Over 30 technical committees offer the opportunity to interact with peers in technical specialty areas, receive newsletters, and conduct conferences and tutorials.

The Computer Society has over 100 local chapters throughout the world, and more than 100 student chapters which provide the opportunity to interact with local colleagues and hear experts discuss technical issues. In addition, tutorials, educational activities, accreditation of computer science and engineering academic programs, the development of standards, and an international electronic mail network all play prominent roles in the society's activities.

Contact: Mike Mulder, Center for Advanced Computing Studies, University of Southwestern Louisiana, P.O. Box 44330, Lafayette, LA 70504, mulder@cacs.usl.edu

ISTE – International Society for Technology in Education

The International Society for Technology in Education, ISTE, is a non-profit educational organization, with 12,000 individual members and over 60 organization and associate members.

ISTE publishes *Learning and Leading With Technology-The ISTE Journal of Educational Technology Practice and Policy* (formerly *The Computing Teacher*), *Journal of Research on Computing in Education, CÆLL Journal, Microsoft Works in Education*, and books and courseware for persons interested in the instructional use of computers at the precollege level. These publications emphasize teaching about computers, teaching using computers, teacher education, and the impact of computers on curriculum.

ISTE has a substantial and growing professional outreach program. Major components currently include:

1. Organization Affiliate Members. Members publish newsletters and/or journals, hold conferences, and directly interact with their own members.
2. Professional Staff. ISTE has a professional staff who write, edit, participate in conferences, process orders, consult by phone or mail, etc. *Learning and Leading With Technology* is put together by a full in-house production staff.
3. Ad Hoc Committees. Such a committee created the "ICCE Policy Statement on Software Copyright" and "Code of Ethical Conduct for Computer Using Teachers."
4. Special Interest Groups. ISTE has organized special interest groups for computer coordinators, teachers of educators, computer science educators, Logo-using educators, telecommunications, and hypermedia/multimedia.
5. Independent Study courses. ISTE offers eleven independent study courses carrying graduate credit from the Oregon State System of Higher Education.
6. Private Sector Council. The Council represents a broad range of corporations and services in an advisory capacity to ISTE's Board of Directors.

Contact: ISTE, 1787 Agate Street, Eugene, OR 97403-1923, ISTE@oregon.uoregon.edu

ISTE SIGTC – Special Interest Group for Technology Coordinators

The Special Interest Group for Technology Coordinators (SIGTC) is a professional organization that helps technology coordinators meet the challenges of a rapidly changing field. We provide an excellent forum to identify problems and solutions, and share information on issues facing technology coordinators at the precollege level.

SIGTC publishes *SIGTC Connections*, a quarterly publication, through the International Society for Technology in Education (ISTE). Articles in *SIGTC Connections* contains helpful information and answers to questions such as:

- Who's doing what to organize and communicate with teachers and administrators?
- What committees and techniques work best for other coordinators?
- How can technology coordinators enlist the support of school site administrators?

Contact: Bonnie Marks, Alameda County Office of Education, 313 W. Winton, Hayward, CA 94544, bmarks@ctp.org

ISTE SIGTE – Special Interest Group for Teacher Educators

SIGTE is the ISTE Special Interest Group for Teacher Educators involved in educational technology. SIGTE provides a forum for members to share successes, raise questions, and meet the challenges of helping other professionals use technology to enhance learning and education. It publishes a quarterly journal, the Journal of Computing in Teacher Education, that works to provide its members with the answers to practical, leadership, research, and theoretical questions such as:

- What is happening in K-12 computer education that relates to teacher education programs?
- What funding issues are in the fore front of current preservice and inservice teaching areas.
- What are the directions in teacher education as related to computer and technology education?
- How can educators become effective critics and implementers of innovations using technology?

Contact: M.G. (Peggy) Kelly, College of Education, California State University–San Marcos, San Marcos, CA 92096-0001, peggy_kelly@csusm.edu

SCS – Society for Computer Simulation

The Society for Computer Simulation (SCS) is the only technical society devoted primarily to the advancement of simulation and allied technology. It has a worldwide membership and a network of regional councils that cover the United States, Canada, the United Kingdom, Europe, and the Pacific Rim.

Simulation is used in every scientific and technical discipline including aerospace, biomedical, business, education, engineering, and manufacturing. Areas that have been specifically recognized as important to SCS members include artificial intelligence, CAD/CAM, education, environmental issues, knowledge based systems, robotics, simulators, and standards.

The society publishes *Transactions of SCS* (an archival journal) quarterly and *SIMULATION* (a journal of applications of simulation) monthly.

Besides the flagship Summer Computer Simulation Conference (SCSC), the society sponsors several other conferences including the SCS Western Multiconference, the SCS Eastern Multiconference, the Winter Simulation Conference, and the European Simulation Symposium.

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Classroom Demonstrations

Saturday, June 17

classroom demonstration

Exploring Your City with Technology

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Key words: multimedia, K-12, arts, social studies, photography, architecture, elementary

Students love field trips and multimedia. This demonstration combines the two, using multimedia to bring the sights and sounds of the city into elementary school classrooms. Students can become architects, engineers, planners, reporters, and even political activists with electronic tools to record their observations and express their opinions. Kids can start at any level. Kindergartners can dictate stories and draw pictures about their homes. Older students can write, record narrations, publish photos, and produce videos about their communities.

Although a wide variety of projects are possible, presenters will focus on techniques for making annotated maps and guides to historic landmarks with examples created by children from the Washington metropolitan region. A professional photographer will offer tips on taking good pictures, and the demonstration will include basic skills, such as combining photographs with sound recordings. Discussion will explore ways to use multimedia to discover children's special abilities and create connections to other areas of learning. Panelists will talk about ways to use picture books to introduce ideas and to prompt children to ask questions. Computer resource teachers will offer strategies for coaxing reluctant writers to express ideas in words.

Multimedia provides many tools for recording and interpreting observations. It can also be an avenue for creating fantasies, moving from what is to what might be. The city, as students know and imagine it, is the focus of this demonstration. Electronic drawings, photos, sound recordings, and writing are the featured work.

classroom demonstration

"Look What I Wrote!" Enhancing Written Language through Big Books, Word Processors, and Telecommunications

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Key words: software integration, written language, special-needs children

Abstract

This presentation demonstrates how the computer can be used effectively as a writing and multimedia tool to enhance written language, reading, and critical thinking skills for severely learning disabled students. We ascertained a need for comprehensive integration of written language skills and whole language units utilizing the computer. The computer provides a motivating and stimulating medium which eliminates the pencil and paper frustration of our students.

A current trend in education is the use of literature-based reading programs. Unfortunately, literature sources are not always appropriate to the reading and interest level of severely impaired students. Therefore, we have used software that creates big books as an integral part of the whole language approach to develop reading, comprehension, and critical thinking skills, as well as to motivate independent creative writing within a language arts program.

The entire program is centered around student generated stories, which are used for development of reading skills. Software integration in the curriculum is possible with graphic-writing programs, desktop publishing stories, and multimedia presentations based upon unit content areas. Telecommunications' projects have included writing pen pals, topic discussions, and teleconferencing between classes. We use the computer and a modem to take away the emotional barriers of shyness and social inappropriateness, to enhance students' self-esteem, and to allow the them to experience written language in a practical sense. We have found that using the computer successfully enhances written language through the use of a variety of programs, strategies, and activities. Highlighted projects include: student-generated big books based on thematic units, original stories using desktop publishing, multimedia presentations, other commercial software, and telecommunications projects. Software to be demonstrated in this presentation includes Macintosh programs: *The Writing Center*, *SuperPrint*, and *KidPix (Slide Show)*, *Storybook Weaver*; and Apple II programs: *Big BookPublisher*, *SuperPrint*, *Clifford Big Book*, *Banner Books*, and *Children's Writing and Publishing*. Appropriate software provides for flexibility and creativity. It also allows for adaptations, which are important to ensure that the student with special needs is actively included in the regular education curriculum.

classroom demonstration
Using Spreadsheets in a General Education Math Course

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Key words: spreadsheet, general education mathematics, problem solving

Abstract

Introduction

Our university has developed a general education curriculum in which all students would be expected to take the same core of courses, regardless of their areas of specialization. This curriculum is not required of all students in the university, but after three years of piloting has been approved by the faculty as an option for fulfilling a student's general education requirements. The mathematics components of this curriculum have been designed based on the assumption that each class will be made up of students of widely different backgrounds.

Material from the first course of the two-course mathematics sequence will be the focus of our demonstration. One thrust of the course is the development of mathematical models that are used to solve various problems. Most weeks, one of the three class periods is spent in the computer lab, working on lab exercises that we have designed to illustrate mathematical concepts. Three of the lab units are based on the use of spreadsheet, and the tasks are summarized in the following paragraphs. We will demonstrate some of these exercises.

Unit 1

The overall objective is to learn to use spreadsheet software in solving problems. Students create a spreadsheet that contains "first-semester expenses" (amounts made-up by the students–this one is fun!) and learn to have percentages of expenses in categories calculated and displayed via pie graphs. The second task in this lab involves using XY-graphs to discover at the point at which a fictitious bank's checking account would be a better deal. Students run this for different sets of parameters regarding number of checks written, and other checking account features. Not only are they learning to use the spreadsheet tool, but they are also learning to identify and modify the parameters of the model.

Unit 2

The overall objective is to use the spreadsheet tool to work with polynomial and exponential functions. Now they work with a simplified model (quadratic) involving decisions that might be made as a college tuition increase is contemplated; the parameters represent assumptions regarding how many students will leave per each increase in tuition. Again, students use graphs to see the effect of different assumptions. Then they look at the exponential functions pertaining to compound interest as they determine how much money needs to be borrowed or how much should have been saved to pay the tuition.

Unit 3

In the third unit, students begin with rate of change problems, using the spreadsheet formulas to show the amount of increases/decreases with various assumptions of rate of change. The final task in this lab unit asks them to graph various kinds of functions to see which have faster growth rates.

Conclusion

What we do with spreadsheet is not particularly novel. The major advantage is that spreadsheet software is widely available; schools that already have computer labs can incorporate similar hands-on experiences without having the expense of additional software. We feel that we are having some success motivating the students to learn mathematics by having them work on problems to which they can relate, and using a tool which allows them to "see" the solution.

classroom demonstration

Interactive Mathematics Text Project: Probability and Statistics Interactive

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Key words: interactive text, mathematics, MathCad, Parkville

In our technological society, students must be competent in advanced mathematics. Recently, there has been national attention on reversing the trend of losing students in mathematics education. In their recent works on curriculum, assessment, and teaching standards, the National Council of Teachers of Mathematics has promoted a change toward more active mathematics instruction. The Interactive Mathematics Text Project (IMTP) was established with the goal of improving mathematics learning through computer-based interactive texts. Since 1992, summer workshops have been held to author these texts. Originally, the workshops were for collegiate faculties, but now opportunities have filtered down to high school teachers. These workshops have been funded by IBM corporation, the Mathematical Association of America, and the National Science Foundation. The IMTP sites are Morehouse College; the University of Houston, Seattle Central Community College, Towson State University, Los Angeles Pierce College, and the University of Michigan. Texts have been developed using *Maple, MathCad, Mathematica,* and *MathKit for Windows.*

In September, 1994, Parkville Center for Mathematics, Science, and Computer Science opened for ninth grade students. The students are enrolled in algebra or probability/statistics and functions, geometry, chemistry, and computer science. The computer science class introduces students to various software packages such as *Astound, Microsoft Works, Turbo Pascal for Windows, Geometry Inventor, Algebra Explorer, HyperCard,* and *MathCad.* The computer lab at the Parkville Center contains 28 networked 486 PC's; every station has access to *MathCad.* The students perform the *MathCad* interactive text labs for probability/statistics and for algebra and geometry (written by DeBlase and Wagner) in their computer science class. The purpose of the labs is to reinforce the concepts learned in the mathematics and science classes, with the students as active participants in the learning process. The students keep a daily log describing their work. Teamwork is encouraged. With an interactive text, the students have the opportunity to proceed at their own pace with immediate feedback, and to refine and extend their knowledge by further exploration.

The interactive text labs were written in *MathCad*. *MathCad*, developed by MathSoft, is a mathematical scratchpad that turns your computer screen into a worksheet capable of integrating calculations, graphs, and text. Individual MathCad documents can be combined into an Electronic Book called a *MathCad* handbook, which comes with a table of contents and index. The handbook can be easily navigated by using a built-in toolbar palette or by double-clicking on entries in the table of contents, index, or in the chapters themselves.

The probability/statistics handbook was developed in a four week summer workshop at Towson State University, 1994. The probability/statistics labs provide "mathematical engines" for exploring probability and statistics concepts. Probability is explored using the coin tosser, die roller, two dice roller, probability of same birthday simulator, and craps game simulator. The students do their work in an annotated handbook that is a copy of the original handbook. The student's work saved in a different color and the original handbook remains unchanged. This becomes a part of the student's portfolio.

The students at the Parkville Center have learned quickly how to use *MathCad* to solve mathematics and science problems. They are performing on a higher level because in order to use *MathCad* to solve their problems they must know how to solve the problem. The interactive labs foster cooperative learning, and the students seem more focused on their work. *MathCad* enables students to organize their work and to create generalized methods for solving problems. The students who finish quickly are encouraged to help others.

On the negative side, some students have trouble organizing their thoughts and don't use the software to generalize. They accept an answer as correct without checking its accuracy or reasonableness. Some students don't understand the mathematical concepts required to solve the problem and these students have trouble staying on task. With only one teacher in the lab it is difficult to help all of those who need it.

Conclusion

The electronic text is a new and powerful tool to help students learn. Interactive texts provide an opportunity for students to actively explore mathematics and affect the learning process by captivating students, encouraging teamwork, stimulating creativity, requiring writing, and extending and refining knowledge. Each student can proceed at his/her own pace and have an individual record of his/her mathematics explorations. The student takes responsibility for learning as an active participant. The software allows the students to focus on real problems and make the connections to other fields. The teacher's role in the classroom is one of an advisor and a facilitator.

classroom demonstration

Integrating Microsoft Works 4.0 into the Curriculum: Using Works for Activities that Encourage Critical Thinking

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Key words: critical thinking, problem solving, Microsoft Works, databases, spreadsheets, word processing

Teachers often ask me, "How can I use a spreadsheet with my students?" or "Do you have any ideas about how to use databases to help my students improve their critical thinking skills?" Now that computers have been available in schools and homes for many years, a large number of teachers have become skilled users of integrated programs like *Microsoft Works*, *ClarisWorks*, or *AppleWorks*. These teachers use their software to complete tasks associated with their profession. They word-process lesson plans and other writing; they use databases to organize student records and spreadsheets to calculate grades, and they print merge documents to personalize communication with parents. These teachers successfully use the computer as a productivity-enhancing tool to improve their total professional performance.

Such skills empower teachers by removing some of the drudgery associated with their professional tasks. However, they don't necessarily improve a teacher's most important role–enhancing the learning process. Nevertheless, once teachers are competent "productivity tool" users, they frequently search for ways to use these same computer powers to enhance their classroom instruction. Unfortunately, practical strategies for integrating computer use into the instructional process can prove difficult to discover or create without the presence of experienced mentors. This classroom demonstration is designed to assist teachers in their attempt to extend their productivity skills to classroom instruction with a critical thinking focus.

Some of the activities presented during the demonstration can be used effectively with a single computer in the classroom, while others are more appropriately used in a computer lab. Most of the practices can be enhanced by using a large monitor or an LCD (liquid crystal display) panel and a high quality overhead projector so that the computer display can be read easily by the whole class. However, the activities can all be modified to suit the instructional style of the teacher, the available equipment, the grade level of the students, and the objectives of the lesson. Although the exercises are demonstrated with *Microsoft Works 4.0* for Macintosh, they can easily be modified for use with other popular integrated packages like *ClarisWorks* or *AppleWorks*.

The classroom demonstration examines the use of *Works 4.0* components–word-processor, database manager, spreadsheets and charting, draw layer, and communications module–for activities that encourage the development of critical thinking skills. The session includes both instructional support ideas, such as using the database manager to enhance brainstorming sessions and student-directed activities, or using spreadsheet templates to allow students to explore the relationships in a three by three Magic Square.

One useful instructional approach for using word-processing powers to provide critical thinking activities is to utilize the "cut and paste" features in lessons requiring students to resequence content area information. Several examples of these resequencing activities will be demonstrated using science, social studies, and language arts content. The database's sorting and searching powers are excellent tools for students to use while exploring information for existing patterns and relationships. Examples of these investigatory activities will be demonstrated using data sets including the planets, the states of the United States, and the Presidents of the United States. The spreadsheet's number crunching powers offer students excellent tools for examining numerical relationships. The demonstrations of these activities will include "Guess My Rule" and "Magic Squares." The charting module offers students the ability to visually interpret numerical data in many different forms. Graphing activities using meteorological data and survey results will be demonstrated. Communication software provides students with access to the rest of the world through the Internet. This connectivity allows students to compare and contrast their climates, cost of living, daily activities, and values with distant peers.

The same software powers that enhance any educator's professional productivity can also be used to improve his/her instructional effectiveness. By using an integrated package like *Microsoft Works* in this way, we are encouraging our students to use the available tools for gaining insights into data relationship as well as for completing routine projects. Over time, this approach will help students master the software tools and help them recognize the help these tools can provide during their lifetimes as learners.

classroom demonstration

The High Tech Road to Making an Oral Report

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Key words: oral reports, educational technology, anxiety-reduction, study skills

Abstract

Oral reports are one of the school activities most dreaded by a majority of students, according to polls taken in middle and high schools. Students in these grades report that research, preparation, and delivery of oral reports are sources of extreme anxiety for many, and high anxiety for most. Much of this anxiety can be reduced by teaching students to use electronic supports at all three phases of the assignment. We present these techniques to students as the 3 R's of Reporting.

The 3 R's

- The first 'R' stands for Research and Write.

  Encourage students to go beyond conventional resources and use a variety of technological sources of data. Depending on their topic, they can access information via CD-ROM, TV, video and audio tapes, and online media. Information can also be obtained from primary sources by interviews via telephone (using an inexpensive device for tape recording), fax, and online contacts. Computers and word processors are highly effective for organizing and writing the speech.

Notes to be used during delivery of the speech are best printed in a large, easy-to-read, bold font.

- The second 'R' is for Reinforce.

  Show students how to enhance the theme of the speech by preparing props that will involve the listeners and maintain their interest without being distracting. Props also help the speaker with the problem of what to do with his/her hands. Sample props include handouts, stickers, stamps, bookmarks, and timeline banners.

- The third 'R' is for Rehearse.

  Provide time and equipment for students to use a camcorder or audiotape recorder to rehearse the speech. Rehearsing helps them become comfortable handling notecards and props, avoids making a presentation that sounds canned, and notes mannerisms that could interfere with audience attention. Emphasize to the students the difference between memorizing and rehearsing.

Handouts for students should include tips on making the actual presentation, with information about how to dress, how to stand, how professionals recoup if they blunder, and any class specific rubrics.

A more detailed discussion of using technology to research, write, and edit can be found in Upgrade: *The High Tech Road to School Success* by Wirths and Bowman-Kruhm, Davies-Black Publishing, 1995.

classroom demonstration

Cruising a Four Lane Highway: Using Telecommunications in Global Education Projects

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Key words: telecommunications, social studies, library media, global education

Our objective is to demonstrate how we use the multiple potentials of telecommunications to make global education projects a dynamic part of a high school social studies curriculum. We shall also demonstrate ways in which a classroom teacher and library media specialist can work together to implement a project that uses telecommunications.

Information searches, retrieval of data, and the online exchange of positions and viewpoints are all part of ICONS (International Communication and Negotiation Simulation) and CPIN (Connecticut Project in International Negotiations). Students receive a scenario of world events set in the near future and assume the role of a specific country as they debate relevant topics that affect the global community.

Both projects stress the different ways in which society uses telecommunications. Working in both the classroom and the library media center, students formulate and refine their information needs based on the scenarios that will be used in each simulation or exchange. The next step is to actually do the research that is required to build the knowledge base needed to intelligently develop positions. Online sources that provide up-to-date, extensive material are essential. These include popular services such as America Online, as well as more sophisticated tools such as Ingenius and DIALOG, through which students access articles from a wide range of publications.

Critical to this first phase is a strong partnership between the classroom teacher and library media specialist. Objectives must be jointly understood, research time must be flexibly scheduled, and instruction in refining and carrying out searches must be available.

The next steps involve discussion and collaboration by the students to determine what position the team will take on such issues as human rights, the arms race, trade, and the environment. Using electronic mail and real time conferencing, students exchange information and negotiate solutions to real-life problems. Using the Internet, these projects have been done with high school students in the United States as well as German and French students.

The projects help students develop the skills necessary to understand the complexity of international issues, as well as those needed to use the technology that makes these fast-paced, exciting activities possible. In addition, students also develop skills in decision-making, creative problem-solving, and online research.

Our intended audience includes high school and college faculty, technology coordinators, and library media specialists. Our demonstration will include a multimedia presentation that shows components of the projects.

classroom demonstration

Enviro Quest: Encouraging Scie''tific Career Exploration

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Key words: scientific career exploration, CD-ROM development

Abstract

Background

In order to remain competitive in a global economy, the United States will need to train enough engineers and scientists to meet the expected demand of the 21st century. To address this challenge, the Medical University of South Carolina received a grant from the South Carolina Universities Research and Education Foundation (SCUREF) to increase students' interest and awareness in engineering, mathematics, and science, using a computer-based multimedia approach.

Early intervention is required to ensure that students have sufficient opportunities to develop strong backgrounds in these areas. Therefore, middle school students were targeted as the most appropriate audience.

Middle school students in South Carolina have received instruction and expressed an interest in environmental issues throughout their school careers. Therefore, the investigators of the grant decided to provide an introduction to the scientific disciplines associated with various environmental issues. The co-investigators also determined that an interactive multimedia program based on these environmental issues would further enhance student interest. The result was an interactive, multimedia CD-ROM developed by the Educational Technology Laboratory on the campus of the Medical University of South Carolina.

The CD-ROM, entitled "Enviro Quest," uses a Superheros theme to provide content and games related to specific environmental issues, as well as videos that focus on environmental careers. Preparation for these careers is highlighted, emphasizing the need for mathematics and science courses throughout high school.

Project Development

For the first three months, a content expert worked full-time with the development team. The development team made a presentation to a meeting of math and science representatives from each middle school in Charleston County, SC, to encourage them to participate in the evaluation of "Enviro Quest." Teachers were asked to submit applications if their schools were interested in being a pilot site for the program. As a result, four schools were selected: two schools evaluated the program in February 1994, and two additional schools evaluated the program in May 1994. During the evaluation sessions, computers were delivered to the pilot sites along with the program. Each school determined the most effective way to provide students access to the program. The program remained in each school for approximately two weeks.

During the February 1994 evaluation, the program's content was presented through two different interfaces. A brief questionnaire was given to each student who used the program aksing them to identify their preferred interface, their likes and dislikes about the program, as well as anything they would change. The results of this evaluation led to numerous program changes, including the combination of the two interfaces.

Following changes, the program was placed at two different middle schools, again, for approximately two weeks. Here, in addition to students completing a questionnaire regarding their likes and dislikes, pre- and post-tests were given regarding specific content.

In total, over 500 students used and evaluated the program. Ninety-five percent responded that they enjoyed the program. Ninety percent of the students completing the pre- and post-tests met the objectives.

Following the evaluation in May 1994, evaluation results were analyzed and program changes made based on the analysis. In September 1994, a CD-ROM was made and delivered to the funding agency.

Future Plans

Enviro Quest will be distributed to all middle schools in South Carolina through the South Carolina Universities Research and Education Foundation (SCUREF). A brief user's guide accompanies the CD-ROM, and a detailed teacher's guide is currently under development. This guide will include correlations with middle school math and science objectives as well as recommendations for classroom incorporation and use. The Medical University of South Carolina is currently working on the second CD in this series, focusing on careers associated with recycling and conservation. This project will use a similar evaluation and documentation process.

classroom demonstration
Sensational Student Science Simulations

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Key words: science simulations, hypermedia, WWW, integrated curriculum

In the Sensation Student Science Simulations Project, students at Baker Demonstration School (BDS) of National-Louis University design hypermedia simulations focusing on a concept in mechanics or chemistry. The faculty and students of the Middle School at BDS collaborate to establish a constructivist learning environment. The essential elements of this environment include peer collaboration, cross-grade student interactions, faculty-faculty collaboration, student-faculty collaboration, and extensive exploration of ideas and processes.

This project involves the eighth grade students at BDS, the science teacher, the technology teacher, selected students in fourth and fifth grades. As seventh graders, the students learned hypermedia authoring as part of a unit in science entitled The Hypermedia Zoo. Each student designed and constructed a hypermedia (*HyperCard*) presentation based on the observational study of a particular mammal at the Lincoln Park Zoo in Chicago, Illinois. As part of the technology curriculum, these students also designed stacks using HyperStudio for a Latin project and began using the Internet with various E-mail projects. They explored the Internet using Mosaic and built home pages using hyper text mark-up language (HTML).

As an essential element of their studies this year, the eighth grade students are using Mosaic to design a simulation of a science investigation. The purpose of the simulation is three-fold. First, the simulation will be used to assess how effectively the student authors understand the information. Second, on an in-house level, they will use their simulation to introduce a fourth or fifth grader to their study. The simulation is a preview for an actual investigation the individual fourth or fifth grade student will perform under the guidance of the eighth grader. Third, specific groups of students in other schools will go through the Mosaic simulations in their own schools and perform the investigations with the eight graders using video conferencing. The students will exchange feedback via the Internet, and eventually meet each other in person.

Students write several reflective summaries during the project describing what they are learning. Written at the end of the unit, a more structured summary includes: a summary of what the student has learned, an evaluation of what the lower grade student experienced, a self-evaluation of the specific simulation, and an evaluation of the teaching methodology to provide feedback to the science and technology teachers to shape the implementation of this project with next year's eighth grade class. These two forms of discourse serve as a basis for examining themes that emerge as the students construct their knowledge.

In the presentation of the Sensational Student Science Simulations Project we will share student simulations, their comments on the learning process, and the technology used to produce the simulations.

classroom demonstration

The Magic of Multimedia

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Key words: multimedia, interactive, integrated, curriculum, student, achievement

Imagine. . .

The morning bell rings. Students enter the classroom, take their seats around circular tables, and focus their attention on the television. Within moments, music begins as a computer-generated animation appears. The students watch as an image of the Earth spins. From behind the Earth, meteors come across the screen introducing Andrew Robinson Elementary School in Jacksonville, Florida. The student-produced morning show has begun. The class watches as schoolmates provide information on upcoming events, announcements, the weather, sports, and positive thoughts for the day from the school' s closed circuit television studio. As the morning show closes, a student leaves his seat to turn on the three Macintosh and two IBM computers in the classroom. The teacher reviews the day's schedule of activities. As she looks around her room, she sees that her students are excited hearing about what the day will hold for them. The day will include classroom computer time working on a science-related interactive product in *Hyperstudio*, a trip to the Macintosh Lab to frame-grab images for an *Aldus Persuasion* cooperative project, a visit to the IBM LAB to conduct research using *Compton's Encyclopedia*, opportunities to build and test a computer driven machine using *LEGO LOGO*, and time to plan and produce their cooperative team's next video storybook. It is a typical day for them; they are students at one of the most technologically advanced schools in the city—a school that emphasizes a positive, stimulating environment in cooperative settings. It is a school in which students learn to use the technological resources available to them to conduct research, plan, and create dynamic computer projects centered around an integrated curriculum. It is a school in which students are excited about learning, and where teachers work together to provide meaningful and stimulating lab and classroom technology experiences.

Experience the magic of multimedia as workshop participants participate in a live demonstration of the integration of text, graphics, animation, audio, and video within an elementary school curriculum. Exciting student multimedia productions that incorporate *Macromedia Director, HyperCard, Aldus Persuasion, Hyperstudio, Digital Chisel,* and *QuickTime* movies will be shared while providing insight on how to teach multimedia production to students in grades K-5.

At Andrew Robinson Elementary, a large inner city elementary school, technology has become a tool that empowers students to pursue purposeful academic exploration within a challenging and dynamic format. Through the use of interactive multimedia production, students have demonstrated improved self-esteem, motivation, leadership ability, and academic growth. Multimedia technology has been effectively utilized to address multiple learning styles, extend critical thought, facilitate cooperation, and promote lifelong learning.

This session will also provide workshop participants with recommendations and suggestions for hardware and software to get started in multimedia production.

classroom demonstration

Technology Transfer from Television Production to the Computing Classroom Teacher

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Key words: digital video, desktop video, multimedia

Abstract

Much is being said about digital video, but it is not easy to get an overview of DTV because desktop video means different things to different people. Part of the solution is for teachers and technology professionals to discover the work that has been done by video professionals over the past several years. This demo will orient teachers and administrators as to what can be done with the new digital video hardware and software tools.

The following areas will be addressed:

- The NTSC analog signal will be briefly explained in simple, easy to understand terms.
- The tools and techniques for encoding, decoding , compressing and manipulating NTSC will be covered.
- Video practitioner magazines and other resources will be identified.
- What preparation is essential?
- What strategies are appropriate?
- How much time and money is involved?

classroom demonstration

Interviewing Skills for Social Welfare Students (A Multimedia Simulation)

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Key words: interviewing, interactive, video, computer-managed learning, social sciences, simulation

Abstract

Introduction

The aim of this study is to improve the interviewing skills of undergraduates utilizing currently available computer-based technology. The target group in this initial study is social work students. However, we anticipate that the skills delineated in this study will have relevance to other course areas. This study creates an environment in which essential interviewing skills can be developed and assessed without involving any potential real-life client or interviewee in misguidance or psychological damage. To accomplish this, a set of simulated client behaviors have been videotaped, following a script prepared by the specialists in the appropriate discipline (in this case, the social work staff). In conjunction with these are a set of parallel responses, allowing the students the choose a response to the "client's" behavior and comments. These parallel responses have been videotaped, using a professional actor and one of the participating social work staff. Further client actions or behavior have also been videotaped, allowing the students to explore the ramifications of their selected intervention strategies and decisions (appropriate or inappropriate).

The criteria used in evaluating the students' performances are:

1. Ability to choose the most appropriate strategies and responses.
2. Increased confidence in handling sensitive interview situations.
3. Improved attitude towards the task of learning interviewing skills;
4. Reduction in the time a student takes to achieve mastery of the core-essential interviewing skills.
5. Increased awareness of the rationale behind his/her actions.
6. Greater understanding of the critical analysis process.
7. Acquisition of self-directed learning techniques.
8. Ability to deal with problems that are ill-defined and for which there are no obvious or easy solutions.
9. Ability to respond to changing situations and client-generated material.

Rationale

A group of core communication skills and related strategies is essential in any interviewing situation. Research results confirm that the skills make a difference in interviewing practice, but only if they are used in real-life situations. This programmed package is based on the single-skills concept. The package presents both positive and negative instances of interviewing behavior. A student is presented with a video clip showing client behavior and asked to choose one of the three video clips of varying counsellor responses. If an appropriate response is chosen, the interview proceeds to the next step of client response, otherwise an explanation of the inappropriateness is presented and the student is directed to return and choose a more appropriate response.

Contribution to Excellence in Teaching

In the first instance this study is directed to social work students. However, this package framework has applications for improving the delivery of active-interviewing skills in other academic disciplines across the university. In social work, the skills critical to interviewing processes are traditionally acquired through theoretical lectures, small-group activities, and sometimes augmented by role-playing. The provision of field practice supplements these approaches, but problems can occur when personal situations arise involving actual clients.

Innovative and Original Features

This study is not just the passive viewing of a static video presentation of material. To be classified as a dynamic presentation, there must be active interaction and intervention with the video program to cause the presentation of the material to divert into alternative outcomes. This moves the learner from a passive observer to an active participant, resulting in a maximization of his/her learning potential. A key innovation is the provision of appropriately sequenced interactive feedback. In particular, the students themselves are able to call upon this feedback as required. This enables them to undertake on-screen post-evaluation following the case scenario vignettes.

classroom demonstration

Imagine NIH IMAGE in your Classroom

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Key words: image processing, NIH Image, HIP physics, math, science, CIPE

Abstract

The National Institutes for Health developed and maintains a freeware program for use by scientists called *NIH Image.*. This is a Macintosh program written and maintained by Wayne Rasband requiring a minimum of 4 MB RAM, a color monitor that can display at least 256 colors, and version 6.0.7 or later system software. For some operations a math co-processor (FPU) is desirable. It is available on Internet at ANONYMOUS FTP: zippy.nimh.nih.gov.

Image Processing for Teaching (IPT) is a CD-ROM distributed through the Center for Image Processing in Education (CIPE) (800) 322-9884, 5343 E. Pima Street, Suite 201, Tucson, Arizona 85712. The full suite of software, images and activities for teaching contained on the CD-ROM, is available through a training and licensing program from CIPE. HIP Physics is an NIH Image based series of activities that does not require licensing and training through CIPE.

Woodbridge Junior/Senior High School obtained a variety of Macintosh hardware, and training and licensing in IPT through a Christa McAuliffe Fellowship awarded to Kathleen Dahlenburg in 1993. The fellowship project focused on experimentation with image processing as a means for providing students with activities that allowed them to demonstrate in a visual way, principles presented in their math and science classes.

Additionally, image processing is a tool used not only be scientists at NIH, but by astronomers, real estate agents, and photographers, to name a few. Students could be given real world problems and a real world tool with which to find a solution.

The first half of this classroom demonstration will illustrate how students at Woodbridge Junior/Senior High were introduced to the *NIH Image* program and an astronomical discovery made with image processing that students can replicate using *NIH Image*.

High School students studied how to use the scanner and created a digital image of their high school facade from a yearbook picture. Junior high students were shown the image and how to set the scale. They were told to find something they could use to determine the scale without leaving the building. They did not even leave the room! The width of a pane of glass visible in the image was measured and the scale set. The image measurement was then checked to verify its accuracy. With the scale set, it was possible for students to determine the height and width of various sections of the building ,and the area of various features on the building. The activity was followed with discussion on making measurements from a remote location, the related benefits and inherent problems.

Students were given a fuzzy image of Jupiter's moon, Io. The students' task was to investigate this image using enhancement techniques and/or false color to try and determine what was happening on Io. Enhancement techniques didn't provide much additional information, but false color application, in addition to magnification, allowed students to determine that some sort of explosion was occurring. Further class discussion determined it to be the first of the volcanoes found on Io. This exercise provides an excellent way for students to understand one way in which scientists can determine the nature of things they cannot hope to investigate at close range.

The second part of the demonstration focuses on the use of the *NIH Image* program in the Physics laboratory with activities and software for *NIH Image* provided through Tom Snyder Productions' *HIP Physics*. Students began by learning some of the capabilities of *NIH Image* and were tested on their skills using the image of the school mentioned earlier.

Physics applications began with Basketball Ballistics, an activity from the IPT CD-ROM and also available on *HIP Physics*. Students analyzed a stack of images tracing the trajectory of a foul shot, frame by frame. Using the macros feature of the program, students measured the horizontal distance between ball positions and graphed the horizontal position of the ball over each time period. The graph was then analyzed to determine changes in horizontal velocity. The process was repeated for vertical movement and the graphs compared. Students were able to see that horizontal and vertical motion are separate, and that while gravity affects vertical motion, it has no effect on horizontal motion.

Image processing was also used by physics students to analyze their own data. Each student conducted a research project and used the technique to analyze the results. Video import capabilities enable students to record a variety of actions and analyze them using *NIH Image*. As an example: towers built for the Science Olympiad competition were loaded and video taped. Image processing permitted analysis of the structures during the loading process and identification of structural defects.

Students quickly realize how useful the computer can be in the analysis of action which happens faster than the human eye can follow. By making fast action visible and measurable, students are better able to comprehend physics concepts that seem to go against their preconceived notions of mechanics.

classroom demonstration

Integrating Technology into a Unit of Study

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Key words: interdisciplinary units, technology, telecommunication, multimedia, HyperCard

Abstract

Any technology used with a unit of study must require the student to think in such a way that the goals and objectives inherent in the unit are stressed. Viewing technology as a constructive medium rather than merely as a means for gathering and quantifying data is the first step to successfully infusing technology into a unit. When deciding what type of technology fits into a unit of study, one of the first considerations should be the unique characteristics of the technology available.

Characteristics of certain technologies

1. Telecommunications supports a "global" view, allowing students to value and be valued by those outside the immediate geographical area.
2. Multimedia presentations enhance observation and documentation skills, ability to understand change, and they connect the "real-world" to the theory of the classroom. Using various multimedia programs to create a presentation

also requires making decisions, weighing options, analyzing choices, synthesizing ideas, and drawing conclusions. Multimedia presentations allow students to share their view of the world.

3. Spreadsheets allow students to record, to analyze, and to communicate data succinctly through the use of graphs and charts. In becoming expert in using a spreadsheet and the accompanying graphs, students also can become competent in discovering how data may be biased using these tools.
4. Graphics and drawing programs facilitate examination of change, scale and proportion, representation of data and relationships, and demonstration of various ideas that may be difficult to describe solely with words. These programs can act as a bridge between hands-on work and symbolic representation.
5. *HyperCard* programs promote the process of webbing, i.e., tying concepts together and allowing the "big picture" to emerge. Using a *HyperCard* stack permits the student to present multiple aspects of a topic, both visually and in written format, while requiring logical thinking and schematic planning. This is especially true when using *HyperCard* to create animation.
6. Peripheral devises such as electronic temperature and pH probes allow students to actively participate in the process of gathering data. They also encourage students to explore cause-effect relationships by manipulating variables.

The characteristics for each specific technology or program listed previously can also be viewed as strengths and their value to a unit of study easily seen. Some terms that describe other strengths of technology usage are changeability, immediacy, control, ownership, willingness to revise, and professional appearance. These strengths are easy to see when compared to the conventional methods of making charts and tables using graph paper, writing or typing reports, or drawing posters to aid in presentations. *HyperCard* and multimedia presentations, which can contain moving pictures and sound, actually have no pencil and paper comparisons . The latter terms listed above support learning in a more general way than the former ones. They support exploration by the ease with which work may be changed without affecting an original. Mastering technology enables a student to control complicated and expensive pieces of equipment, and in turn, gives ownership and self-confidence to the student. These attributes allow students to bring more enthusiasm to their work than they do to pencil and paper work, allows them to explore and revise easily, and encourages them to continue working on a project until it is complete.

Technology and interdisciplinary units

When creating an interdisciplinary unit of study, the first consideration should be the goals and objectives to be mastered. When considering math and science, these goals must come from a nationally recognized source such as the NCTM or Project 2061 Benchmarks if we are to move our students towards world-class standards. After choosing goals from each discipline that fit together, the type of technology that will support them should be considered. The strengths of different technologies previously cited aid in selecting which type of technology can be used. Technology can help in gathering knowledge, it can enhance understanding of information, and it can act as a means for assessing progress in the acquisition of goals in a unit. Technology can also be used in creating a culminating event for a unit. In other words, it can be used at all stages of implementing an interdisciplinary unit.

Some examples of technology used in a unit:

Acquiring knowledge

- Use of computer drawing programs to learn about relationships between perimeter and area in a unit about garbage.
- Use of computer interface and probes to gather information on pH and temperature of water in a water quality unit.
- Use of spreadsheets to sort and quantify data in a unit on waste.

Enhancing understanding

- Use of multimedia to create a presentation that shows and discusses patterns found in nature.
- Use of graphs and spreadsheets to present results of a probability experiment that deals with types of trash found in school trash cans.
- Use of pictures to substantiate findings about water quality.

Assessing knowledge

- Use of Hypercard templates (which must be completed by students) concerning systems of the body.
- Use of multimedia to synthesize the relationship between math and science concepts learned and activities completed in a unit on waste.
- Use of telecommunication to share results with a peer group on a unit about local woodlands.

classroom demonstration

Using Presentation Software in the Classroom to Enhance Education

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Key words: hypermedia, presentation software, PowerPoint, Mosaic, Astound

The objective of this panel is to share our experiences using presentation software in the classroom. Presentation software allows one to develop well-organized and professional looking presentations with limited computer skills. However, this relatively new technology does have some disadvantages to go along with the advantages. This panel will demonstrate a variety of software packages including *PowerPoint*, *Astound*, and *Mosaic*. The focus will not be on specific features of each package but how the software is being used successfully in elementary, high school, and college classrooms.

Each participant will demonstrate the capabilities of a different software package by showing sample presentations that have actually been used in classrooms at all levels of education. Participants will also share their successes and failures with this technology. Audience questions and observations will be encouraged throughout the discussion. Audience members will gain a better understanding of presentation software and how they can start using it in their classrooms.

classroom demonstration
If You've Got Internet, You've Got a Weather Laboratory

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Key words: Internet, meteorology, science, weather

Abstract
Introduction

When I teach meteorology, I spend about two-thirds of allotted time teaching out of the textbook, providing the students with a gradually-expanding scientific background in meteorology. The remaining one-third of the time is devoted to a teaching activity I call "Today's Weather". In this segment of the course, I use an "immersion" technique, in which contemporary weather data and phenomena are studied. These case studies focus either on current weather or on other recent significant weather events. The location of the weather being studied during this segment might be of local, regional, national or global origin. However, the data used for this component are almost exclusively gathered from sources on the Internet.

Whereas the lecture component of the course is taught in a traditional classroom, the case-study segments are taught in a computer laboratory. The computer lab has eighteen stations, each with a 486DX-class computer, and each tied both to a laboratory-wide LAN and to the Internet. The class enrollment is limited to eighteen students, providing one workstation for every student. The instructor's position at the front of the room is connected to a large-screen TV that can be viewed by the entire class. Most data is obtained in a graphical format, and viewed with Windows-based software that allows zooming, scrolling, and simultaneous viewing of multiple images, each in its own window.

For most of the presentations, the data and images are downloaded off the Internet during the hour prior to the class meeting. These data are loaded onto the server of the computer-lab's LAN. Having the data already resident on the LAN results in much quicker loading during class time. (During some sessions, the students do request sets of "real-time" data directly off the Internet). Once the information is on the LAN server, the students each control the loading of the information into her or his own computer. The students are generally capable of learning the OPEN, CLOSE, ZOOM, SCROLL, and multiple WINDOW operations of the software within the first half-hour of the first lab session.

After the appropriate images are loaded into each individual computer, the class as a whole discusses what they see, addressing particular topics that have been chosen by the instructor. Activities might involve exercises in identification, definition, interpretation, explanation, or forecast preparation.

Examples of data types available via the Internet:

- Satellite imagery (IR, VIS, water vapor).
- Surface analysis (station, pressure and frontal) maps .
- Radar summaries (images).
- Radiosonde data.
- Field maps of single data types (temperature, dew points, wind, stability indices, snow cover, etc.) .
- Cloud catalogs.
- Maps of severe weather outbreaks.
- Forecast model output and maps.

Course lessons that utilize the data types listed above:

- Structure of the atmosphere(radiosonde data).
- Operation of weather satellites.
- Types of meteorological data.
- Weather systems: fronts, storms, wind patterns.
- Hurricanes, Thunderstorms, Tornadoes.
- Clouds.
- Climate.
- Forecasting.

URL's of some of my favorite sites for obtaining data:

ftp://kestrel.umd.edu/pub/wx
gopher://apollo.lsc.vsc.edu
gopher://geograf1.sbs.ohio-state.edu
gopher://grizzly.uwyo.edu
gopher://wx.atmos.uiuc.edu
http://rs560.cl.msu.edu/weather
http://thunder.atms.purdue.edu
http://www.atmos.uiuc.edu

NOTE: A complete list of ALL sites providing meteorological data can be found in Ilana Stern's compilation, updated every two weeks, and available at:

ftp://rtfm.mit.edu/pub/usenet/news.answers/weather/data/part1
ftp://vmd.cso.uiuc.edu/wx/sources.zip
http://www.cis.ohio-state.edu/hypertext/faq/usenet/weather/top.html

Implementation notes

Although the activities outlined above are best suited for sites where individual students, or teams of students, each have access to a computer, the activity can easily be adapted for use in those situations where only a few computer-stations, or even a single large-screen station, is available.

- The only software required at the viewing stations is an image display program. Several freeware, shareware, and even low-cost commercial programs are capable of providing this capability.
- Direct high-speed connection to the Internet is not required. Until this year, I relied solely on a dial-up connection to access the Internet. (I continue to supplement my at-school high-speed Internet connection with a 14.4Kb dial-up connection at home.)
- The nature of the data outlined above does not limit itself to any single "level" of user. Although I am using it in a college-level liberal-arts meteorology course, its use at the secondary-, or even primary-education level could be quite appropriate.

classroom demonstration

Skill Development for Maneuvering on the Information Highway

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Key words: computer skills, teaching strategies, Internet, utilizing technology

Abstract

Introduction

With all the hype regarding the Internet and the National Information Infrastructure (NII), the true meaning of global information became a topic of concern at our institution. Easy access was not enough. Students seemed to need something more. We decided to offer students an opportunity to better prepare themselves for the competitive work world by developing their cognitive skills while utilizing technology. Specifically, they were required to use their communication skills, critical thinking skills, analytical skills, and problem-solving skills to explore the avenues of information available on the superhighway. Our primary objectives were skill development in using the information superhighway and investigation of their perceptions of how the superhighway might be used in the workplace, the benefits and risks of global information access, and how such a skill might increase their marketability in the work world.

Our Teaching Technique

We developed a two-hour pilot program with 10 hours of guided access time to test our method for instructing students in the basics of maneuvering along and extracting information from the superhighway. The pilot was designed as a two-part instructional session. Part I was a seminar with complete explanations of what global access to information means. Part II was a hands-on workshop developed to provide participants with textual access via Unix, and graphical user interface (GUI) access via AmericaOnline. Our pilot participants were graduate students with current work experience because they would be able to offer us immediate feedback on specific workplace needs and tasks. They could also provide us with follow-up information regarding work-related problems they encountered during the 10 hours of guided access time and subsequent usage in the workplace.

Computers In Education: Our New Frontier

As a result of the pilot program, we restructured the Computers in Education course offered to graduate students in the School of Education. This course assists current teachers, future teachers, and individuals in industry with implementing computers in learning environments. This course was never meant to be a beginner's introduction to the computer. Therefore, our first priority was to ensure that each student had an acceptable working knowledge of computers. We purchased an interactive CD-ROM, "Easy Tutor: Learn Computers," which provided basic knowledge and hands-on practice with word processing, spreadsheets, databases, and desk top publishing applications. Use of the CD-ROM has been included in the curriculum and is currently undergoing testing.

We used another CD-ROM, "The Internet for Everybody," to work the Internet component into the Computers in Education course. The interactive disk served as an introduction to the concept of the Internet and allowed each student to move through simulations at his or her own pace. Immediately following its use, students became actual electronic travelers.

Assignments were designed to develop exploratory and investigative skills, and to encourage the sharing of resources. Students discovered numerous databases containing information pertinent to their fields and interests. For example, one student with interested in music stumbled upon a directory of musical artists and their upcoming musical releases. Her reaction, "Wow! Look at what I found!" does not adequately describe her motivation for future exploration. A student in Adult Education located a database exclusively on adult literacy issues. She has since taken the information she located on adult education services, grant information, and telephone numbers of social services to her professor for dissemination to their class.

Our method of instruction for the Computers in Education course was different from that of our pilot because the AmericaOnline services proved to be too expensive. Instead, we first exposed our students to textual interfaces to the Internet, and gradually moved them to a graphical user interface (GUI) called Mosaic that was available on our campus. Once again, as per the pilot, we used a combination of educational strategies with training strategies that emphasized hands-on practice. Our Computer in Education course allocates 50% of class time toward the actual use of computers. In addition, our method required the use of workbooks designed specifically for the course by graduate students in our instructional design course.

Approximately 65% of the students in Computers in Education are teachers. The remaining students have jobs in business and industry. Currently, twice as many students attempt to take this course as did a year ago–most of the overflow students have majors outside the School of Education. Suffice it to say, there appears to be high demand for skill development on the Internet among graduate students at our university.

classroom demonstration
Teams and Technology: Setting Up Student Teams for Success

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Key words: team, computer, cooperative learning, learning strategy, procedural facilitator, productivity, learning disability

Abstract
Need
It is not unusual to see students in elementary school, secondary school, and even college working in partners, small groups, and teams. New ways of learning together are dramatically changing the classroom organization. At the same time, the diversity in the regular classroom is increasing, with more students with disabilities and other special needs being included in these settings. Often, these students need assistance in attending school regularly, completing homework, being on time, and coming to class prepared.

Team Set-Up
Team Set-Up provides an organizational structure that allows the teacher to manage student performance through a motivating and engaging program. Not only does it monitor student performance, but it also gives the students an opportunity to use the computer as a tool for self-improvement.

Team Set-Up is a technology-supported procedural facilitator designed for cooperative learning teams. It ncorporates the essential cooperative learning principles that research has shown to be necessary for effective teaming and student achievement with menu-driven, interactive computer technology. It provides an organizational structure that allow the teacher and students to continuously monitor attendance rates, tardiness, homework completion rates, and preparedness for class, and promotes goal-setting for improvement.

Requirements
- Macintosh computer available for each team.
- *Team Set-Up* software.
- Teacher and students using a structured approach to cooperative learning.

Procedures
1. Students log on the computer with their team name and a password.
2. Team members then read a greeting from the teacher that includes directions for a start-up learning activity.
3. After completing the start-up activity, the facilitator leads the team in evaluating their success in meeting improvement target goal(s) from the previous day.

4. Team members evaluate and record their performance on attendance, tardiness, homework completion, and preparedness.
5. Next, team members decide to maintain their improvement target or select another improvement target.

Benefits

- Enhancement of intrinsic motivation for learning.
- Growth in self-monitoring and self-evaluation skills.
- Development of positive communication and collaborative problem solving skills.
- Structure for tracking improvement.
- Rapid start-up with "can do" attitude.
- Ability to track specific student behaviors and provide accurate performance information to parents.
- Increased participation & engagement.
- Opportunity to set goals /improvement targets.
- A culture of high expectations and support for each other to learn & achieve at high levels.
- Empowerment.
- Nurturing a sense of responsibility and independence.
- Avoidance of learned helplessness.
- A sense of inclusion and belonging.

mixed session
Using Technology to Enhance Learning and Retention in Developmental Reading and ESOL Programs

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Key words: developmental reading, English as a second language, technology-enhanced instruction

Abstract

CCC has experienced a dramatic increase in underprepared and international students at a time of budget shortfalls (a 60% increase in Developmental Reading enrollment and a 1300% increase in ESOL enrollment). To meet the needs of these students, CCC installed two LANs (one 50 station and another 25 station CD ROM network). The following **TEN COMMANDMENTS FOR TECHNOLOGY-ENHANCED INSTRUCTION** are thus offered for individuals planning to use technology to enhance learning.

I. Technology is not our competition, but a tool to be used to facilitate learning.

Technology-Enhanced Instruction (TEI) will never replace the master teacher. TEI allows the master teacher to facilitate learning rather than "spoon feed" information. TEI can free us from mundane tasks and allow us to better utilize our talents as educators.

II. Everything will be more costly, take longer, and be more complicated than planned.

Don't rely on specifications given by sales representatives. Have technology experts review the specifications for "hidden costs". Consider electrical, cooling, and lighting needs. Include installation, training, and maintenance costs. Assume that the cost and process of installation will be greater than planned.

III. Like people, not all technology is compatible.

Evaluate the effectiveness of the existing program in terms of its goals and objectives. Which are successfully met? Which are not being met? Are there existing means to resolve these shortfalls? In which areas can technology help you do a better job?

Conduct a careful review of existing software. Project SYNERGY at Miami-Dade Community College offers an extensive review of existing software in the fields of ESL and Developmental Education. Contact other colleges and plan site visits. Request complete packages for preview and run tests not only with faculty, but also with students. If you have existing hardware, insist that the software be loaded and run prior to purchase.

IV. You don't have to know everything about a technology to use it.

BUT YOU DO HAVE TO KNOW SOMEONE WHO DOES! If you do not have a computer services department, be sure that the bid for hardware and software includes installation. Final payment should not be made until everything functions to your satisfaction. Bids should also include training for the hardware and software systems AND an ongoing service contract.

V. If it doesn't work, see if it's plugged in and turned on. If all else fails, refer to the manual. Most importantly, be sure you know someone who really understands the technology.

All faculty should be trained to conduct simple troubleshooting when systems go down. Nothing is more embarrassing than an expensive service call for a loose cable.

It is also important to identify an individual to serve as LAN manager, a content specialist with added training in LAN management. The responsibilities of this individual will include maintenance, scheduling, and troubleshooting. It is the manager's responsibility to diagnose problems and call the specialists when needed.

It is also important to have a backup plan for when the technology fails. Have an alternative assignment for students. Don't add "manager breakdown" to technology breakdown.

VI. Those who hesitate will never act.

Such excuses as "I'm waiting for prices to go down" or "The available software doesn't do exactly what I need" are not valid. As prices are reduced, companies add more features which again increase the cost. Software is constantly being written and rewritten. Often, those who use the software have the greatest input in future development.

VII. Although the initiation of technology should be planned and organized, do not allow setbacks to serve as an excuse for inaction.

Accept that you will experience success AND setbacks as you begin to initiate a new TEI program. It is vital that the institution establish a supportive climate when any new instructional approach is implemented.

Do not attempt to conduct a formal evaluation of the program during the first year of implementation. This year should be a learning experience.

VIII. The next higher level of technology is too much trouble and has too many problems to be worth the time to master.

It is said that only babies appreciate change. However, once change has occurred, most professionals will adapt if given adequate time and training. Expect resistance. Find at least one advocate to act as a model. For new TEI to be successful, institutions must make it a priority and provide adequate training, access, and rewards for those who accept the call of the "paradigm pioneer."

IX. We live in a world of change and technology. To choose not to use technology will make us obsolete.

Faculty may feel that they do not need to integrate technology into their curricula. That is a fallacy. The role of faculty is not to "teach" students facts, but to encourage students to become lifelong learners in our fields. It is through the use of TEI that instructors can help students access, process, and use information in our fields of study. It is imperative that faculty learn to use, and thus facilitate our students' use of technology, if our students are not to become "roadkill" on the 21st Century Information Highway.

X. These are Loflin's Ten Commandments. Go out and get your own!

These 10 Commandments are based on the experiences of installing LANs at one community college. Your experiences may differ. Successful integration of TEI requires hard work, determination, and a faith that our students will reap the benefits of your efforts.

project

Instructional Technology Support Center: Enhancing the Use of Instructional Technology in Primary, Secondary, and College Classrooms

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Abstract

The presentation will describe the Instructional Technology Support Center (ITSC) in place at Middle Tennessee State University. This innovative and unique center allows MTSU to address emerging technologies through redesign and enhancement of university teaching within existing teacher education programs for pre-service teachers, and by assisting in on-going training in the use of new technologies for K-12 teachers. To date, technologically, the ITSC is second to no other teacher education facility in the country. The role of the center is to initiate and support efforts to increase the effective use of educational technology in both K-12 and college classrooms. Therefore, it follows that the recently-developed and implemented ITSC, and resultant modifications in teaching and teacher education curriculum, relate to important ideas in education and curriculum such as collaborative programs, innovative classroom activities, diversity, and technology. As a result, MTSU has been able to put in place an innovative and unique model teacher education program.

In addition to describing the role that the Center plays in training teachers, specific ways in which it has enabled MTSU to address the changing technologies by redesigning teacher education programs and curriculum will be highlighted. Increased collaborative efforts between K-12 teachers and MTSU professors in the content areas will also be discussed. Multimedia technology used to improve the quality of university teaching will be shared, as well as examples of multimedia lessons/software developed for use in K-12 and university classrooms. A video highlighting the construction and utilization of the center will be presented to illustrate the physical facilities, faculty attitudes and perceptions, and students' responses.

The ITSC's three major goals and their objectives are as follows. These will be discussed in further detail during our presentation.

Goal One: Train pre- and in-service teachers in the use of instructional technology

Specific Objectives:

1. Through the programs of the ITSC, pre-service and in-service teachers and administrators will:
   a. learn to use existing instructional technologies.
   b. learn to develop their own multimedia lessons.
   c. learn strategies.for integrating instructional technology into their content areas.
   d. collaborate with MTSU professors in their academic disciplines in developing multimedia lessons.
2. The Instructional Technology Support Center also serves as a resource for the State Department of Education in its efforts to integrate instructional technologies into the curriculum of primary and secondary schools.

Goal Two: Improve university teaching through the increased use of instructional technology.

Specific Objectives:

1. Through the programs of the Instructional Technology Support Center, faculty will:
   a. learn to use instructional technologies.
   b. learn to develop their own multimedia lessons.
   c. learn strategies for integrating instructional technology into their content areas.
2. The Center will also develop a communication network for professors to share information and ideas concerning the use of the instructional technologies in college classrooms. Professors will be notified regularly concerning Center activities and programs.

Goal Three: Develop multimedia lessons for use in K-12 and university classrooms.

Specific Objectives:

1. Development of multimedia courseware for K-12 and university classrooms.
2. Development of multimedia products that can be used to train K-12 teachers and university faculty to create their own multimedia.

project
A Study of Online Telecommunications in Graduate Education

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Key words: on-line, telecommunications, distance education, group work, e-mail

Abstract

The purpose of this study is to determine the benefits of online education (via a modem or through the Internet) in two

graduate courses in educational technology. This investigation is a systematic look at the benefits and use of an online bulletin board system (BBS). These courses are part of a master's degree program in Educational Technology Leadership that is offered via cable television or videotape; students in the program are located across North America. Students were required to participate in class discussions and to solicit help in solving practical problems via a BBS during the co ᵘ ,e.

Data collection

The survey instrument was designed to elicit student responses regarding the benefits of online education, via the BBS, during both courses. The survey instrument contained: 16 belief statements and 3 open ended questions. The subject population was 187 potential respondents to the survey in two classes. Approximately sixty-three percent (117 of 187 students) of the population completed the survey instrument.

Results

The benefit rated as most important is that the BBS helped supplement video presentations. Two additional benefits were cited with less intensity. The survey results indicated that respondents believed that the BBS helped students assume the role of teacher and was an authentic learning environment.

One important demographic variable, length of student's participation in the degree program, led to significant differences between students who were new to the program and those with more experience. The results indicated that new students were interested in spending more time on the BBS than the experienced students. Additionally, new students indicated that the BBS was more helpful for research and obtaining information than did the more experienced students.

Conclusion

The most salient trends noted in this study are that students found the use of an online BBS enhanced communication and that there are significant differences among students in these classes based on their experience in this program. The benefits cited by respondents of this survey indicated that the BBS helped students assume the role of teacher in these classes and the BBS use was considered to be authentic.

project

The ECPDN Satellite Training Experience: Comprehensive Professional Development for Rural Head Start Programs

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Key words: distance learning, early childhood education, evaluation, professional development, rural education, technology, training

Abstract

Background

The Early Childhood Professional Development Network (ECPDN) represents a significant attempt on the part of Head Start to ensure that all grantee programs have equitable access to high-quality education and training. ECPDN, located at South Carolina Educational Television, has established a collaboration of the early childhood professional community, postsecondary institutions, and public broadcasting. Its purpose is to provide instruction to learners in rural and isolated areas of the United States and its territories.

Design

ECPDN has designed and is delivering a 120–hour training package via live, interactive satellite seminars, and complemented by other technologies, including audio bridge and fax. Weekly telephone discussion groups link participants in groups of 10 or 12 with veteran early childhood educators and with each other. The instruction is based on child development and early childhood education principles, Head Start Program Performance Standards, and the requirements for the Child

Development Associate (CDA) credential, to be required of Head Start staff in September 1996.

Many national distance learning networks use satellite and telephone technology. What differentiates the ECPDN initiative is the extensive amount of personalized instruction via telephone and the presentation of events in a wide range of Head Start classrooms in various parts of the country. The program producers have traveled to remote sites throughout the United States and beyond, gathering video footage and broadcasting live.

The first participants began the course in 1992. To date, the project has enrolled approximately 2,500 Head Start trainees in 38 States and various territories. A unique aspect of the ECPDN training is that participants attend the weekly seminars as members of a classroom team. The educational and experience levels of the training participants are quite varied. However, despite this wide variation among participants, the majority of participants shared similar learning styles–nearly 80 percent of the participants were found to prefer concrete, experiential learning to more abstract approaches. The ECPDN program, which is highly visual and oriented to specific classroom applications, is well-suited to these types of learners.

Evaluation

Macro International is conducting the third-party evaluation to report on the various participating populations, implementation, outcomes, and effectiveness. This evaluation has been ongoing since the implementation phase began and has involved use of both quantitative and qualitative methods. Formal onsite observations, in-person and telephone interviews, and questionnaires have been employed. During the 1994–1995 academic year, the focus is on case study investigations of six participating programs.

The findings on delivery and outcomes are summarized below:

- Participants gave high marks to the new experience of using technology for training. The majority reported that the technology seemed very personal and interactive (77%) and helped them to understand better (54%).
- The content and modes of presentation used in the weekly video seminars have been well-received. Most participants said that the training was at least as interesting and easy to understand (92%), was more informative (61%), and provided more new ideas (74%) than traditional training.
- The weekly telephone discussion groups have been a particularly successful element, according to course assessments and interviews. The groups have allowed participants to obtain new information and share problems and ideas with colleagues across the country.
- Technical problems have not interfered with program delivery at most reception sites.
- Participants have reported significant changes in attitude and classroom practice as a result of participation in the ECPDN training. Site visits using pre/post structured observation instruments have documented improvements in the physical environment, the introduction of new activities, teacher–child interactions related to guiding behavior, and the encouragement of independent learning.
- Participation has enhanced the trainees' professional and personal development. Between 58 and 68 percent will get college credit and/or a Child Development Associate credential as a result of the training program. Many plan to continue with their education.
- Although few of the trainees had participated in distance education previously, 94 percent of those completing the program said they would take another distance learning course.

project

Training, Tips and Tools for Technology-using Teachers: A CD-ROM Developed by Teachers for Teachers

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Key words: multimedia, teacher training, computer literacy

Abstract

Kathy and Tom kept linking us, via Applelink, about obstacles they were encountering with the technology and software they had won in the Apple Computer, Inc. Crossroads Grant Program. These folks are visionary educators and were determined to make their programs successful. What these two educators had in common was a lack of technical support in their

schools and communities. Tom in Oelrichs, South Dakota and Kathy in Maxwell, Nebraska were both more than one hundred miles away from a major metropolitan area where actual experts might have been available. Training, Tips, and Tools for Technology-Using Teachers, T5, was born. We have collected a series of reoccurring technology and isolation related obstacles and asked a variety of teacher experts to design solutions that can be shared via CD-ROM with teachers in remote sites.

It's late at night and you are trying to figure out how to make some piece of technology work. You have directions but they don't explain what a particular connector looks like. Technical support for the company is closed and even if you wait until tomorrow, how will they tell you over the phone what this connector looks like? The other key factor that is working against you is that you live far from a major metropolitan area.

The question we constantly faced was "How can beginning technology teachers find help for those everyday questions that more advanced users take for granted?" I remember when I first started teaching television production and then later using computers, the task of learning the vocabulary specific to that arena became a monumental task. Why? Because there was no resource available related to teaching and instruction that addressed the things I, as a teacher, needed to know. There were plenty of resources specific to the television industry professional producer, director, and writer.

We have collected a series of reoccurring technology and isolation related obstacles and asked a variety of teacher experts to help us design solutions that can be shared via CD-ROM with teachers in remote sites.

We know T5 is not complete and, as long as education, technology and teaching continues to change, so will the information provided. Updates and revisions are expected. This disc is to be the first of many more products designed for innovative technology-using teachers. We welcome your comments, suggestions, and contributions.

T5 parts

GlossDex Terms Home Stack

This *HyperStudio* stack includes a variety of terms related to technology. Each of the terms is linked to a subject area stack with a definition of the term, sometimes a picture of an object (like connectors), and demonstrations in *QuickTime* movies. Individual GlossDex stacks include:

General GlossDex Terms, Animation GlossDex Terms, Video, TV & Film GlossDex Terms, Radio & Audio GlossDex Terms, Flow Chart GlossDex Terms, Hardware GlossDex Terms, Software GlossDex Terms, Connectors GlossDex Terms, Telecommunications GlossDex Terms, Company Contact Information

Stuff We Made For You

Stuff we made for you contains a variety of backgrounds, sounds, and icons made by students and teachers that are free for you to use.

- Graphic Backgrounds–designed to be used for media presentations.
- Sound Effects–can be used as computer sounds or in presentations.
- Icons.
- Folder Icons.
- Button Icons–contains three files of icons for *HyperStudio*.
- Miscellaneous Icons–icons created in paint programs.

Stuff You Might Need

Stuff you might need contains preview or player versions of several different programs. Some of these are needed to use parts of the disk.

- *SimpleText*
- *CinePlayer*
- *HyperStudio* Preview
- *HyperStudio* Preview Higher Education
- Shareware
- Freeware

Choosing Technology

Products We Like and ways to use

Vendor Permission

- *Koyn Fractal Studio 2.0* Info
- *Troll Touch*
- *HyperStudio*
- Music & Sounds
- Creative Support Services Samples
- SoperSound Music Library Samples
- Signature Music Library Samples
- Dimension Music & Sound Samples
- Types of Technology

- Technology Plan Examples

How To Use Technology

Screen Size Considerations

- *HyperCard* Scroll Test
- *Director* Edge Test

Trouble Shooting Tips

- Disk Warnings–*HyperStudio*
- How to Clean Your Mouse–*HyperStudio*

Cable Tips

Video Taping Tips

Technology and Student Instruction

Curriculum Topics

- Mass Media Curriculum Ideas
  - assignment files
- TV Production Curriculum Ideas
  - assignment files
- Computer Animation Curriculum Ideas
  - assignment files
- Multimedia Curriculum Ideas
  - assignment files
- Teacher Technology Training Ideas
  - Teacher training Director presentation
  - Technology & Multicultural–*HyperCard*
- Multimedia Intros & Ideas
  - Multimedia Mac Intro–*Director*
  - Multimedia Recipes–*HyperCard*
  - Citrus Multimedia example–*Director*
  - Hello Carlos & Jessie–*HyperCard*
- Telecommunications
  - Internet info
  - Communications Thoughts–*HyperCard*
  - Radio Telecommunications Project
- School Advisory Council Demo
  - School Improvement Committee template
- Mac Drivers
  - Drivers manual for Mac in *Pagemaker*
  - Drivers manual in print to PICT
- Learning Stuff
  - Intro Questionnaire–*HyperStudio*
  - What is your Environmental Style–*HyperStudio*

project

The Instructional Framework System: A Multimedia Approach for Teacher Professional Development

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Key words: multimedia, staff development, standards, teacher training, teacher education, videodisc

Abstract

Description

The Instructional Framework System is a computer and videodisc-based technology to help teachers develop classroom instruction and assessment consistent with state and national standards. The system provides access to a database containing the following information and resources:

- Descriptions of instructional strategies based on research and "best practices".
- Model lessons linked to specific learning levels, content areas, and state standards.
- Assessment tasks and activities that relate to student and school performance.
- Video segments that show teachers using specific instructional approaches and assessments in their classrooms.
- Resource lists of professional development contacts as well as supplementary print and non-print materials.

The program is configured as a two-screen system and runs on an Apple Macintosh hardware platform in conjunction with standard Level III videodisc players. The current version of the system has been upgraded to assist in the future development of a DOS platform version.

As a technology-based tool, the Instructional Framework provides a unique opportunity for increased access at school sites to research and exemplars that can help teachers study effective teaching practices, reflect on and refine their own practice, and build and implement effective instructional programs according to their classroom or school needs. It is a powerful resource to facilitate on-going training programs and support what the National Staff Development Council calls "growth-promoting processes" such as study groups, action research, and peer coaching. The videodisc component is especially powerful as a staff development device because teachers observe their peers applying instructional methodologies in the classroom and hear from these practitioners (as well as students) about why these instructional approaches promote learning. Because the videodisc is controlled by the computer program, video segments can be accessed instantaneously and in an order that is most meaningful for the teacher.

Development and Future Plans

The current material, focusing on learning outcomes and teaching approaches in English language arts, mathematics,

science, social studies, technology education, and adult basic education, has been developed through collaborative partnerships among state and local education agencies and institutions of higher education. The collaborative model increases the amount of quality material that is available and decreases the fiscal and human resources needed by any one agency to develop similar products.

Plans are under way to develop an Instructional Framework consortium that would enable members (state departments of education, school districts, and other educational institutions) to access existing modules and to contribute to the development of new text-and videodisc-based materials. The consortium would be supported through membership fees based on the size and type of the institution or organization.

project
Empowering Teachers to Use Technology

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Key words: staff development, curriculum integration, teacher training model

Abstract

If teachers are expected to progress from novices to full integrators of technology in the teaching/learning process, staff development must enable them to link technology to the efficient completion of instructional and administrative tasks. The Educational Information System (EIS) Department's support ranges from systemwide staff development classes to site-based workshops and locally developed inservices. Personnel resources available at all sites include an Educational Computing Specialist who is a certified teacher receiving a small supplement to teach field-based staff development courses and a technology paraprofessional who is responsible for technical aspects of the LAN. EIS provides intensive training in our labs for these support people using the "train the trainer" model. The most challenging and most effective job we do is to make the technology–curriculum connection for teachers. This connection is made by including technology resources in curriculum guides, lesson plans, model classrooms, and model lessons using an integrated approach to daily instruction.

EIS staff spend each summer teaching teachers, adapting or creating technical implementation manuals to support ECSs and Technology Paraprofessionals, training on technology updates, preparing teacher packets for field-based training, and instructing on new software to be implemented during the school year. During the school year. training is devoted to support inservices for teachers, ECSs, Technology Paraprofessionals, Department Heads, Instructional Lead Teachers, and Administrators.

EIS has just completed a five-year implementation of an Integrated Learning System (ILS) distributed in third through sixth grade classrooms. The key factor to successful implementation of technology has been the curriculum connection. All ILS activities were correlated to the core curriculum for science, social studies, mathematics, and our integrated language arts program for all learners. There is a set of ILS/Curriculum correlated assignments for regular students that can be accelerated or paced, a special education component, an ESOL assignment, and a Potential Achievers in Reading correlation for students reading below grade level. All students, regardless of ability, are included. Correlated assignments and a resource packet for "Managing a Computer Rich Environment" were developed for teachers, ECSs, and technology paraprofessionals by master teachers selected to participate in a summer stipend course.

Another example of our procedure for integrating technology into the curriculum is last year's Business Education Department's adoption of new curriculum, hardware, and software. EIS provided leadership in the selection process, curriculum guide creation, and teaching materials for all components implemented in the 1994/95 school year.

Some of our publications include: *ECS/Technology Paraprofessional Handbook*, *Managing a Computer Rich Environment*, staff development flyers, and teaching modules.

project
Using Computers to Teach Science: The CT-TEAM Teacher Enhancement

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Key words: computers, science, K-12, teachers

Abstract

The Camden County (North Carolina) School System teachers have driven the development of the teacher enhancement Computational Training for Teacher Enhancement, Action, and Motivation (CT-TEAM) project to prepare teachers and administrators to incorporate computational science methods and tools in the K–12 curriculum. The CT-TEAM project is systemic and has focused on teachers as change agents. Camden's partners in this project include Elizabeth City State University (local support and training), East Carolina University (curriculum change), the North Carolina Supercomputing Center (computational science training) and the NC Science and Mathematics Alliance (extension of the NSF State Systemic Initiative to northeastern North Carolina). The CT-TEAM project was developed to address Camden County's need for:

1. A trained workforce with basic computer competency, problem-solving skills, and awareness of advanced technology.
2. An informed and scientifically literate populace.
3. Improved schools that will contribute to the county's economic development.
4. Enhanced interest in math, science, and technology in the county's students to increase the number who choose these fields of study in college.

Teachers are being trained to use computing and telecommunications technology and to become change agents, providing in-service training to other teachers and acting as mentors to their peers. This CT-TEAM initiative, a pioneering effort to incorporate computational science into the K–12 curriculum, is in the second year of funding by the National Science Foundation. The team has studied premodeling skills and tools relevant to all K–12 levels from elementary life science data to middle school analysis of wetland pollution issues, to high school chemistry density study. At the end of year one of three, Camden County teachers are already able to implement what they have learned into their classrooms.

Computational science, the application of numerical and computer techniques to the solution of scientific problems, is one of the newest methodologies in scientific research. The focus of this project is not on new concepts to teach, but rather in teaching familiar concepts with a new methodology. Computational science is an important method for teaching and learning science because events of scientific interest that occur too quickly (molecular interactions), occur too slowly (deforestation), are too large to replicate in the laboratory (galaxy analysis), or are too dangerous (chemical experiments with carcinogenic materials) can be simulated using computers. Not only can the events be simulated, but the experimental input variables can also be modified and the event can be re-enacted to observe the effect. This is a hands-on process of teaching that gives the students rapid feedback on their experiments and helps develop intuition.

This presentation and the accompanying handouts will show the goals of the project, its history of implementation, collaborative involvement, and a description of the project plan. Also discussed will be the teacher training curriculum, the project impact on the Camden County schools, and the process that might be used to replicate this project in other school districts across the United States.

project
The Change Process for Integrating Technology

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Key words: technology integration, change process, elementary science and technology

Abstract

The integration of technology in elementary schools requires changes in the environment and delivery of instruction. Computers networked throughout a school building accessing a file server loaded with software related to the curriculum bring new dimensions to the student/teacher interactions. Teachers must change their methods of teaching to include technology that is accessible and appropriate for all children. Administrators must change their perceptions of effective teaching strategies for meeting state and national standards. Parents must provide support, interest, and enthusiasm for the innovative instruction with technology. Finally, all students must be allowed time to use the new learning tools technology offers in their classrooms. Changes that occurred in an urban elementary school as a result of a recent intensive staff development project for integrating technology into science and science across the curriculum were measured and analyzed using the Concerns Based Adoption Model (CBAM) (Hall & Hord, 1987).

For the past twenty years the develop the CBAM have focused on what happens to educators as they tryout new practices (Hall & Loucks, 1977). This methodology provides a systematic way to evaluate teachers' concerns about their use, or readiness for use, of innovations in schools. For this project the CBAM instruments were adapted to evaluate a training program to use technology in science and across the curriculum in an inner city elementary school. The battery of CBAM measurement were administered periodically throughout the three year project. The data were analyzed and reported as the percent of teachers at each intensity of concern and level of use. Observational data were collected using the Innovation Configuration (IC) checklist for the percent teachers implementing each component of the technology integration program. The components considered essential to effective implementation included: (a) teachers and students actively engaged in daily instruction using technology in science activities and across other elementary curriculum; (b) all students participating in collaborative learning structures with students enrolled in special education included; (c) parents serving as classroom volunteers for technology activities; and (d) teachers sharing ideas and lesson plans with their colleagues in the school and throughout the district.

This training model provided extensive information about the integration of computers for instruction. Activities included hands-on practice as well as activities for developing resource materials requiring participants to plan for applications of technology in their instruction. The teachers were actively engaged in collaborative planning for integrating science across the curriculum. This collaboration fostered collegiality and support among the participants in their efforts to master the requisite skills for using the technology in the classroom.

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Hall, G.E. & Loucks, S. F. (1977, Summer). A developmental model for determining whether the treatment is actually implemented. American Educational Research Journal, 14(3) 263-276.

project

Pathways to School Improvement World Wide Web Server

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Key words: Internet, school improvement, engaged learning, content areas, educators, students, methods

Abstract

The implications of instant access to information and resources for society as a whole, and education in particular, are staggering. Imagine being able to immediately access the most current research and supporting information on school improvement dealing with a problem or issue your school is trying to solve. Imagine a school improvement team instantly finding just the right information about a lesson to be taught, a teaching strategy, or guidelines and standards. Instant access to just the right information–just when you need it. That's exactly what you'll find when you connect to *Pathways to School*

Improvement.

Goal

The goal of *Pathways* is engaged, meaningful learning for all students. School teams with access to *Pathways* can help students achieve this goal. Indicators of engaged learning can act as a "compass" for reform instruction–helping educators to chart an instructional course and maintain an orientation based on a vision of engaged learning and what it looks like in the classroom and community.

School Improvement Process

In the school improvement process a team of administrators, teachers, and the local community engage in a continuous, self-regulating cycle of improvement. The team defines the goals for their district and how they should be implemented. The elements of this process can be described as (1) identifying areas for change, (2) deciding what needs to be done, (3) implementing the changes, and (4) evaluating the effectiveness of the cycle and starting again. *Pathways* can support school community teams as they strive for improved learning by providing a variety of resources that are designed to guide teams as they design models of teaching and learning grounded in the belief that all students can learn. It is our belief that school community teams that engage in a continuous, self-regulating cycle of school improvement, supported by *Pathways*, will be better able to "think globally but act locally" to achieve real and lasting educational reform.

The components of Pathways

Critical Issues

Pathways to School Improvement addresses school improvement issues in the following areas: math, reading, science, curriculum, goals and standards, leadership, professional development, safe and drug-free schools, family and community development, governance and organizational management, school to work, assessment, instruction, technology, learning, and underserved children and youth. Critical issues contain a practical, action-oriented, two to three page summary of best practice and research, descriptions of schools that have successfully addressed the issue, and collections of materials to support change. There are also examples of how schools have put these ideas into practice. Throughout these issues there are many links to additional information. For example, under Science, two of the critical issues are entitled "Providing Hands-On, Minds-On, and Authentic Learning Experiences in Science", and "Ensuring Equity and Excellence in Science." Within these issues you have the opportunity to link to elaborations on the issue, movie slide shows, audio comments, and also to other relevant servers on the Internet.

Trip Planner

The *Pathways School/Community Trip Planner* will provide site-based school and community teams with customized guidelines for school improvement. To ensure that school change remains sharply focused on student learning, the process is built around recognized indicators of engaged learning (Jones, Valdez, Nowakowski, & Rasmussen, 1994; Means, et al., 1993).

Rather than providing a list of boilerplate steps for school improvement, the *Trip Planner* helps schools and communities engage in a process of developing a deep understanding of their strengths and development needs, which then will allow them to take the current research available in *Pathways* and apply it to those needs. It helps schools and communities go beyond surface issues to the heart of teaching and learning within classrooms. The *School/Community Trip Planner* assists teams in bringing a rich body of evidence on learning and instructional practice to the task of developing a school improvement plan. It is not primarily a tool for accountability, but a system for school learning that helps principals, teachers, and others identify priority areas for improvement that are directly linked to engaged student learning.

Pathways Traveler Support

Traveler Support is designed to provide important products and services directly to your school that cannot, at this time, be transmitted electronically or that require human-to-human interaction. *Pathways Traveler Support* provides telephone and e-mail support, print, videotape, audiotape, and multimedia products, and technical assistance. Send an e-mail message to info@ncrel.org for more information.

What do you need to run Pathways?

Pathways is an Internet-based World Wide Web server that can be accessed from a variety of World Wide Web browsers. Some of the more popular browsers include *Mosaic, Enhanced Mosaic, Netscape, MacWeb*, and for text only browsing, *Lynx*. You should use a 14.4 or 28.8 modem, or a direct connection to access the server. ISDN support is scheduled for the near future. You can access the server from many popular computer platforms including Macintosh and Windows.

The address for the server is: http://www.ncrel.org/ncrel/sdrs/pathways.htm

While online please feel free to send us comments on what you find, ideas for additions or corrections, or general comments at info@ncrel.org.

project

The Medium and the Message: Using Multimedia to Present Evaluation Findings

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Key words: evaluation, second language, ESL, multimedia

Abstract

Momentum is growing in all educational domains for innovative uses of technology. The combined use of computers and multimedia– including video, audio, still photography, and animation– holds tremendous potential as a tool for presenting educational program evaluation findings.

This session will demonstrate the use of multimedia as such a presentational tool, providing the audience with an intimate look at key elements of one school district's ESL program and the progress it has achieved. Teachers who use instructional computer technology, students, administrators, staff members, and parents will be highlighted as the audience observes the program's activities and listens to commentary about the program's design, target population, activities, achievements and future direction. The CD-ROM that carries the information includes full menus of general information, information for parents, and information for school system personnel.

The presenters will demonstrate the versatility and flexibility of the medium and show how it is not only useful in group presentations but also in meeting the individual's need to access information related to his/her particular interests. The presentation will allow time for questions from the audience regarding the expertise needed to construct multimedia presentations such as this one with an integrated visual database created using the *MacroMind Director.*

project

The Role of Technolc ;y in a Continuous Progress Environment

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Key words: continuous progress, technology, technology integration

Abstract

During the fall of 1991 the Fox Chapel Area School District (FCASD) began to develop a continuous progress instruction (CPI) delivery system. The CPI model employed by FCASD utilized the work done by Margaret Wang as part of her Adaptive Learning Environment Model (ALEM). What distinguished FCASD from other ALEM sites was its integration of technology. Technology included not just computer-related tools, but also video and voice components. The major thrust of all the technology threads was to enhance the delivery and management of instruction as defined in the strategic plan of the FCASD.

The FCASD initial plan for the integration of voice, video, and data communications developed in 1986. At that time the one high school in the district underwent renovation. The building was rewiring for an RF video distribution system, an Ethernet data network, and a voice communications system. Each classroom teacher would have access to a telephone for communications and classroom management, a terminal (and later a computer) for both the delivery of instruction and the management of instruction, and a 27" monitor for the delivery of instruction.

Today, this type of plan does not seem out of the ordinary, but eight years ago there were few school districts with the foresight to infuse voice, video, and data elements. With the success of the high school model the Fox Chapel Area District moved ahead during the 1993-94 school year, and equipped each remaining site (four elementary buildings and one middle school) with the same capabilities. More importantly, each of the sites was linked together with a series of strands of fiber. Dedicated strands of fiber transmit either voice, video or data.

This infrastructure was intended to fulfill several strategic planning goals:

- Increase communication between parents, the general community, and the teaching faculty and school administration.
- Provide the support tools to generate an individual prescription plan for every student.
- Monitor the progress of all strategic initiatives through the use of data-driven evaluative tools.

To evaluate the progress of this systemic attempt for a restructured approach to instruction, the FCASD invited Duquesne University of Pittsburgh to help in the design of appropriate tools. In addition, the FCASD developed working partnerships with technology related companies, including Computer Curriculum Company, Apple Corporation, and the Digital Equipment Corporation, as well as governmental agencies, the Department of Education of Pennsylvania. The results of this undertaking are just beginning to become clear. This presentation will relate the role of technology in the systematic development of continuous progress instruction for one school district.

project
Communicating with Graphs: Cross-Curricular Activities that Help Students Understand Data

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Graphs are communication, and communication is part of every curricular area. A graph can tell a story at a glance. Most students would rather read a graph than a page full of numbers, and even though reading a graph takes only fraction of the time, students generally end up with a much clearer understanding of the data. When students learn graphing skills in context–as part of math, science, social studies, language arts and other subject areas–then graphs have more meaning. Students see how these skills relate to the real world and how they can use them in their own lives. Understanding, retention, and the ability to apply newly-acquired skills are enhanced.

In this session, you will discover how even young children can learn to collect and organize data and create and interpret graphs. The presenter will suggest dozens of creative ideas for integrating graphing skills into almost every curricular area while adhering to NCTM guidelines. She will demonstrate software and share a variety of student activities and projects including interviews, surveys, graphing big books, posters, t-shirts, and more. The focus will be on students as active learners, on understanding and communicating data, on the development of thinking and problem-solving skills, and cross-curricular integration.

project
The Power of Electronic Musical Composition

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Key words: MIDI, electronic music, composition

Abstract

Modern music is as hard to imagine without a synthesizer as business is to imagine without a personal computer. The electronic partnership of these 2 different devices created by musical interface MIDI (Musical Instrument Digital Interface) gives the composer and/or musician great possibilities. The results of such a partnership are explained in more detail in the following report.

The mystery of music has attracted more scientific research than any other art form. All musical sounds and tones, just like any form of what we consider "noise," are a simple result of the change in air pressure. Whereas normal "noise" is a more chaotic change in air pressure, in music we have the repetition of the conformity to natural laws.

In 1885, German physicist, Hermann Van Helmhotz explained in his work, *On the Sensation of Tone* ,that sound is a special vibration of the air that is represented in a long periodic wave. Sixty-three years before, French mathematician and physicist, Jan Batiste Fourier, studied the complex structure of waves and developed a powerful mathematical method allowing for the lay-out of periodic functions of the sinusoidal parts. The principles of Fourier's analysis (method) are used in computer software programs; they help the computer analyze the sound wave very similar to the way hearing aids work. Sinusoidal is the simplest sound wave and is characterized using two parameters: frequency (high pitch) and amplitude (volume). Musical sounds consist of dozens of sinusoidal frequencies. These high frequency sinusoidals are called overtones and these overtones determine the timbre of the musical instrument. For natural sound, there should be approximately 12 to 24 overtones. Every musical instrument has its own individual and characteristic natural sound.

Sound structures are found in the following ways: complex filtration and calculation; taking samples; and digital frequency modulation. In its determined stage of development, each one of these methods was very progressive, but more must be mentioned about digital frequency modulation. We can trace its beginning to 1973, when an American, John Chowning, published an article that noticeably influenced the development of "computer music." The digital frequency modulation theory attributed to the surfacing of computer software programs and did away with cumbersome calculations, allowing synthesis of rich and complex musical compositions.

Sub-programs, called generators of FM, produce sinusoidal frequencies. The whole principle comes down to the combination of one formatted sound carrier with another modulated frequency modulator. It is enough for 2 digitized modular sinusoidal vibrations. Intensity of sound is determined by the carrier amplitude, while richness of overtones is determined by amplified modulation and the correlation of the carrier and modular frequencies. Now giving a different meaning to the music, attenuation, frequency, carrier and modular amplification, a musician has the ability to create and save in computer RAM the most diverse sounds. In this way, sound may be moved in space, echoes added, and volume increased/decreased; in short, the choices are only limited by the musician's imagination.

The synthesizer stands alone as a powerful instrument, but when attached to the computer, the possibilities have no boundaries. One variant allowing the musician/composer his/her own space is the computer sound modular SC-7, adapter, MIDI keyboard, sequencer, and MIDI interface. The MIDI standard was developed in the 1980's by the specialists at Roland. The MIDI interface gives the musician an incredible convenience, the ability to combine musical instruments, and to orchestrate. The sequencer is a software program that turns the computer into a sound studio. Most sequencers allow the user to record music at different times and have on screen graphical displays of the orchestration giving the user the ability to easily re-orient himself/herself to the ever changing music. Editing does not damage the quality of the recorded music.

The City Palace of Culture has the above mentioned working studio, computer, and synthesizer. The recording being done with this partnership at the City Palace of Culture stand out in both quality and originality of the composition of children's music and song that the children of Omsk sing with great joy.

project

A Generic Project that Lends Itself to Multimedia Productions

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Key words: multimedia, HyperCard, World Wide Web, Internet, interdisciplinary, cooperative learning

Abstract

Project

This project uses the generic idea of creating a commemorative stamp. It can be applied to many different areas of study. In addition, the products generated can be used to create a HyperCard Stack utilizing generic templates that incorporate text, digitized photos, art work, and audio. Recent projects have been used to create web pages for the WWW. These various technologies are used as tools for creating products. This multidisciplinary project can be adapted very easily to most areas of study. Students become producers of educational resources others may use.

Examples

Each assignment requires the student to:
1. Create a commemorative stamp to tell something about a subject.
2. Generate a written report to accompany their visual.

Possible extensions to the above activity:
1. Digitize pictures of stamps and photos of students for a HyperCard Stack.
2. Generate a sound clip about their stamp that will be added to the HyperCard Stack.
3. Generate worksheets or other educational extension activities that can be used as educational resources for other students.

Projects Examples:
1. Read a biography and create a commemorative stamp to honor that person. Write a three paragraph essay.
   - The first paragraph will tell about the person' s life.
   - The second paragraph will tell why the person is famous.
   - The third paragraph will tell what your stamp represents.
2. Choose one of the ten Bill of Rights and create a commemorative stamp that shows something that tells about that Right. Write a three paragraph essay.
   - The first paragraph is a copy of the Right as it appears in the Constitution. (The students get practice in copying from a read only folder that has been set up by the teacher.)
   - The second paragraph tells what the Right means and how it affects or can affect a person' s life.
   - The third paragraph explains the commemorative stamp.

Both these project (plus others adapted to your area of study) lend themselves to the production of multimedia educational resources.

Technology and Skills necessary to complete this project

Computer technology used include:
- Word processor and desktop publishing programs
- Graphics programs
- Hyperacid
- Scanner using *Ofoto*
- Video digitizing (Video Spigot) using a camcorder
- CD reference resources
- Internet (WWW and gopher as a resource)
- Digitizing sound
- E-Mail to connect to mentors

Other skills learned and used:
- Navigating through various programs
- Manipulation of graphics
- Interrelating disciplines
- Creating educational resource for others to use
- Use of the writing process
- Use of cooperative work groups
- Becoming a facilitator and learner
- Working through their strengths and seeking help in areas of need
- Atmosphere of risk taking

Internet access to projects available for viewing on the net

URL: http://www.inform.umd.edu/UofMd-System_and_State_of_Maryland/UMD-Projects/MCTP/Technology/School_WWW_Pages/FairlandHomePage.html

classroom demonstration

Individualizing for Reading Skill Differences in Inclusive Classrooms: Exploring the Power of CD-ROM Video

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Key words: inclusion, CD-ROM multimedia, elementary reading

This collaborative school based-research partnership examines and demonstrates how individualizing captioned prompt rate and vocabulary level can be a successful technological teaching approach in inclusive classrooms. Reading content and captioned prompt rate are manipulated to match each student's reading rate and comprehension level using CD-ROM multimedia. Results will give educators and business trainers new directions in improving reading level, comprehension, and retention skills.

Using a cluster equivalent materials design, two groups of fourth grade students (mildly disabled and nondisabled) in two classroom environments (inclusive and noninclusive), are participating in both a limited Pilot Study and a Full-Scale Study for the 1994 academic year. These groups of students will receive alternate treatments of (1) digital video interactive materials with individualized prompt rate and vocabulary, and (2) closed-captioned 4th grade reading vocabulary videotapes with no individualization of prompt rate. Treatment 2 is used for comparison evaluation measures. A demonstration of this technology in both inclusive and noninclusive classrooms will be conducted in the 1995 academic year.

If prompt rate matched to individual student's reading level and comprehension reading rate is successful, all students, including those with disabilities and literacy deficits, can learn and retain information more efficiently through improved reading skills. Benefits include: gains in reading comprehension skills through technology-enhanced reading material, higher literacy skills/improved performance, lower school drop-out rates, and a greater probability to graduate high school and secure and maintain stable employment in a technologically demanding workplace.

Initial findings of the Pilot Study and the first semester of the 1994 academic year study will be presented, briefly discussed, and disseminated. Sample classroom programs will be presented encouraging hands-on experiences for those in attendance. It is anticipated that demonstration and training workshops will be offered through distance learning technology. Videotape, as well as CD-ROM products, will be produced for a national educational market for implementation in schools. Products would also address business and industry demands in regard to provisions of the Americans with Disabilities Act.

(Research sponsored by the U.S. Department of Education: "Demonstrating and Evaluating the Benefits of Educational Innovations Using Technology"–PR Award #H180E30034.)

classroom demonstration

Tomorrow's School Today: Computer Animation and Multimedia/CD-ROM Production in Florida

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Key words: multimedia, computer animation, CD-ROM production

At Edgewater High School in Orlando, Florida, we have been working with a variety of multimedia over the past several years and have discovered the changes it can make in our curriculum design. We believe that real-world projects provide more educational value, therefore, we invite numerous community groups to work with our students. Once a group or an organization agrees, we bring all of our multimedia programs into its development. Students find themselves responsible for every aspect of the project, and discover that their capabilities are often equal to those of adults.

Multimedia production gives each student a place to be successful. Clearly, all kids are not good at the same things. This type of collaboration helps the students gain respect for each other's strengths and allows all students–regardless of proficiencies–to be part of the team. It also enables students to explore their own capabilities and interests.

In this type of program, students take their educational process more seriously than they did in a more traditional setting. They feel a sense of ownership for the project. They like the idea of having control over the final outcomes, and take pride in doing a qua''ty job that demonstrates their capabilities to the adult world. Projects are open to all students, regardless of academic ability. If a student shows interest in a particular project or area of concentration, he/she is encouraged to pursue it. Many of the students we work with are not even enrolled in any of our classes; they are pursuing the projects before school, during lunch, and after school.

Some examples of projects over the past two years include:

- High school students are working with the Orange County Public Schools district elementary science coordinator, the Florida Audubon Society, and the Center for Birds of Prey to create an interactive program for elementary and middle school students on CD-ROM.
- 9th graders are developing a series of three 10-minute videos and an interactive computer program outlining the history of the county fire department for the Orange County Historical Society.
- Students are creating flying logos and animations for local companies, elementary schools, and district office productions.
- A group of students produced a video for a local pharmaceutical company. The project also provided each of the student a $100 scholarship upon graduation.
- Several students designed a computer animation production for the 1993 Apple Computer Grantee Showcase at the National Education Computer Conference, Orlando, Florida. In addition, this led two students to develop a multimedia presentation for the Florida Educational Technology Conference.
- Bat Conservation International, Inc. has given permission to use a large selection of their slides for a student-produced program on bats for elementary and middle school students.
- A student group is creating a kiosk for the Orlando Museum of Art about the Museum's Pre-Columbian art collection.
- A group of students interested in media literacy and future studies are working with the school district and Time Warner Interactive to create a CD-ROM intended to help users become more critical media consumers.

The real impact on our school is the way these projects have changed our teaching methods, our classrooms, and our curriculum to meet our students' needs. They are learning to work together, solve problems locate resources. They are learning to listen, think, and communicate intelligently with both peers and adults. They are learning that reading, writing, math, and science are not separate subjects, but are intricately interwoven into a marvelous web that can catch and hold their attention long after the class bell has rung.

We, as teachers, are learning as well. We soon realized that we don't have all the answers! We learned that many of our students knew far more about computers and multimedia than we did—so they got the chance to teach us something. By doing so, they reinforced their own understandings. We also learned that this teaching approach required us to spend much more time at school because we couldn't get rid of our students—they were always in the classrooms working!

There were a number of teachers who thought we were entirely on the wrong track. They were concerned that we were not meeting "state mandates." Some administrators have also had a difficult time with this type of curriculum. What we are doing doesn't seem to fit into their concept of what school should be. But others are encouraging. They seem to realize that people like Willard Daggett and David Thornburg may be right in their assessment of American education and how to best prepare our students to compete in a global marketplace. If our students are to regain the leadership role in a global society, they must have the skills necessary. We realize that multimedia may not be the means that many people would consider using, but if you think that it might work as a change agent for you, start looking for projects for your students. There are projects everywhere!

classroom demonstration
Tying It All Together

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Key words: technology, curriculum integration, HyperCard, elementary

Abstract

Learning Experience/Program

Through this project, students learn that skills and concepts taught in school are inter-related, and are intimately linked with the "real world" of employment and daily life. Technology was integrated into the curriculum plan. Centering around the social studies theme of families and the community, a local supermarket provided the thread for this project that involved students in a variety of activities throughout the school year. As a "kick off" to the project, students toured the store and interviewed staff members. The store personnel stressed school-related skills that they used on their jobs. Pictures were taken with a regular camera and a Canon Xapshot camera. Upon returning to the classroom, the students were able to view the Xapshot pictures on a TV screen and gave oral presentations regarding their interviews. Subsequently, all students engaged in a writing project and sent thank-you notes, which were displayed in the store. Photos taken with the regular camera were developed, and a large poster containing the pictures and student-written captions served as a bulletin board and was displayed in the store. After transferring the photos from the Xapshot camera into the Macintosh computer, the computer coordinator worked with the students and teacher to develop an interactive *HyperCard* stack or computer program. The result was a "tour" of the grocery store. From a central map, the computer user is able to visit any section of the store, read student reports about the personnel and their jobs, and hear additional information recorded by the students. The *HyperCard* program was later presented at a statewide PTA Conference.

Now that students had seen a real store, they set up their own classroom store. Much math was needed to determine counter space and to fix prices. The math coordinator worked with the teacher to present lessons on box design, volume and space utilization. Students used a commercial software program to turn their computer into a cash register, and rotated through various "jobs" in the store. At each step of the project, student products were presented and evaluated. Evaluation varied, from self-evaluations to peer/group evaluations to teacher evaluation, depending on the activity.

Near the end of the project, the store manager was invited to visit the classroom. The students gave an oral presentation of the various aspects of their program. The store manager expressed both surprise and delight that the students had such a good grasp of the working world and the skills they would need to succeed.

This program was the recipient of a Celebration of Excellence award, a program sponsored by the State of Connecticut and Southern New England Telephone to recognize excellence in education.

Intended Audience

The program was developed for and implemented with fourth graders, although similar programs could be developed with students in grades 2–8. The presentation is appropriate for elementary and middle school teachers, computer coordinators, and others involved in integrating technology in the classroom curriculum.

Equipment Requirements

To implement this program the following equipment and programs were used:

- 1 Apple IIgs.
- 1 Macintosh LC.
- Canon Xapshot Camera.
- TV monitor.
- Computer Eyes (Black & White).
- Little Shopper's Toolkit from Tom Snyder.
- HyperCard.

An extension activity involved a modem and the National Geographic Society's "What Are We Eating ?" unit.

pa.iel

Youth CaN '95: An International Event for Youth Communications and Networking on Environmental Issues

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Keywords: telecommunications, environmental, youth, K-12

Abstract

Introduction to Youth CaN '95

The mission of Youth CaN '95 is to empower youth to work collectively with others around the world on environmental projects using telecommunications. The event will be the culmination of school environmental projects started in September 1994, and conducted throughout the year via networking on a wide variety of educational telecommunications networks. One of the fundamental objectives of the Youth CaN conference is student participation and organization. Elementary and high school students are involved in all aspects of planning and implementing the program which includes demonstrations, workshops, and discussions.

Youth CaN is an annual international conference involving hundreds of K–12 students and youths from many different countries. It will be held at the American Museum of Natural History in New York City, on April 21, 1995, to coincide with Earth Day. We are expecting at least 1,000 elementary and secondary students in attendance at the Museum this year. The theme of Youth CaN '95 is restoring damaged habitats, ranging from reversing desertification to restoring damaged wetlands. Results of projects will be presented at the conference via electronic mail and conferencing, videophone connections, and videos.

Youth CaN Panel at NECC '95

We plan to provide an overview of the Youth CaN conference being held in April 1995. Panel members will be drawn from schools and youth organizations located in the United States and other countries. We will highlight students' environmental projects and the methods undertaken to coordinate such projects. Since students play a key role in producing this conference, we will ensure student participation on the panel. We plan to show student produced videos and engage in real-time phone conversations with international participants of YouthCaN '95. Our desire for presenting a panel is to foster more participation in future Youth CaN conferences by interested schools attending NECC and to demonstrate the learning potential of conferencing and networking for students and teachers alike.

Co-Sponsors of Youth CaN '95

UN Environmental Program, UNESCO, I*EARN, New York University, H.F. Carey Environmental Council, EcoNet, American Museum of Natural History, River East Elementary School

panel

Report on Progress Made in Implementing the ACM Computer Science Curriculum in High Schools

Task Force of the Pre-College Committee of the Education Board of the ACM

Task force members:
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Darlene Grantham, Montgomery County Public Schools, MD
Susan M. Merritt, Pace University, NY
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Gerry Segal, Bank Street College of Education, NY
Carol E. Wolf, Pace University, NY

Moderator: Dr. Susan Merritt, Pace University

Abstract

A task force of the Pre-College Committee of the Education Board of the ACM has prepared a model high school computer science curriculum that was published by the ACM in June 1993. A summary appeared in the May 1993 Communications of the ACM. The full report is available for purchase from the ACM.

The report identifies computer science topics that provide a broad introduction to the field for high school students. The appendices of the report contain a number of different ways to incorporate these topics into courses. The intention is that this course be similar in scope, depth, breadth, and methodology to typical high school science courses.

From the beginning, the task force recognized the problems involved with implementing such a course in the high schools. In this country, education is organized by state and local jurisdiction. There is great variance among states, districts, and schools with respect to curriculum goals and criteria, teacher preparation and certification, resources, and understanding and appreciation for computer science.

The panel will report on the progress made in addressing "systemic" issues including federal, state, and local leadership, Educational Testing Service and college board exams, scientific societies, and high school--university articulation. "Grassroots" issues such as talks that could be given to high school classes, development of teaching materials, and "adoption of local schools" will also be discussed.

panel

Cool Kids' Stacks: How to Get Your Students Motivated, Engaged and Empowered with HyperCard

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Key words: hypermedia, multimedia, HyperCard, middle school, collaboration

Abstract

How would you like to get your students motivated, engaged, and empowered by HyperCard? For the past three years our middle-school students have become enthusiastic HyperCard authors. We would like to share our experiences and their stacks during this panel session.

The students in our three schools have developed some cool stacks. We will show a developmental sequence of student stacks from simple to complex and discuss what they learned at different stages: autobiographies, choose-your-own-ending adventure stories, flip books (animation), biomes around the world, introduction to our school for new students, travel logs, mammals at Lincoln Park Zoo, chemistry experiments for younger students, an investigation of the physics of motion, and Spanish vocabulary.

The multimedia tools our students used to create their stacks also ranged from simple to complex: clip art stacks and stacks of sound clips, microphones for recording their own voices or music from a CD, *ClarisWorks* for original color graphics, scanners to scan color and black and white pictures, *QuickTake* and *XapShot* cameras to include their own photos, commercial videodiscs, camcorders and a video digitizer to make their own *QuickTime* movies.

Our panel presentation will focus on three questions:

- What do kids learn as *HyperCard* authors?
  As teachers, we will discuss what our students have learned, from our point of view, about synthesizing information, about problem solving, about visual literacy and design, about the technology, and about the content area of their stacks. In addition, some of our students will share via videotape what they have learned, from their point of view, as a result of their *HyperCard* experiences.
- Since students' sense of audience is critical, how do we provide an audience for their work?
  We have involved students in peer review, oral presentations to other classes, teaching younger students, and opportunities to share their stacks with their peers at other schools and with teachers at conferences.
- How do we manage a multimedia authoring environment with one teacher, one scanner, one video digitizer, and two videodisc players?
  We will discuss our different classroom environments, both the physical design and strategies for resource sharing and collaboration.

panel

Reinventing Middle School Mathematics Classrooms with Technology Perspectives from Practitioners

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Key words: mathematics, technology, training, in-service, adolescence, projects

Abstract

Participating in this panel presentation are educators who are involved in collaborative projects (school districts and universities) to revitalize mathematics instruction through the use of technology at the middle school level.

Summaries of Participating Projects

Enhancing Mathematics Instruction through Computer-Oriented Active Learning Environments.

This mentorship project provides intensive training and support to 45 middle and high school teachers in 16 school districts in New Jersey. The project uses computer software and calculators as catalysts for creating classroom environments that are more constructivist in nature and promote active learning. After developing several personal models for using technology involving one computer classroom, classroom labs, and computer labs, the teachers will act as mentors for their schools and school districts. In addition to the mentorship project, CIESE is engaged in a national outreach effort which includes a videoconference series produced in cooperation with New Jersey Network and distributed to a national audience by the Satellite Educational Resources Consortium (SERC). There is a "hands-on" component that is done in collaboration with community colleges.

Empowering Teachers: Mathematical Inquiry Through Technology

Through graduate courses, inservice workshops, and interactive satellite based distance learning courses this NSF-sponsored teacher enhancement project is focusing on a comprehensive teacher education program to foster the strategies, art, and practice of mathematical inquiry teaching in middle school mathematics classrooms. The program employs interactive computer software and video technology as key instructional tools for the development of inquiry learning and teaching skills.

Leadership Infusion of Technology in Mathematics and its Uses in Society

Project LITMUS was created in response to a special solicitation from the National Science Foundation that specifically targets the need for inservice education of mathematics teachers grades K-12 to enable them to integrate computing technologies in their regular classes. This project represents a major effort in the reform of mathematics teaching practices throughout two school systems. The use of computing technologies is seen as the catalyst for this reform effort. The project will attempt to develop and evaluate a model for the system-wide infusion of computing technologies in mathematics instruction that could be adapted for use by school systems throughout the nation. The core of our model is the development of Leader Teachers in every school in the system. These Leader Teachers are becoming expert users of technology in their own learning and teaching and will act as mentors for the other teachers in their schools. All Leader Teachers have Internet accounts and most of the communication is by e-mail. The project also has a support team of graduate students and project staff who make regular trips to the classroom.

Empowering Mathematics Teachers in Computer-Intensive Environments

This teacher enhancement project funded by NSF has sponsored a Computer-Intensive Mathematics Education Institute (CIMEI) that seeks to empower secondary mathematics teachers to teach in environments that assume continuous access to a variety of computing tools for investigating mathematical ideas. Project activities include the implementation of an innovative curriculum, Computer-Intensive Algebra, that focuses on the application of mathematics and the development of its understandings. CIA provides students with an opportunity to explore mathematics in real-world situations through development and evaluation of mathematical models. Students learn properties of variables, functions, relations, and systems as they investigate realistic questions using computers and calculators.

panel

Computer Enhanced Photographs: Issues and Responsibilities

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Key words: computer illustration, digital imaging, photo manipulation, enhanced photos, copyright, ethics, visual communication

Abstract

We are bombarded with images. We used to say that a picture is worth a thousand words. That might still be the case. We used to believe that if there was a picture of a person at an event that the person was surely there. Now we have to rethink our

trust in images. With computers and imaging software, newspapers have printed pictures of events that never happened. Magazines have moved the pyramids closer together and have even used the head of one person and the body of another to depict one being.

As teachers, we need to give students tools for viewing the world. What's real and what's not? It isn't just the multimedia giants who can enhance photos with extremely expensive computers and software. Our fourth graders can do the same on their LC's with a $50 program. As we give more assignments to our students that incorporate photographs into computer projects, we have to give students the whole picture about using images. What photographs can they legally use? What's theirs and what's not? We need to give students criteria for the creation of their own work. If our students always rely on fabulous pictures of some adult's creation will they ever develop their own skills and capabilities?

Copyright and creativity aren't the only issues. There are also ethical issues. Is photo imaging used to create a clearer photo, a fantasy or a lie? Even if we don't teach kids how to manipulate photographs on the computer, as responsible citizens we have to know about imaging techniques. Guidelines for evaluating visual information are essential. Recently the whole country had become aware of computer illustration. *Time* and *Newsweek* each published a cover using the police booking photo of O. J. Simpson. The *Newsweek* cover showed the unretouched photo while the *Time* cover showed a darker, blurrier portrait made from the very same photo. Was the manipulated *Time* cover journalism, art or exploitation?

The exciting new field of computer imaging has helped people communicate better. Sometimes it has also helped to obfuscate information. We can't, however, condemn the technology. We should only condemn its misuse. Photo manipulation has created wonderful fantasy artworks and illustrations. Architects plan buildings; manufacturers design fabrics and garments; and doctors help patients visualize their plastic surgeries with photo manipulation. Sometimes it is just used to make a bad photo better, not just

better but printable. What we tell students about digital imaging may determine how they use or misuse it in the future. The topic raises ethical, legal, moral, and aesthetic, questions. There is a difference between darkening O.J.Simpson's skin; erasing a traffic light coming out of someone's head; and making pigs fly! Those differences provoke stimulating and meaningful discussions that help us better understand visual communication.

paper

Characteristics of a Good Programming Teacher

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Abstract

This paper presents characteristics of a "good" programming teacher derived from a study of four programming teachers at the high school level. Results are discussed in relation to: (a) characteristics demonstrated by the teachers in the classroom; (b) criteria for effective computer teachers gathered from district coordinators, computer teachers, and students; (c) summary of (i) programming concepts emphasized, (ii) problem-solving strategies emphasized, and (iii) teaching strategies used.

Paper

Having taught programming at the high school level for seven years and at the college level for 15 years, I became interested in the concept of what makes for a "good" programming teacher. In the Midwest, I would always run into teachers who would say, "I can teac BASIC in two weeks," and I knew that I was spending two semesters or a whole year to teach BASIC. Then, one day it finally hit me: "I wasn't just teaching BASIC; I was teaching programming techniques and problem solving, as well." Many of my students would go on to major in computer science or into careers in other fields using computers because of the one course they took from me.

So, when I received a sabbatical year from teaching, I decided to study a group of high school teachers to find the characteristics of a "good" programming teacher. A metropolitan area in the Midwest offered an excellent setting for my study. The Greater Kansas City area encompassed 20 school districts (12 in Missouri and 8 in Kansas) with 50 high schools which include inner-city, urban, and suburban. Four teachers who taught a beginning BASIC programming course the year of the study were selected as my subjects for the study. Selecting the four teachers based on their variation in degree of computer preparation, site of teaching, and gender provided for information-rich samples and provided some interesting results.

The concepts of programming and problem solving that these teachers stressed and the teaching strategies they used in teaching BASIC programming to novice programmers were examined from three perspectives: the teacher, the teacher's supervisor, and the students. Data collection instruments included: questionnaires, observations, interviews, and classroom documents. Each teacher was observed for one unit or chapter (three to four weeks). This meant consecutive daily observations of one class. All aspects of teaching a single unit: the teacher's handling of lectures (large and small groups), laboratory supervision (individual and teacher interaction), assignments, grading, and testing were part of the study. Interviews were conducted with each teacher, the immediate supervisor, and several students in each class. Any classroom document pertaining to teaching the programming course was examined. Information gathered about each of the teachers provided several characteristics of a successful programming instructor.

Special Characteristics of Each Teacher Studied

After observing each teacher for three to four weeks, I described each teacher using two to three descriptive words about their approach to teaching programming. Two words that describe Gene (teaching in Kansas with most coursework) are *questioning* and *patient*. Throughout the three weeks of observation, Gene consistently helped his students reach an understanding of the material by asking them questions to help them answer their own questions. He would patiently wait for them to think and arrive at an answer or ask another question to lead them to the right answers. Larry, one of Gene's students, explained it this way. "When he's having us write a program on the overhead–when he's writing it–he'll ask us what the next line is. If we don't give him the right answer, then he'll question us and make us think about it." It would have been so much faster to give the students the answer, but Gene wanted all of them to stay with the thinking process in order to understand the material.

Two words that describe Leigh (teaching in Missouri with most coursework) are *understanding* and *responsive*. The word, understanding, characterizes Leigh in the way he treated students and by what he desired students to get from his class. He always treated each student with kindness. Throughout the three weeks of observation, Leigh consistently encouraged his students to strive to understand the material. Although he worked with students who did not value education as much as students in the other schools, he was responsive to the needs of each student, his second characteristic. Approaching the students individually, he accommodated each one according to need and depending upon the situation at that time. He wanted his students to see the importance of really understanding what they were doing and to develop their thinking skills.

Three words that describe Kathy (teaching in Kansas with least coursework) and her classroom are *practice*, *fun*, and *equity*. Kathy's theme in the classroom was, "Practice makes perfect." She followed every lecture with an immediate assignment to practice the concepts previously explained, to be done either in class or at home. She had the students correct their own papers the next day for immediate feedback. One might think that high school students today wouldn't like doing all this work, but Kathy's students described her and her class as "fun." Kathy kept a light atmosphere in the classroom. Throughout the four weeks of observation, she consistently treated her students with respect and fairness even though five of the students were absent quite often. These attitudes helped each student in her class think and feel that they were learning something–something important.

Two words that describe Mary (teaching in Missouri with least coursework) are *dynamic* and *affirming*. Dynamic describes Mary in three ways: (a) she is a lively, vibrant force in the classroom; (b) she makes the computer field living and current to her students; and (c) she is ever adapting her teaching approach to meet the needs of her varied students. Praising her students for the tasks that they accomplish and affirming their efforts, Mary motivates and challenges with a positive approach. These characteristics of Mary are key to her enthusiastic effect on her students.

Criteria of Effective Computer Teachers

Based on these observed characteristics, one might say a "good" programming teacher is questioning, patient, understanding, responsive, fun, equitable, dynamic, affirming. But, it might be difficult to find one teacher who embodies all these qualities. So, next I examined criteria of effective computer teachers given by: the district coordinators who identified their best computer teachers, the computer teachers who were described as effective and who responded to the questionnaire, and the students of the four teachers who were the subjects of the main study. The criteria are listed from most frequently mentioned to the least. These are given in a table for each group and then summarized into a composite picture.

District Coordinators' Perspective

The district coordinators, who are the computer coordinators or the curriculum coordinators, from the 20 districts in the Greater Kansas City area were contacted by phone. Each coordinator was asked to submit the names of one to five (depending on the size of the district) high school teachers whom they considered effective computer teachers. Table 1 summarizes the criteria given by the 20 coordinators. Only two items, "knowledge of the subject" and "get good results," are mentioned by more than half of the coordinators. All the criteria are listed to show the variation in districts in one metropolitan area. It is important and possibly sad to note that only one coordinator mentioned, "Teach students to think."

Table 1. Criteria of Effective Teachers Given by District Coordinators

Criteria	Frequency
Knowledge of the subject	12
Get good results *	10
Good rapport with students	9
Keep up-to-date	7
Help develop curriculum	6
Enrollment increase or stable	5
Innovative, vision the future	4
Experience of working with them	4
Enthusiastic	3
Use various teaching strategies	3
Develop student interest	3
Good performance evaluation	2
Experienced teacher	2
Respected by colleagues	2
Train other teachers	2
Cooperative	2
Good communication skills	2
Lots of energy	1
Teach at a college	1
Teach students to think	1
Manage classroom behavior	1
Patience	1

*Get good results includes: what students are able to produce, grades students merit, and percentage of students who obtain advanced placement.

Computer Teachers' Perspective

Questionnaires were mailed to the 60 teachers, described as "effective" by their coordinators. These teachers from 40 different schools were asked to provide various demographic data and to state the characteristics they would attribute to an effective computer teacher. Twenty-two teachers responded to the questionnaire, but only 20 teachers answered this specific question. Table 2 summarizes the criteria given by the 20 computer teachers who had been deemed effective by their district coordinators. No item is mentioned by a majority of the teachers. However, the wide range shows that the teachers looked closely to identify the characteristics that make an effective computer teacher rather than simply listing criteria found in an educational textbook. The comments indicate that most of the criteria came from self-inspection. Also noteworthy, is the fact that four of the teachers considered the criteria, "effectively teach problem solving," as important for an effective teacher.

Table 2. Criteria of Effective Teachers Given by Computer Teachers

Criteria	Frequency
Knowledge of the subject	7
Flexible–work with varying abilities	7
Seeks self-improvement, keep up-to-date	5
Patience	5
Effectively teach problem solving	4
Able to communicate well	4
Help students become self-motivated	3
Creativity	3
Deep interest in the subject	3
Positive and reaffirming	2
Truly cares	2
Works hard and long hours	2
Enthusiasm	1
Ability to organize	1
Ability to work with those doing various tasks	1
Always moving about the room helping	1
Let students learn by mistakes	1
Like teaching	1
Humor	1
Attention to detail	1

Appreciate computer ethics	1
Use cooperative learning	1

Students' Perspective

The student perspective on what makes an effective computer teacher was also sought. Three to five students from the classes of the four teachers who were the subjects of the main study were interviewed. Each student was asked, "What characteristics would you attribute to an effective computer teacher?" If a student had trouble responding to this question, he or she was asked, "How would you describe a 'good' teacher to a friend?" Every student was able to respond to one of these questions.

Table 3 summarizes the criteria given by the 16 students. Only two items are mentioned by more than half of the students: "helpful" (10 students) and "teaches you, explains well" (9 students). Although most items are only mentioned once by one student, all of them might be of interest to computer teachers.

Table 3. Criteria of Effective Teachers Given by Students

Criteria	G (4)	L (4)	K (5)	M (3)
Helpful	3	3	2	2
Teaches you, explains well	2	3	2	2
Makes sure you understand	1	2	2	
Knowledge of the subject	2			2
Good rapport with students	1	1	1	1
Ability to communicate with the students	1	1	1	1
Jokes, is fun			2	
Patience		1		
Makes us practice a lot				1
Well-organized	1			
Interesting	1			
Shows how to apply to life				1
Spends time after school			1	
Stresses doing things on your own		1		
Makes you earn your grade			1	
Outgoing		1		
Understands and fosters different rate students learn				1

The three sets of criteria are examined for common themes. The intent is to look at those criteria that are mentioned by the majority in each group; however, in the teachers' list, no item is mentioned by the majority. Since there are two such items in each of the other groups, the top two criteria from the teachers' list are used to examine common themes. "Helpful" in the students' list was grouped with "flexible–work with students with varying abilities," the second item in the teachers' list. The common criteria that resulted are: (a) knowledge of the subject; (b) helpful, flexible–work with students with varying abilities; (c) teaches, explains well; and (d) get good results. "Get good results" included what students are able to produce, grades that students merit, and percentage of students who obtain advanced placement.

Concepts and Strategies Emphasized by the Four Teachers

In the final analysis, the teaching activities of the four teachers were examined using the list of concepts and strategies gleaned from a search of the literature and through discussions with computer educators at the college and high school level. (See the article, "Teaching Programming and Problem-Solving Strategies in High School Courses Today: A Case Study," (Kushan, 1993) for a detailed description of these concepts and strategies.)

The programming concepts, problem-solving strategies, and teaching strategies emphasized by the four teachers were determined through the observations, teacher interviews, supervisor interviews, and student interviews. The presence of a concept or strategy in the classroom of each teacher was rated high, medium, low, or none. A high (H) rating means that the concept or strategy was noticed several times during the observation and was found in the data from three or more instruments. A medium (M) rating means that the concept or strategy was noticed several times during the observation but was found in the data from only two instruments. A medium rating was also given if one aspect of a concept or strategy was missing in that teacher's presentation. A low (L) rating means that the concept or strategy was noticed only a few times or was found in data from only one instrument, for example, the teacher interviews. A rating of none (N) means that the concept or strategy was not present in the data from any instruments, not even the teacher interviews. The degree of emphasis of each of the concepts is given in the tables with the concepts or strategies listed vertically and the teachers' pseudo-names listed horizontally. The entries in the table are the ratings of presence of each particular concept or strategy in a teacher's classroom. The rating for each teacher was a judgment by the researcher based upon all the information gathered.

Programming Concepts Emphasized

Table 4 shows which programming concepts were emphasized in the programming classes of the four high school teachers (Gene–G; Leigh–L; Kathy–K; and Mary–M). A concept was considered emphasized if two or more teachers had ratings of medium or high for their emphasis level. Eight (marked with >) of the 12 programming concepts listed as important were considered emphasized and ranked according to overall emphasis by all four teachers: (a) syntactic knowledge, (b) semantic knowledge, (c) modularity, (d) structured programming, (e) internal documentation, (f) top-down design, (g) debugging, and (h) external documentation (design tools).

Table 4. Degree of Emphasis of Programming Concepts

	G	L	K	M
Structured Programming	H	L	M	H
Top-down Design	L	L	M	H
Bottom-up Design	N	N	N	N
Modularity	H	M	M	H
Syntactic Knowledge	H	H	H	H
Programming Practices	H	H	H	H
Meaningful Names	M	L	L	L
Initialization	M	N	N	N
Generalization	N	L	L	N
Internal Documentation	H	L	M	H
External Documentation	N	L	M	H
Debugging	H	M	L	L
Testing	L	L	L	L
Maintenance	N	L	M	N

H–High M–Medium L–Low N–None

Because of the importance given to structured programming as an element for success in college computer courses in the Taylor and Mounfield (1991) study and to show how the ratings were assigned on this topic, a step-by-step analysis of the teaching of structured programming by the four teachers follows. Structured programming requires that a program be composed of only the three structures, sequence, decision, and loop, and that every structure be entered only at the beginning and exited only at the end. An emphasis on the use of subprograms and discouraging the use of the GOTO statement in BASIC are signs of structured programming.

The units on arrays taught by the four teachers used the FOR/NEXT loop structure which meets the one-entry/one-exit principle. During large group lectures, Gene and Kathy both reminded the students not to use GOTO statements in their programming projects, but only Kathy made mention of the one-entry/one-exit principle when lecturing on one of the sorting methods.

Gene and Mary required that every program be written with one main routine that called several subroutines. Kathy and Leigh encouraged students to think in terms of modules for inputting data, sorting data, and then printing data. However, Kathy presented a sort module that also printed the results and Leigh's students repeated code for printing the original array and the sorted array rather than writing a subroutine.

Gene and Mary had students clearly mark subroutines with REM statements and indicate loop and decision structures with indentation. Mary indicated that this was an important part of structured programming. She explained, "Also, part of the structured programming would be a lot of the formatting of your program–the loop indentation and the documentation of the REM statements." Kathy stressed indentation of structures to her students but did not require that modules be marked with REM statements. The rating of low was given to Leigh because he did not stress two of the aspects of structured programming.

Problem-Solving Strategies Emphasized

Table 5 shows which problem-solving strategies were emphasized in the programming classes of the four high school teachers. A strategy was considered emphasized if two or more teachers had ratings of medium or high for their emphasis level. Five (marked with >) of the 10 problem-solving strategies were emphasized and ranked according to overall emphasis by all four teachers: (a) selecting the best solution, (b) analytical approach, (c) breaking into smaller steps, (d) re-analysis, and (e) the steps of problem solving.

Table 5. Degree of Emphasis of Problem-Solving Strategies

	G	L	K	M
Steps of problem solving	L	N	M	H
Breaking into smaller stepsM	L	L	H	
Looking for a pattern	N	L	N	N
Using a model	N	N	H	N
Analytical approach	M	L	M	H
Visual approach	L	N	N	H
Selecting the best solution	H	H	M	N
Problem posing	N	L	N	N
Plan composition	L	N	N	N
Re-analysis	H	M	L	L

H–High M–Medium L–Low N–None

To better understand the process of the ratings in regard to problem-solving, the topic on re-analysis is explained further. By teaching the techniques of debugging, Gene and Leigh were the only ones to emphasize re-analysis constantly during lab supervision. When the students asked for help, these teachers asked questions to enable students to answer their own questions. Clements (1990) noted the importance of encouraging re-analysis rather than just patching code. Gene always asked questions in response to students questions about problems in their programs. Leigh sometimes asked questions that would lead students to correct errors in their programs and other times he just told the students what they needed to do. Kathy always told her students where the bug was and what to do to change it. Mary didn't spend much time stressing debugging techniques because she used the time to emphasize design; she said that more time spent on design would result in less debugging.

Teaching Strategies Emphasized

Table 6 shows which teaching strategies were used in programming classes at the high school level. A strategy is considered used if two or more teachers had ratings of medium or high for their usage level. The four most common teaching strategies used are: (a) mediated instruction in lab, (b) hands-on practice of the concepts, (c) guided instruction in lecture (mostly question-answer method), and (d) process testing. These are ranked according to overall usage by all four teachers.

Table 6. Degree of Usage of Teaching Strategies

	G	L	K	M
Rule instruction	L	L	H	L
Discovery instruction	N	N	N	N
Guided Instruction	H	M	L	H
Mediated Instruction	H	H	M	H
Group Learning	N	L	L	N
Hands-on Practice	H	H	M	H
Process Testing	N	L	H	L
Hands-on Testing	N	N	N	N

H–High M–Medium L–Low N–None

Mediated instruction was used by all of the teachers during lab supervision. Lehrer, Guckenberg, and Sancillo (1988) noted that mediated instruction in Logo was necessary for the transfer of problem solving skills to other domains. Mediated instruction differs from guided instruction in that the point of discussion is usually student initiated and the teacher does not have a defined set of content he or she plans to cover. The teachers used the opportunity of individual student's questions or problems to re-teach a concept, to help a student with a debugging problem, or to model problem-solving strategies. They used these moments of teaching to emphasize programming concepts and problem-solving strategies that they considered important. In using mediated instruction during lab supervision, Kathy had one failing which she readily admitted: she told the student where the syntax error was and how to fix it rather than using the error as a teaching moment.

The concepts and strategies that I first used in my own teaching and most recently verified in the literature search have also been observed in the classrooms of effective computer teachers. The key programming concepts derived from this study are structured programming, design tools, and debugging techniques. These three provide the means whereby teachers can teach the three problem-solving strategies of breaking into smaller steps, steps of problem solving, and re-analysis respectively.

Conclusion

A good programming teacher might be described from three perspectives. If the qualities that characterized each of the four teachers of this study were combined, then the good programming teacher might be someone who is questioning, patient, responsive, understanding, fun, equitable, dynamic, and affirming. Yet, district personnel directors might not be able to find one person possessing all these qualities–certainly not one person for every school wishing to teach programming as part of their curriculum. If the good programming teacher is presented as someone possessing the common criteria derived from the district coordinators, other teachers, and the subjects' students, then programming teachers should (a) be knowledgeable of the subject matter, (b) be able to work with students of varying abilities, and (c) be able to explain well. These are qualities for which district personnel directors might look when hiring computer programming teachers if they want to see "good results." If the good programming teacher is described as someone: (a) who emphasizes structured programming, which includes a high-degree of modularity and internal documentation; (b) who emphasizes top-down design, using design tools extensively; and (c) who emphasizes the problem-solving strategies of the steps of problem solving, breaking into smaller steps, the analytical approach, and selecting the best solution, then both present and future programming teachers can strive for this goal. Selective teacher education programs can be designed to prepare such teachers.

District personnel directors might use data from all three perspectives when hiring teachers of programming. And, these ideas might also be used by computer programming teachers, themselves, to set goals or for self-evaluation. In my present academic position, I certainly plan to use them in three ways: to set goals in my own teaching of programming, in self-evaluation of teaching, and in evaluating the teaching of programming by graduate assistants. The lists of qualities derived from all these perspectives provide "food for thought" for any teacher.

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paper

Teachers, Technology & Testing: Exploring New Tools for Alternative Assessment

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Abstract

Since January, 1994, 15 teachers from the Teachers Using Technology to Measure Mathematics Meaningfully (T²M³)[1] Project have been developing assessment materials for elementary and middle school mathematics, that make use of technology for the delivery and collection of student achievement information. This paper discusses the tools and methodologies utilized by the T²M³ teachers as they expanded their repertoire of classroom assessment techniques to incorporate a range of technologies. The tools included computers and software, video cameras, the Newton, scanners, and the Learner Profile. Assessments methods included interviews, portfolios, and scoring rubrics. Discussion of the results of the T²M³ Project suggest ways that technology can allow teachers to embrace alternative assessments. Implications for expanding the use of technology beyond instruction to assessment offer new areas of research. This paper addresses the implications for the use of technology for alternative assessment.

Introduction

Teachers "test" their students using an assortment of teacher made paper and pencil exams that focus primarily on the content domain they teach. However, their assessments often go beyond these measures to include observations, interviews, continuous instructional monitoring, and performance samples of their students' work in a variety of situations. These data provide additional feedback about individual student's growth and change and the effectiveness of the teachers' instruction. The resulting evaluations are holistic appraisals depicting broad pictures of students as learners (Brophy & Good, 1986; Carpenter, 1989; Natriello, 1987; Reynolds, 1992). These new models of assessment allow for increased understanding of how learners construct new knowledge (Cobb, 1990Greeno, 1989). However, these new assessment techniques require new tools.

Instructional technology can help teachers formalize these alternative assessment. Educational technology holds promise for addressing some of the increased demands that meaningful and dynamic assessment place on teachers. For example, projects such as the Jasper Series (Vanderbilt University, 1990) highlight the possibilities of using technology in more supportive ways. These projects have helped move educational technology from being a tool for varying traditional instructional activities to creating powerful educational environments (Scott, Cole, & Engel, 1992). However, for the most part, even teachers who are using technology for instruction have not fully incorporated these tools into their assessment repertoire (Ginsberg, Sebastian, Underwood, Anderson, Kridel, & Stevenson, 1994).

Technological tools furnish the means for presenting a variety of assessment tasks and situations. Technology also allows us to record students' performance, tracking the actions they take while forming, testing, and verifying hypotheses. Lastly, technology allows for fuller reporting of information, for example, video vignettes of student performance. Affordable videotape and videodisk equipment, as well as microcomputers, calculators, and other interactive systems, can facilitate dynamic assessment (Kaput, 1992). Technology makes it feasible to capture and store students' actions and procedures and provide structured and more accurate records of prior actions. Yet, only 12% of video-based courses integrate any assessment tools as part of the courseware (Barrett, 1990).

Exactly how current and future technology can contribute to assessment is still mostly speculative. Potentially, educational technology promises the delivery of more realistic assessment situations and the tools for going beyond paper and pencil records and informal observations to more fully record student achievement. However much of the previous research related to educational technology and assessment has focused on computer-based techniques for administering, scoring, reporting, and interpreting test items (Bunderson, Inouye, & Olsen, 1989)

Research examining teachers' use of educational technology for assessment is scarce. Many questions remain. The role technology takes in teachers' development and use of instructional assessment is relatively unexplored. Teachers are often excluded from the investigative process. If we are to successfully build integrated instructional and assessment systems that are valid and useful for teachers, then teachers must be partners in the process. They can articulate the everyday functions of assessment, and help to identify specific problem sets that integrate assessment with curriculum and instruction. Their experiences in the classroom make them useful guides in the journey to reform.

The entire Teachers Using Technology to Measure Mathematics Meaningfully Project (T^2M^3) had three underlying goals: (1) to determine expert and novice teachers' capabilities to develop comprehensive integrated assessment materials in mathematics; (2) to investigate the role that technology plays in helping teachers present integrated assessment situations and record and analyze student achievement; and (3) to investigate the changes in teachers' pedagogical reasoning, pedagogical content, and schemata as they develop and use integrated instructional assessment tasks. We hypothesized that investigation of these three research areas would increase our understanding of how capable teachers are of integrating assessment with instruction. We proposed to identify some of the ways that researchers, technology experts, and assessment experts can contribute to teachers' efforts to create integrated assessment. Data related to all of the research questions were collected by interviews with the participating teachers, observations of the teachers as they developed and used assessment materials, and comparisons of teachers' field notes and actual assessment materials. Details of the entire study are presently being compiled. Final analysis of the project will be available in forthcoming articles. However, throughout the project some themes have emerged. This paper deals specifically with one of these themes: the features of available technology that enhance teachers' abilities to deliver instructional assessment to students and continuously record, analyze, and evaluate information about students' knowledge, cognitive processes, and development in mathematics.

Methods

Participants.

Subjects for T^2M^3 were 15 teachers who met the following criteria: (1) taught elementary or middle school mathematics; (2) used some technology for instruction, (3) showed potential for extended involvement in the development and field testing of the T^2M^3 tasks; and (4) represented diverse groups and/or classroom situations that included students from under-represented groups. At the time they were selected, three taught primary level, six taught upper elementary level, three taught middle/junior high, two taught gifted children in grades one to six, and one taught math and computer for grades five to eight.

The selected teachers represented a broad range of expertise in teaching mathematics and in using technology. In addition, their schools provided very diverse populations. This teacher and student population allowed us to compare the application of tools and techniques across a wide domain of situations.

Treatment

The study consisted of four phases. During Phase 1, the 15 teachers were selected. Each teacher proposed a mathematics curriculum module they wished to expand to include assessment. Upon acceptance into the project each received a video camera to use in assessing themselves and their students. The camera was under the control of the teachers, available to them whenever they wished to use it.

Phase 2 entailed the development and presentation of the instructional treatment to help the teachers create an assessment module to the math module. The training program informed the teachers about various technological methods of presenting assessment information; available technologies for evaluating learning in mathematics; models of interactive assessment in mathematics; *National Council of Teachers of Mathematics* (NCTM) Curriculum, Professional, and Assessment Standards; and techniques for being a teacher-researcher. Workshops, hands-on activities, and collaborative work times provided the teachers opportunities to work with content area specialists, assessment experts, cognitive scientists, and technology specialists.

The teachers participating in the T^2M^3 Project received extended training in creating and using integrated mathematics assessment. Following the training, the teachers developed the instructional assessment component for their modules. This schedule of training and meetings ensured, as much as possible, that teachers received the support needed to successfully create effective assessment tasks.

In order to document teachers' capabilities to create meaningful classroom assessment materials, the progress of the participating teachers was carefully observed. These observations, conducted through videotapes and in-class visits, provided a thorough description of factors that enhanced or impeded the successes of teachers who have a range of pedagogical expertise. Providing detailed explanations of the progress of the various teachers furthered our understanding of teachers' capacity for developing original assessment procedures. Teachers' work during the project sessions provided exemplars of the models for assessment.

Results

The collaborative investigation of the project participants provided an opportunity to articulate technology's role in classroom assessment. The results are reported in two areas: tools and methodologies.

Tools.

An important component of the T^2M^3 was the actual technology that was available, or was made available to the teachers throughout the project. In order to depict the influence of these tools on the teachers' assessment techniques, we report our findings within three categories: school resources, new toys, and prototypes. These categorizations allowed us to represent all the tools that the teachers used during the project.

School Resources.

There was a range of technology available at each of the participant schools at the beginning of the project. Every school had televisions, video cassette recorders, calculators, and computers, and at least one videodisk player. Many of the 15 teachers had some of this technology in their classrooms.

Specifically, all had televisions available and could procure a VCR, videodisk, or video camera. At the beginning of the project, 5 of the 15 had one computer in their classrooms (either Apple IIEs or Macintosh LCs), 4 had two or more computers (a combination of Apples and either Macintosh LCs or MS-DOS 286 or 386s), and 6 had no computers in their classrooms. By the end of the project, all but 2 of the 15 had computers in their classroom, and most had acquired newer model Macintosh or DOS computers.

When the project began, only the four teachers with more than one classroom computer were using them for anything besides extracurricular activities or rewards for students. They used their computers for student projects and for classroom management and presentation. Few were using them for any aspect of assessment except record keeping. Throughout the project relevant use increased. The T^2M^3 teachers increased their use of technology to administer assessment information and record student responses.

New Toys.

Once into the T^2M^3 network, many of the teachers used their membership to learn about new sources of funding for equipment, to find out who had access to the resources, and to discover how to ask for their share. For many, it was also an opportunity to make better use of the technology at their schools. For example, few had used the videodisk player before the project began. Either they didn't know how to use it or didn't know what disks were available that would be appropriate to their curriculum. After being introduced to the Jasper Series many found ways to incorporate this technology into their instruction. Several found ways to acquire Jasper or similarly useful videodisk software.

In addition, each of the T^2M^3 teachers was given a video camera so they could chronicle their assessment situations throughout the project. It also provided them with a "new toy." All but 1 of the 15 began to incorporate the camera into their daily class routines almost immediately. It provided them with a way for capturing classroom events, delivering information to students, parents, and colleagues, and documenting changes. By the end of the project, 14 were consistently using the camera as an assessment tool.

In several cases, involvement in T^2M^3 gave the teachers the credibility they needed to be part of the group at their schools who got the new toys. Their participation in the project demonstrated their capability for using the technology and sharing their expertise with others. For one of the middle school teachers, it meant going from a classroom with no computer to having a high-end Macintosh with an overhead panel and a notebook computer in one year.

Prototypes.

With the fast pace of technological innovation, new tools are always emerging. However, teachers rarely gain access to these cutting-edge technologies early enough to influence their adoption and/or use at their schools. Throughout the T^2M^3 the teachers were given access to potential assessment tools such as *Sunburst's* Learner Profile. This accomplished several things: it encouraged innovation and exploration, it enabled the T^2M^3 teachers to be involved in professional development, and it provided informed feedback about the usefulness of the new tools to the educational community.

For example, the Learner Profile gave the teachers a way to quantify their observations. While many had previously used a paper-based system for recording observations (a folder with individual "sticky notes" for each student), the bar code and pen-based versions added several levels to their evaluations. With this tool, they were able to easily generate reports by student or by skill area. This facilitated their planning as well as their progress reporting. However, the consensus was that the bar code reader was difficult to use. The alternative, interfacing with the Newton, added several hundred dollars to the cost, which put it beyond the affordability of most of the schools. The teachers' recommendation was that, while the concept of an electronic tool for observation is useful, the technology itself still needs improvement.

Methodologies

The T^2M^3 teachers found that incorporating technology into their assessment repertoire dramatically changed their assessment practices. The technology altered the ways they delivered assessment information, their methods of data collection, and their techniques for reporting information about their assessments.

Delivery.

Training during the T^2M^3 enabled many of the teachers to discover ways to use different technologies to provide scenarios for assessment. They found diverse ways to present tasks, such as simulation exercises and audio taping tasks. Many learned how to use presentation software like *Hyperstudio* or *PowerPoint* to present mathematics tasks.

Data Collection.

Technology increased the teachers' capacity for accumulating indicators of student achievement. Sometimes the camera served as a "third eye," allowing teachers to monitor one group of students while working with another group. All of the teachers reported having used the camera to sometimes gauge the thinking processes of their students.

Video taped vignettes became an essential part of the teachers' analysis of students' performance. By the end of the project, 14 of the teachers were using the video camera regularly to record students as they worked on mathematical tasks. These samples provided extended information about students' mathematical accomplishments.

Other tools made it easier for teachers to collect and record information about their students during a lesson. For example, several of the T²M³ teachers have became proficient with the Learner Profile. They were able to record their observations during class activities. In addition, by the end of the project, all of the 15 teachers were using spreadsheets and other management tools for recording their appraisals.

The video camera also allowed opportunities for the teachers to assess themselves. They were able to examine their classroom management skills, interaction patterns, and instructional effectiveness. For most of the 15, observing their own teaching was a new experience at the beginning of the project. By the end, all reported reviewing tapes regularly to improve their instruction.

Reporting Techniques.

Teachers typically use assessment information to derive grades for their students. Frequently these grades provide the only feedback students get on their progress. Report cards have also traditionally been the sole means by which parents and school administrators get information about individual students. With the integration of technology into their assessment, the T²M³ teachers have been able to improve the reporting of assessment information to all of the stakeholders in education.

Several of the project teachers videotaped interviews with their students before and after instructional units. They used the tapes to conference with parents to illustrate their child's progress in mathematics. Some teachers now routinely include videotapes in students' portfolios. In addition, some use other technologies, such as telecommunication, to increase communication about assessment with parents and administrators.

The teachers reported that encouraging students to scrutinize their performances made them more aware of their own strengths and weaknesses. Sharing the analysis of videotaped classroom episodes enabled students to become more proficient at self- and peer-evaluation. For example, one of the teachers attached a monitor to the video camera during student presentations. This allowed students to watch themselves as they gave their reports. The students were able to evaluate their communication skills as well as their mathematical competencies.

Overall, the methodologies fostered by technologies had far-reaching effects on the teachers' assessments. It expanded their repertoire of strategies while changing their beliefs about assessment. For many, it provided new ways to demonstrate their high level of professionalism.

Discussion

The T²M³ Project provided some preliminary data about the impact of technology for assessment. The 15 teachers refined their assessment strategies as they became familiar with a variety of technological tools. The results indicate three issues that are critical to further development of instruction that integrates assessment with curriculum: availability of the technology, opportunities for professional development, and consistent support.

The T²M³ Project has allowed us to begin to understand the impact of integration of technology in mathematics assessment. These participants have become familiar with a variety of technological equipment and they have refined their methodology through the use of these tools. Their strong foundation in technology-based assessment will make them leaders among their colleagues. If the tools, the training, and the support are present, teachers will embrace new technologies to enhance their assessment methods.

The results of the T²M³ project underlined the importance of the availability of equipment to promote new methods of assessment in mathematics. If teachers are going to be asked to prescribe education for students who will live in a technological society, they must have the right equipment to assess their needs and accomplishments. Funding for equipment may be available through grants, but teachers typically are not informed about these funds. Software is sometimes purchased but not made available to classroom teachers. If we want teachers to use the tools they must be easily accessible.

Consistently, the teachers told us that the best thing about T²M³ was that it gave them access to the resources to demonstrate to teachers, administrators and parents, the effectiveness of technology-based assessment. Gaining access to the technology was the biggest challenged faced by most of the teachers in T²M³. Throughout the project, most teachers also told us that the single biggest impediment to the implementation of educational technology was the lack of funds. Many reported that writing their own grants was the only means they had of acquiring any technology in their classrooms. They were sometimes disheartened that the allocation was competitive and that grants were their only means of equipping their classrooms.

The T²M³ Project provided an opportunity for continuous professional development for almost two years. The teachers participated in workshops on the use of technological tools and they were trained in how to use these tools to assist their assessment efforts. Many of the 15 teachers then found other training to improve their use of technology-based assessment at the district, state, and national levels. In addition, they became models for their colleagues.

Support for change and development is crucial to the systemic incorporation of technology throughout the curriculum, especially in assessment. Tools such as video cameras and electronic portfolios provide school administrators, parents, and researchers with actual samples of performance. However, the adoption of these tools requires input from the stakeholders, time for implementation, and final acceptance by the users and interpreters. For example, the T²M³ teachers were consistently asked to fit the new kinds of information into old report forms. Support for alternative assessment may entail both administrative modification of current policies for assessment and meetings with parents and school boards to explain the benefits of the changes. In addition, these areas can be addressed, at least in part, through professional standards that incorporate assessment goals as well as curricular ones (Donavan & Sneider, 1994).

The T[2]M[3] enabled 15 teachers to experience assessment with technology in a pragmatic, meaningful way. They were able to try out the technology, get assistance with the technology they already had, and share expertise with colleagues. The project team provided teachers with sustained opportunities to learn about the technology that enhanced their evaluation of students' achievements. The project also provided them with advocates and experts. This helped many of them make the case for technology with other teachers and their building administrators.

T[2]M[3] empowered 15 teachers, providing them with easy access to technological tools, models of use, collaboration, and support. It helped diminish teachers' isolation and gave their students access to new forms of assessment. It offered support for the creation of new, dynamic educational assessment. It developed a strong network of active teachers willing to lead the way to new educational models. The group's continuation, through the dissemination of their work, will allow us to expand the network and provide teachers with leadership and continued support for alternative assessment.

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paper

Assessing Computing Knowledge among College Students

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Abstract

This paper reports on a study involving the administration of an assessment instrument designed to evaluate student knowledge in several areas of computing. The purpose of this study was two-fold. First, we were interested in determining whether our computer science curriculum impacts knowledge of computing topics that are not part of the explicit objectives of courses within the curriculum. This includes areas such as computer literacy (e.g., how to read technical specifications in computer advertisements), the history of computing, and events in commercial computing. Second, we were interested in measuring the degree to which a "breadth-first" CS introductory course sequence provides high-level familiarity with the breadth of the discipline. Our results indicate that computer science majors are substantially more familiar than non-majors with computing topics in general, even those topics that are not targeted explicitly by the computer science curriculum. In addition, students just completing a breadth-first course do not seem to exhibit knowledge spanning the entire breadth of computing.

Paper

Introduction

The topic of outcomes assessment is becoming increasingly important in many areas of education (Light, 1992). Given that computer science sometimes means different things to different people, such assessments can be important tools in determining the concepts that are being conveyed as part of a computer science education. In previous work, we discussed the construction of an outcomes assessment instrument to measure the familiarity of computer science majors with the breadth of the computing discipline (Cordes, *et. al.*, 1994). This assessment instrument took the form of a multiple-choice/matching exam, where questions were directed toward assessing high-level familiarity with computing concepts. We reported the findings of administering this exam in a limited setting, which resulted in several observations with potential of providing guidance for both curriculum design and future research.

Based on the results from our previous work, we administered a second exam to an expanded group of students, including computer science majors at various points within the CS curriculum, as well as non-majors enrolled in CS courses from disciplines such as engineering and management information systems. Thus, we were able to compare the performance among CS majors at various points in the curriculum, as well as between CS majors and "computer literate" non-majors. We constructed this second exam with emphasis in three major areas:

- Traditional computer science concepts. This included coverage of technical concepts that would normally be addressed in computer science courses. Our objective was to select a broad set of basic questions, where the underlying concepts have been covered in a breadth-first introductory sequence.
- Computing history and contributors. This includes both historical events in computing as well as the major contributors to the field. It also included a number of questions from the commercial computing arena, requiring a familiarity with major computing commercial enterprises, as well as with the leaders who contributed to these enterprises.
- Computer literacy. This area included coverage of concepts needed to purchase, install and utilize products available in the commercial computing market. In general, this area included coverage of material that might be found in a computer literacy course for non-majors, as well as material generally related to being literate computer consumer.

Of course, the "computer science concepts" area is explicitly covered by our computer science curriculum. However, the other two areas are not explicitly stressed in most computer science curricula (including our own). Nonetheless, we would ideally expect computer science students to be experts in these areas, even to a greater degree than non-computer science students who are frequent computer users. However, our own experience suggests that CS majors are unfamiliar with computing history, must sometimes struggle to read technical specifications in computer advertisements, and are often not particularly good at installing and using computer systems and software. The inclusion of the latter two categories was an attempt to determine the extent to which these observations are actually correct.

In this paper, we report on a follow-up study on the results of administering the new exam. Our study addresses the following questions:

1. Are CS majors significantly more knowledgeable in the above three areas than non-majors who are frequent computer users? While we would expect CS majors to be more knowledgeable regarding computer science concepts explicitly targeted by the curriculum, it is less clear what to expect regarding computing history and literacy concepts. As stated above, we would hope that CS majors are relative experts in both of these areas as well. However, given that these areas are not explicitly targeted by the curriculum, it is quite plausible that the performance of computer literate non-majors is comparable to the performance of CS majors.
2. How do the CS freshman who have just completed our introductory sequence compare to other groups (particularly the more advanced CS students) with respect to the three areas? Our introductory sequence is organized in "breadth-

first" fashion, where the focus is on the breadth of the discipline (addressing issues such as operating systems, artificial intelligence, multiple programming paradigms, etc.), as opposed to the classical approach of attempting to first achieve depth in software design and development. Breadth-first curriculum design in computer science has been a subject of considerable discussion and controversy (Baldwin, 1990; Locklair, 1991; Motil, 1991; Pratt, 1990). Are students completing a breadth-first course obtaining at least high-level knowledge (sufficient to answer multiple choice questions) spanning the breadth of the discipline?

The paper is organized as follows. Section 2 addresses the details of our previous study (Cordes, *et. al.*, 1994). Section 3 addresses the design of the new exam, as well as the overall design of the accompanying study. Finally, Section 4 addresses our results.

Previous Work

In this section, we review the results of our previous study (Cordes, *et. al.*, 1994) from the Spring 1993 semester. The students involved in this study ranged from second-semester freshman to graduating seniors. An exam was constructed with 100 questions that cover the basic areas of the CS discipline, as well as computing history and basic computer literacy. Questions were multiple choice, true/false, and matching.

The exam was presented to the students (unannounced) during a regularly scheduled class meeting towards the end of the Spring semester. The exam was administered to three different classes: a second-semester freshman-level course, a sophomore/junior-level course, and a course consisting primarily of graduating seniors. The three courses involved were:

- CS 124 : Introduction to Computer Science: This course is a second-semester freshman course. All of the students within the course are familiar with the concepts of programming and software development. The class develops a breadth-first introduction to the discipline of computing as a whole.
- CS 325 : Software Development and Systems: This course is part of the "middle tier" of our CS major. After students complete the first year of the discipline, they must complete four additional CS courses (data structures, assembler, discrete math, and this course) prior to moving on to the upper-level courses in the discipline.
- CS 426 : Introduction to Operating Systems: This is one of four required senior-level courses within the major. All students must take this course prior to graduation. The majority of the students in this course were in their last semester when this exam was administered.

The overall performance on the exam was approximately 68% for seniors in CS 426, 57% for juniors in CS 325, and 45% for freshmen and sophomores in CS 124. The 68% average for seniors was consistent with the average GPA of students in the class (a high C). The average scores indicate, however, that the CS 124 students failed to master a substantial percentage of the material. Given that the CS 124 students are freshmen and sophomores, this appears to be an intuitive result. However, in light of the fact that CS 124 is a breadth-oriented course, one might argue that students should have turned in a better performance on a multiple-choice/matching exam, where depth of knowledge is not needed. We revisit this issue in a more rigorous fashion in this paper.

The exam also revealed a weaknesses in the ability to recognize important contributors to the computing field (both historical and contemporary figures) in all three groups of students. We revisit this issue in this paper as well.

Administration of the Second Exam

A second exam was administered during the Spring 1994 semester. The exam consisted of multiple choice questions covering the three areas mentioned earlier: computer science, history of computing and its major contributors, and basic computer literacy. Sample questions from each area are as follows:

Computer Science

1. ADT
   a. Automated Data Transfer
   b. Average Daily Traffic
   c. Aborted Data Transaction
   d. Abstract Data Type
2. Flip-flops are commonly used to:
   a. prolong the life of a value in memory
   b. implement the basic registers in a machine
   c. store negative values
   d. increment variables by one

History, Contributors and Commercial Computing

1. Grace Murray Hopper
   a. was heavily involved with the development of COBOL
   b. worked on the original ABC computers
   c. worked actively to promote the use of analog register accumulators
   d. founded the National Science Foundation
2. Steve Jobs and Bill Gates
   a. worked together to form the first business data processing corporation
   b. are both committed to supporting IBM through the year 2000

c. are identical twins separated at birth
d. founded Apple and Microsoft

3. The UNIVAC was the first machine to focus on data processing, and was used by:
   a. the Department of Defense for payroll
   b. the US Census bureau
   c. the League of Women Voters to help track voter registration
   d. Sears to manage its catalog mailings

Computer Literacy

1. RGB
   a. Register Generated Bi tstream
   b. Regular Generation of Baudrates
   c. Register's Global Byteorder
   d. Red Green Blue
2. font
   a. a style of characters
   b. the size of characters
   c. a character set adopted for the United Nations' universal language
   d. a mixture of graphics and text on the same page

Table 1 illustrates the distribution of questions among the three categories. Some questions were placed in both the computer science and computer literacy categories. Questions in the computer science category covered topics from our breadth-first introductory course, while questions chosen for the computer literacy category covered topics related to reading computer advertisements, installation and usage of hardware and software, and basic terminology that educated computer users would normally be familiar with.

	Category	*Number of Questions*
	Computer Science	32
	History/Contributors/Commercial	17
	Computer Literacy	24
Total		73

Table 1

The exam was given (unannounced) during the last week of the Spring, 1994 semester; students were allowed approximately 75 minutes to complete the exam. The exam was given in five separate courses; in addition to the CS major courses discussed in Section 2 (CS 124, 325 and 426), it was also given in two courses for non-majors:

- CS 412 : C Programming for Non-Majors: This course is designed for seniors and graduate students in disciplines other than computer science. The course is divided between engineering and business majors, and focuses on basic C programming concepts with some discussion of implementing basic data structures and algorithms in C. Students enrolled in this course have taken at least one other programming course (Pascal or FORTRAN).
- CS 466 : Information Systems: This course is designed for juniors and seniors in business, who are majoring in management information systems, or minoring in computer science. The course involves two major components: (a) human factors in software development and (b) metrics, cost estimation and software project management. Students enrolled in this course have generally taken at least two programming courses, and have completed a variety of other computing related courses.

Study Results

The results of the exam were analyzed in terms of the five student groups to which the exam was administered (CS 124, 325, 426, 412 and 466), and in terms of the three categories of questions (computer science, history, and literacy). The mean scores for each student group on each exam section (given in percentages correct for each section) are given in Table 2 below. N is the number of students who took the exam in each course.

Course	*N*	*Literacy*	*History*	*Computer Science*
CS 124 (CS freshmen)	44	47%	15%	34%
CS 325 (CS juniors)	32	63%	25%	65%
CS 426 (CS seniors)	27	71%	35%	72%
CS 412 (non-CS, technical)	46	57%	25%	54%
CS 466 (non-CS, business)	60	58%	18%	49%

Table 2–Overall Summary

We performed an analysis of variance (ANOVA) on the means in each of the question categories in the above table. From these, we were able to determine which student groups differed significantly in performance on each question category. In the subsections below, we separately address the results of these ANOVAs for each category.

Computer Science

Table 3 indicates means, standard deviations and standard errors for the computer science area scores. Unlike the percentage scores in Table 2, these scores are expressed in terms of "raw scores," with a maximum score of 32 (i.e., the number of questions in the computer science area).

Course	*N*	*Mean*	*Std. Dev.*	*Std. Err.*
CS 124 (CS freshmen)	44	10.955	3.815	0.575
CS 325 (CS juniors)	32	20.844	4.608	0.815
CS 426 (CS seniors) 2	7	23.148	3.110	0.598
CS 412 (non-CS, technical)	46	17.348	5.396	0.796
CS 466 (non-CS, business)	60	15.733	4.161	0.537

Table 3–Computer Science Statistics

An ANOVA indicated a significant difference among the above mean scores ($p < .0001$). A post-hoc test is therefore needed to compare specific pairs of groups. Given that sample sizes were both small and varied, we used the (relatively conservative) Bonferroni/Dunn post-hoc test. Table 4 contains the results of this test.

Course Pair	*Mean Diff.*	*Crit. Diff.*	*Significant? (.05 level)*
CS 124, 325	-9.889	2.871	Yes
CS 124, 412	-6.393	2.606	Yes
CS 124, 426	-12.194	3.021	Yes
CS 124, 466	-4.779	2.453	Yes
CS 325, 412	3.496	2.844	Yes
CS 325, 426	-2.304	3.229	No
CS 325, 466	5.110	2.705	Yes
CS 412, 426	-5.800	2.996	Yes
CS 412, 466	1.614	2.422	No
CS 426, 466	7.415	2.864	Yes

Table 4–Computer Science Post-Hoc Test

Based on Table 4, two observations can be made:

1. CS 426 students performed significantly better than all groups except the CS juniors in CS 325.
2. CS 124 students performed significantly worse than all other groups of CS majors, and significantly worse than CS 466 students as well.

Observation 1 indicates that by the end of our computer science curriculum, our CS majors have obtained knowledge regarding computer science concepts that is mostly unavailable in non-major courses. This is an intuitively desirable result, and suggests that the technical content in computer science is not simply "common sense" facts that all computer users know, but is instead a specialized collection of concepts that need formal curricular exposure to learn.

Observation 2, perhaps the more interesting result, involves CS 124 performance. The CS 124 students' performance was significantly inferior to the more advanced CS majors. On the surface, this seems intuitive. However, recall that CS 124 was part of a breadth-oriented introduction to the discipline. We can formalize the idea of "breadth-oriented" vs. "depth-oriented" in terms of Bloom's taxonomy (Bloom, *et. al.*, 1956), which is a well-known way of defining educational objectives in terms of the level of cognitive skills to be obtained. Bloom's taxonomy consists of six levels:

- Knowledge
- Comprehension
- Application
- Analysis/Problem Solving
- Synthesis
- Evaluation

The "knowledge" level simply requires the student to recall specifics of the discipline. In contrast, higher levels require more abstract thinking, synthesis and problem solving. The highest level ("evaluation") requires the student to make judgments about the value of various techniques in the discipline, as well as the fitness of methods for their intended purposes.

One possible goal of a breadth-first computing curriculum might be to attain the "knowledge" or "comprehension" levels of the hierarchy with respect to the entire discipline of computing in the introductory sequence. Subsequent courses would then be targeted toward increasing the cognitive level in the hierarchy. On the other hand, in a depth-first curriculum, one might expect to attain the "analysis/problem solving" level in the introductory sequence, but with respect to a smaller number of concepts. Subsequent courses would then be targeted toward increasing the breadth of knowledge over a wider variety of concepts.

Our results (along with our preliminary results (Cordes, *et. al.*, 1994)) provide some concrete evidence that the breadth-first model may not work as stated. As noted previously (Bloom, *et. al.*, 1956), success in achieving the "knowledge" level can be measured via tests such as multiple choice, matching, etc., since most of what is required is simple recognition of terms and recall of their definitions. Since CS 124 students performed significantly inferior to students farther along in the curriculum on a multiple choice test over basic CS concepts, then we conclude that CS 124 students have not achieved the breadth that they are likely to ultimately obtain, even at the lowest level of Bloom's taxonomy.

Thus, even if a curriculum is nominally breadth-first, the term "breadth-first" is probably a misnomer; in our breadth-first curriculum, students are actually only gaining "some breadth first," followed by a continual evolution of breadth and depth throughout the curriculum. It is likely that there is no such thing as a truly "depth-first" curriculum either; students are not mature enough to initially obtain complete depth in an area, and exposure to a breadth of concepts will allow students to visualize new applications that can be used to obtain additional depth. We believe that it is probably best to abandon terms like "breadth-first" and "depth-first" and seek other models as well as terminology that accurately describes such models; efforts to integrate breadth-first and depth-first curricula have already made some progress in this regard (Shackleford & LeBlanc, 1994).

History, Contributors and Commercial Issues

Table 5 indicates means, standard deviations, and standard errors for the raw scores in the history/commercial area (maximum raw score is 17):

Course	*N*	*Mean*	*Std. Dev.*	*Std. Err.*
CS 124 (CS freshmen)	44	2.636	2.273	0.343
CS 325 (CS juniors)	32	4.219	2.661	0.470
CS 426 (CS seniors)	27	4.130	2.762	0.407
CS 412 (non-CS, technical)	46	5.889	2.806	0.540
CS 466 (non-CS, business)	60	3.017	1.882	0.243

Table 5–History Statistics

An ANOVA indicated a significant difference among the above mean scores ($p < .0001$). We again used the Bonferroni/Dunn post-hoc test to compare group pairs; the results are given in Table 6.

Course Pair	*Mean Diff.*	*Crit. Diff.*	*Significant? (.05 level)*
CS 124, 325	-1.582	1.598	No
CS 124, 412	-1.494	1.451	Yes
CS 124, 426	-3.253	1.682	Yes
CS 124, 466	-0.380	1.365	No
CS 325, 412	0.088	1.583	No
CS 325, 426	-1.670	1.798	No
CS 325, 466	1.202	1.506	No
CS 412, 426	-1.758	1.668	Yes
CS 412, 466	1.114	1.348	No
CS 426, 466	2.872	1.594	Yes

Table 6–History Post-Hoc Test

Again, the CS 426 students performed significantly better than all other groups except the students in CS 325. There are, however, no other significant differences among the data. Since topics in this area are not targeted by any of the courses tested, the absence of a significant difference in most cases is not surprising. The fact that a difference was observed between CS 426 and three groups indicates that by the time CS students are seniors, they are learning at least a portion of this material from somewhere (possibly from in-class discussion where a name or historical incident is mentioned or through peer interactions).

On the other hand, the scores for all groups in this area were the worst of the three sections of the exam by a substantial margin. Table 7 is a breakdown of performance (i.e., percent correct) by topic area of each question, for each group of students.

Question	*CS124*	*CS325*	*CS412*	*CS426*	*CS466*
ABC Computer	5	3	7	7	2
DEC	20	38	13	52	15
Dijkstra	2	19	17	33	7
ENIAC	5	3	4	0	2
Hoare	0	38	1	11	2
Grace Hopper	2	6	22	22	3
Jobs andGates	23	29	59	59	60
Knuth	2	13	20	44	2
VonNeumann	9	22	24	48	22
T. J. Watson	9	6	20	4	3
Wozniak	11	19	35	19	22

Table 7–Summary of History Performance

The results in this area reflect no improvement over the results in this area on the previous exam (Cordes, *et. al.*, 1994), indicating a need to include such topics explicitly in our curriculum. We have recently developed a new senior-level course, entitled "Ethical and Societal Issues in Computing," which will include coverage of a variety of historical, ethical, societal, and commercial topics. This course will be offered for the first time during the academic year 1994-95; an outline is given elsewhere (Cordes, *et. al.*, 1994). We plan to administer this exam to students who have completed this course, with the hope of obtaining an improvement in overall performance in this area.

Computer Literacy

Table 8 indicates means, standard deviations and standard errors for the (raw) scores in the computer literacy area (maximum raw score is 24):

Course	*N*	*Mean*	*Std. Dev.*	*Std. Err.*
CS 124 (CS freshmen)	44	11.341	4.513	0.680
CS 325 (CS juniors)	32	15.156	4.719	0.834
CS 426 (CS seniors)	27	13.848	4.269	0.629
CS 412 (non-CS, technical)	46	16.926	3.088	0.594
CS 466 (non-CS, business)	60	13.983	3.496	0.451

Table 8–Computer Literacy Statistics

An ANOVA indicated a significant difference among the above mean scores ($p < .0001$). We again used the Bonferroni/ Dunn post-hoc test to compare individual group pairs; the results are given in Table 9.

Course Pair	*Mean Diff*	*Crit. Diff*	*Sinificant? (.05 level)*
CS 124, 325	-3.815	2.674	Yes
CS 124, 412	-2.507	2.427	Yes
CS 124, 426	-5.585	2.813	Yes
CS 124, 466	-2.642	2.284	Yes
CS 325, 412	1.308	2.649	No
CS 325, 426	-1.770	3.007	No
CS 325, 466	1.173	2.519	No
CS 412, 426	-3.078	2.790	Yes
CS 412, 466	-0.136	2.255	No
CS 426, 466	2.943	2 667	Yes

Table 9–Literacy Post-Hoc Test

These results essentially parallel the results of the computer science portion of the test. The CS 124 students performed significantly below many of the other groups, while the CS 426 performed significantly above many of the other groups. In fact, the CS 426 students actually performed significantly above both groups of non-majors. We found these results surprising, given that these questions were deliberately designed to be questions that every literate computer user would know. Since many of the topics in this area are not targeted by the CS curriculum, and the topics are basic computer literacy related, we would have expected everyone to be equally prepared for these questions. Yet the senior CS majors outperformed the non-majors, perhaps confirming that many of these concepts are indeed discussed from time to time in majors classes, or that CS majors are simply more frequent (and motivated) computer users than non-majors. Regardless of the reason, this result may help dispel the notion that CS majors are mostly theorists, and are illiterate with respect to the actual purchase, use and installation of computers.

Additionally, the fact that CS 124 students significantly underperformed the other groups may suggest that college freshmen are perhaps not entering college as computer literate as one might expect. Given the degree to which computers are ubiquitous (in high schools, homes, etc.), one might expect a freshman who has elected to major in computer science to be already an experienced computer user. While the freshmen have probably used computers before, this result at least suggests that freshman are not at the level of many of the other students (majors and non-majors) with respect to understanding terminology associated with basic computer use.

Conclusion

In this paper, we have discussed the results of administering an exam to test knowledge among a variety of student groups with respect to various computing related topics. Our results show that, for this particular exam, senior computer science majors were significantly superior to most other groups on all areas, even with respect to areas that the curriculum was not explicitly designed to cover. In addition, freshman computer science majors who have just completed a "breadth-first" CS introductory sequence tended to underperform relative to the other groups on all areas. Given that the exam was multiple choice and did not require high levels of cognitive understanding, this result was somewhat surprising, suggesting that a breadth-oriented introductory sequence is actually insufficient to deliver the entire breadth of the discipline.

Additionally, students as a whole showed very limited knowledge of computing history, contributors and commercial developments. This result has been partially responsible for motivating the development of a new senior-level, capstone course that will cover many of these issues, as well as ethical and legal issues in computing.

Future work will involve efforts to improve our assessment, with attempts to expand the scope to include more questions related to computing history and commercial developments, as well as computer literacy. In addition, we plan to administer the exam to students at other institutions so as to further generalize these results.

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paper

Building a Learning Community: Telecommunications, Collaborations, and Sharing on Long Island

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Abstract

The Long Island Team is a collaborative system comprised of K–12 teachers and students, university faculty, undergraduate, and graduate students, and community members. All are connected electronically and meet in person as they build our "Long Island Learning Community." People and resources are potentially within reach 24 hours a day, continually. Synergy arises as connections are formed while participants collaborate on meaningful work.

Introduction

The Long Island Team is a "living" learning community, a collaboration of children, teachers, and community resources who for two years have been linked by telecommunications and in–person sessions and who have culminated their work together at a sharing event each June. It personifies such calls for collaborations as in *A New Compact for Learning*, a New York State initiative stressing decision making among partners – parents, teachers, administrators, higher education, business/industry, and others in the community. The Long Island Team falls within the words of the *Compact* and other reports but differs from many activities in the force of its passion and commitment to define and create a shared vision of a learning community. Greatly inspired to use technologies when needed or effective, we strive to work and live synergistically and give to community.

We focus on broad educational systems that see beyond themselves and into the future. We see teaching and learning without artificial or arbitrary boundaries, defined collaboratively by players within a fluid system who create a shared vision of the future and then move toward that future *together*. We build especially upon Peter Senge's (1990) learning organizations and shared vision, Howard Gardner's (1991; 1993) work on teaching and learning, and Lewis Perelman's (1992) and Roy Pea's (1992) reconceptualization of new learning systems using technology.

Our History

In 1991, we met with several New York educators to clarify what we most value for the future in education and to envision "break the mold" schools we could create across New York state. We submitted a proposal to President Bush's America 2000 call. Although not funded by America 2000, we linked ourselves to the New York educators, forming New School Vision, Inc. a not–for–profit–organization, and committed ourselves to act upon what we had dreamed and ultimately desired. Our Long Island collaborative group was then formed, creating our vision of a learning community – ours (as a first step) locally. We became the Long Island Team, builders of a learning community on Long Island. Most significantly, we grew from a deep understanding of what we value and what we have passion for. Wanting to begin by defining ourselves within our community, we selected fourth grade as our initial focus because fourth graders study community.

A Long Island Learning Community

Our learning organization is anchored in action. We *use* technologies for purpose rather than just study how to use them. With support and encouragement from numerous sources, teacher training for technology is woven into purposeful action and threaded through disciplines as our teachers choose to see their own learning as part of a greater whole. We go beyond the mold that has some teachers see "learning how to word process," for example, as something to be studied in a "formal teacher workshop or class on word processing." We much prefer computers and modems available within the classroom and at home with teachers, as learners, working on projects, and having electronic access to their district technology facilitator, to one another, and to others in our community. In concert with this are opportunities for hands–on workshops within and outside districts to support whatever is being done. Synergy arises among teachers and students collaborating on projects that naturally result in college students and faculty, people in business and industry, parents, neighbors, and so on, informally contributing to the class or contributing outside of the school day. They, too, become ongoing support as well as learners and contributors.

In the Half Hollow Hills School District two teachers from two separate elementary schools participated during the first year of our work together. One had extensive experience using technologies while the other did not. Each was provided with two computers and modems; one for use in the classroom, the other at home. This offered them 24 hour ongoing contact and support and modelled the strategy set forth in the district's long range plan for technology. Because of the success of this first year, in the second year five teachers from five elementary schools in the district each received a computer and modem for their classrooms. This year 24, all of the fourth grade teachers in the district, are provided similar equipment.

To share with you the Long Island Team year for all participants, we present a map showing our presence on Long Island, and descriptions of 1) our Kick–Off event, 2) our activities throughout the year, and 3) our Sharing Event.

Who We Are

Spanning 100 miles of Long Island, 500 children and their teachers participated last year and more than 1,000 children and their teachers are committed to participate in the 1994–1995 school year.

Long Island Team Past and Present Major Contributors include:

Long Island University (C.W. Post Campus & Southampton Campus)

K–12 School Districts (including both private and public): Bay Shore, Bridgehampton, Comsewogue, East Islip, East Rockaway, East Williston, Half Hollow Hills, Hampton Day School, Huntington, Jericho, Kings Park, Lindenhurst, Massapequa, Mill Neck School for the Deaf, Mineola, Oceanside, Patchogue–Medford, Plainview– Old Bethpage, The Portledge School, Roslyn, Southampton, Three Village, The United Nations School in Queens, Valley Stream, and West Babylon.

Newsday

Cablevision

The Theodore Roosevelt Sanctuary
Ventana East Corporation
Voice of America
New School Vision, Inc.
The Society for the Preservation of Long Island Antiquities
IBM
Lackmann Foods
Wholesale Tire
New York State's Board of Cooperative Education Services (BOCES) –Suffolk County

Kick–Off

Face–to–face sessions such as a Kick–Off, seed and build activities for the year, connect people and resources, energize and motivate and, most importantly, permit the development of an on–going creation of "shared vision" amongst learners who establish context for our learning community in the coming year. Action and meaning are synergized from the start. Learners (be they teachers, students, community–resource members) are immediately central in a learning system seeing all people and resources within their reach. *They* must take charge of their learning and see beyond the walls of a 4th grade class, a school building, or school district. This process begins at the Kick–Off with activities such as the ones highlighted below from our August 1994 day together.

Telecommunications Hands–On Workshop

Every participant at the Kick–Off has the opportunity to learn to use the telecommunications system that opens the learning community to continual/forever access to one another. All leave confident that they can send and receive e–mail and participate on the forum. They meet and know people in the system who give them support and comfort.

A Model of Envisioning Community Resources (Live Birds of Prey)

This fall the Theodore Roosevelt Sanctuary showed live birds of prey and chatted with us about them. The director was active on the forum the preceding year asking and fielding questions and beginning to define for herself the role of constant communications, planning, and hands–on experiences with live animals. We model a place for "non" technology aspects of projects that seem most appropriate "live." However, we seek to enrich "live" experiences by deepening, extending, and expanding them when we are not face–to–face. Rather than see the nature sanctuary as a place to visit on a field trip *only* or to have the director visit one's school *only*, we began to explore how to collaborate on real environmental projects that jointly connect us at the personal level and sustain and enrich our efforts electronically.

A Model of Envisioning Business/Industry Resources (Newsday)

The Long Island newspaper, *Newsday*, provides the accounts and support for the telecommunications backbone of our organization and has people available via telecommunications and at our in–person sessions. In the 1994 Kick–Off, more opportunities for the future were explored as Newsday itself grows into today's information society. Again, we seek to model how to rethink our roles together. What is Newsday interested in? What are we? Where might we meet? Newsday has provided services What do we provide to and with them?

Group Systems V, A Groupware Tool

Our afternoon was spent modelling our use of technology for purpose as we planned for the coming year. We used Group Systems V® (GSV) software, donated to us for the day by Ventana East Corporation. (GSV is a new version of what was TeamFocus®, a software product provided by IBM during the two preceding Kick–Offs.)

We did three online brainstorming sessions:

1. **Resources** – Exploring how *we* are resources and asking what other resources are around us
2. **Dreaming** – Letting go of the constraints of politics, enclosures, "can't be" mindsets, and dreaming about what we value and desire
3. **Specific Long Island Team Activities** – Planning for initial activities on the forum to kick off the year

A Model of a HyperCard Project From the Previous Sharing Event

A fourth grade teacher, active in the Long Island Team since its inception and knowledgeable and conversant in technology, demonstrated the interdisciplinary, multimedia project her class created. The HyperCard project, *Long Island Past to Present*, dealt with areas such as Native Americans, Famous People, Places of Interest, and Weather on Long Island. It included an original song written and performed by the students as well as scanned images of people and places of Long Island, links to video clips found on the Suffolk County Explorer (a videodisc produced and donated by Suffolk BOCES III), databases, and student reactions to and reflections on people and places studied and visited. The teacher talked about student research involved in the project, ongoing electronic communications with other teachers, students, and community resources, and creativity, motivation, critical thinking, and problem solving exhibited by the children throughout their work on the project. Also mentioned was the need for all to be actively involved throughout the year in order for Long Island Team to be maximally effective.

Following testimonials and conversation, participants at the Kick–Off left the day energized, excited, and eager to be creators and learners in the system throughout the year – and hopefully, forever.

Throughout the Year

Since we see a system with open access to unlimited people and resources 24 hours a day, we must model such a system within our own community. Rather than have in person meeting times as the only contact, connections can be fluid and continual. Face–to–face time can then be used maximally for what cannot be done electronically. This view is open to a blending and new definition of how to use time, effort, energy, space, and resources as well as how to efficiently channel individual work and collaborations. Used most powerfully, synergy arises from people working interdependently on meaningful projects that **do** something. These need not fit into the traditional structure of a day. We look for continual building of people together throughout the year.

Telecommunications

Telecommunications is natural and ubiquitous in our learning community. It is defined by participants throughout the year in the broad forum topics of *Reflections, Activities, Resources, Dialogue, How Do I?, and Other.* Telecommunications is a first step in our building with other information technologies, too.

Face–to–Face Meetings, Workshops, Get–Togethers

The management team, open to all participants, meets once a month at various locations across Long Island. We make it easy for people to host and attend if they wish. Those who do not attend are urged to discuss issues for the management meetings electronically or in person with anyone who will be attending. Feedback is given on the electronic forum. Ultimately, we envision distance learning equipment (now available in several sites for us) connecting management sessions across the community. We hope to use interactive tools such as GSV as part of our planning, too.

Some districts hold meetings for their participating teachers on a regular basis. Some make these open to others in the project. The management team runs six sessions throughout the year. These are nurturing and informal, intimate in a way, and always include planning and team building as well as workshops. Whoever "knows," "gives" and "does." Workshop topics range from using various technology tools as part of the project (*e.g.*, telecommunications, word processing, databases, spreadsheet, desktop publishing, multimedia, computer graphics and presentation tools) to using various multimedia equipment such as those incorporating computers, CD–ROMs, laser discs, television, and video. Cablevision, for example, hosted a video workshop with their news and documentary producers to introduce Long Island Team participants to concepts and techniques for scripting, editing, and taping video projects.

Projects

Throughout the year teachers and their students work on projects that they present at the Sharing Event. These are often interdisciplinary, blending social studies, science, language arts, and mathematics naturally. Teachers and students communicate what they are doing and why, seek resources, and often collaborate via telecommunications. Issues of specific course content in the K– 12 schools and the university are addressed within such projects. Outcomes are often measured using authentic models and portfolio assessments. Motivation is usually intrinsic as learning is meaningful. Once someone does a project, everyone benefits by it. Everyone knows about it, can use it, and can build next steps with the "doers" of the project in the future phases of the learning system.

Sharing Event

All work for the year culminates in a Sharing Event – a non–competitive, celebration of learners, learning, giving, and achievements hosted on the campus of Long Island University.

Fourth graders make presentations in the morning at three 20 minutes sessions attended by 1/3 of three 4th grade classes and a smattering of others at each session. Community members (some active throughout the year and some new at the sharing event) present in the afternoon at three 20 minutes sessions attended by similarly constructed audiences. This structure builds small, intimate, cohort groups of no more than eight students and an adult teacher/leader and integrates them into an audience. Each cohort group joins a different two–thirds of the audience at each of the six sessions. This is a complex design but built to model creating communities within and between audiences and presenters.

Examples of the more than 100 past presentations include:

Fourth Grade Contributors

- American Revolution on Long Island
- Animals of Long Island Database
- Culper Spy Ring During the American Revolution
- Hypermedia Explorations of Local Communities Sites
- Industry, Environment, & Famous Places of Long Island
- Interviews of Long Island Political Figures
- Long Island Stamp Album
- School Life on Long Island in 1877
- Senior Citizens Tell Their Stories
- Timeline of Signs of Spring (Animals, Weather, Flora Observed)

Community Member Contributors

- Cablevision/Nickelodeon
- Environmental Center of Smithtown & the Setaukets
- Lego Dacta
- Marian Carll Farm

Members of the Shinnecock Nation
New York Islanders Organization Sportscaster
Newsday
Society for the Preservation of Long Island Antiquities
Theodore Roosevelt Sanctuary
University Hospital (SUNY/Stony Brook)
Voice of America

We had an ethnographer participant who travelled from Albany to attend, a still photographer, and a video crew from a local high school audio–visual class. Each made contributions to our recordings of the event.

Looking on, one sees lots of little workshops bustling with interactive audiences. Student groups represent themselves, their class, and their district. They are responsible for learning throughout the day and reporting back to the rest of the class afterwards. All members of the audience write User Names of people they meet into their programs with the intent to continue conversation and learning after the day. Because *everyone* does not participate in *every* session, participants are charged with the responsibilities of telling what they experienced so others can experience it, too. Dialogue continues electronically as people share observations and seek to learn more.

In order to see us all as connected and also keep us small enough to be part of an active working group, one session at the event is attended by a single representative from each class. In 1993, the director of SPLIA, the Society for the Preservation of Long Island Antiquities, held a barn raising – building a twenty by twenty foot replica of a local historical structure. When all sessions were over and we convened in our large lecture hall, a choral ensemble from one of the high schools performed and representatives from each class were on the stage with their model barn. In 1994, each class sent a representative to a session held by a reporter from Voice of America. The Sharing Event was covered and translated into 40 languages and broadcast to 400 cities throughout the world. The student representatives had the opportunity to meet in a small, intimate setting to find out about Voice Of America and how our learning community would be shared with the world. They, then, shared what *they* learned with their teachers, classmates, and parents.

While energized within a festive and vibrant atmosphere, participants built new links in the creation of our learning community throughout the day in each of our Sharing Events – 1993 and 1994.

What Does It All Mean?

Perhaps, in part, because the Long Island Team is thus far an unfunded project and no one gets paid or pays to participate, people freely give to it and resources are plentiful. Contributions in services and the sharing of equipment (*e.g.*, from Newsday, Cablevision, Long Island University, the schools, the community) and the time, effort, and energy of its "giving" participants are extraordinary. At the moment, though, not every participant in our community functions beyond traditional school structures. Some use computers programs and access to telecommunications much as they would use a new textbook or piece of equipment. Nothing much changes; our activities are merely "exciting" new classroom projects. For other people, however, who are most growing within the community, there is a freedom and openness about their involvement. It is a very different model from what we routinely see around us. People *give* and learn, commit and connect, engage and do with energy and purpose.

We open thoughts about new paradigms – new ways to think about integrating what people do into collaborative activities within meaningful contexts. Our separate goals at the university and in participating schools, nature sanctuaries, libraries, museums, businesses, and industries are not only **compatible**; they are often powerfully **linked** as we see beyond our traditional work settings. We look toward the time when we will not ask, "What kinds of meaningful work can we do together?" but where the presence of meaningful work arises naturally from our shared goals and desires for community. We intuitively strive to see, create, and do them together. For this, it may be necessary to see beyond borders and do more time and place shifting.

We are all teachers in this system – guides, coaches, navigators. We are also learners – pilots, discoverers, adventurers. Young children as well as adults blend their teaching/learning roles as they guide, coach, navigate, and pilot to, from, and for one another, us, and others to learn deeply within and beyond our traditional school setting. As adults in this system, we re–examine the teachers/learners within ourselves, within our work and life settings. Boundaries and borders seem to blur as we reach out, often using powerful technologies, to create a shared vision of teaching/learning and community for purpose. We move ever–closer to living that vision. It is a forceful image that has energy and vision not contained within "projects" or "activities" alone. It is something else, much deeper, and growing into an active model for extending our learning communities to and with others.

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paper

The Living Textbook: A Demonstration of Information on Demand Technologies in Education

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Key words: information-on-demand, multimedia servers, high-performance computing, communications

Abstract

This paper describes trends in high-performance computing and communications favoring information based applications and "education on demand." NPAC's InfoMall model of technology transfer, small business partnerships, and collaborative software development is used to develop an innovative set of educational applications that include: video on demand, New York State–The Interactive Journey, Collaboration technology in education, and a set of text, speech, and simulation based education software packages.

Author's note: The figures illustrating the concepts described in this paper were originally produced with screen capture software and converted to GIF as part of our on-line information system. These figures cannot be scaled to the required 3 1/4 inch width nor can they be converted to PICT format and retain reasonable image quality. Please see paper SCCS # 647 The Living Textbook in

http://www.npac.syr.edu/pub/by_index/sccs/papers/index.html.

The Living Textbook Project

As a National Information Infrastructure (NII) evolves to link schools, libraries, homes, and offices with high-speed digital networks, will K-12 schools be prepared to take advantage of communications, computing, and software technologies that are currently available only to research universities, scientific laboratories, and large corporations? As our society moves into the information age, will high school graduates be capable of performing in a high-technology workplace? A growing concern is that our nation is failing to provide a technology infrastructure for K-12 education that will enable our graduates to compete in the information based economy of the next century.

The Living Textbook project is designed to deliver real-time, multimedia, information on demand for use in classroom instruction in six K-12 pilot schools. We are in the first month of a multi-year project. Our task in the first year is to demonstrate a glimpse of the future where schools will be connected to the NII, and have access to terabytes of multimedia information sources stored on centralized digital information servers. This project is funded through support of the New York State Governor's Office and the New York State Science and Technology Foundation, and corporate support from NYNEX.

Our project is centered on NYNEX's NYNET, a regional ATM (asynchronous transfer mode) gigabit commercial network. The Living Textbook project is among the first in the nation to link K-12 schools to an ATM wide area network infrastructure. NYNET connects three K-12 schools in the Syracuse-Rome area of upstate New York, and three schools in New York City with state of the art parallel computers, databases, and large scale digital storage facilities at the Northeast Parallel Architectures Center (NPAC) at Syracuse University.

Our project team includes computational scientists from NPAC, education researchers from Syracuse University School of Education, and Columbia Teachers College, and teacher teams from the six pilot schools. The four major components of our project include:

- developing multimedia educational applications and tools based on high-speed computing and communications networks
- developing pilot demonstration projects in six New York State high schools or middle schools
- creating the educational and technical support for teachers to implement new high-technology based instructional applications
- assessing the educational effectiveness of these new instructional applications.

This paper outlines our view of a technological approach needed to deliver information on demand to the classroom using state of the art high-performance computing and communications technologies. Development of teacher teams, collaboration between educators, learners, and computational scientists, software development for the classroom, and assessment are essential components of this project but are not described in this technological overview.

The upcoming sections of this paper are as follows: section 2 of this paper describes trends in high-performance computing and communications technologies; section 3 describes InfoMall, NPAC's technology transfer program and how it is used in the Living Textbook project; section 4 describes InfoVision–NPAC's suite of information on demand applications and technologies, the Living Textbook is an example of InfoVision in education; section 5 describes the initial set of information on demand applications to be delivered in year one of the Living Textbook project; section 6 summarizes the technological approach we plan in the first year of the Living Textbook project.

Trends in HPCC

Three important developments in the high-performance computing and communications (HPCC) community motivate and support this innovative application of technology in education. First, a thousand fold increase in compute power has been achieved over the past decade. Second, a shift in emphasis from Grand Challenge scientific applications to National Challenge societal applications of HPCC technologies has occurred at the federal policy level. Third and most recently, a thousand fold increase in telecommunications performance has occurred, matching the growth in available compute power. Together, these changes open new opportunities for collaboration between computational scientists and the education community. New HPCC applications include educational uses of scientific simulations, delivering video on demand to the classroom, and developing the concept of "education on demand" by linking K-12 classrooms to digital services on the NII.

Trends in computing performance on the largest over the past three decades are measured in megaflops (million floating point operations per second) in the 1970s, gigaflops (billion operations per second) in the 1980s, and the teraflop (trillion operations per second) in the 1990s. A one-thousand fold improvement in computing performance has been achieved over the past ten years. Parallel computers have won out over sequential, vector based supercomputers as the highest performance computers. Now, all computers are becoming parallel computers. For example, by 1995, we expect to see 100 megaflop video game controllers in the home entertainment market produced by alliances of video game and computer vendors. This next generation of home computer/home entertainment system will be based on parallel processing. This level of compute performance was a supercomputer only five years ago.

The President's High-Performance Computing and Communications Initiative of 1991 was the driving force behind the development of high performance computing. The initial focus of the HPCC program was to support the science missions of federal agencies such as NASA, the National Science Foundation, the Department of Energy, and the Advanced Research Projects Agency. Global warming, the human genome project, and molecular modeling are examples of scientific "Grand Challenges." More recently, the Clinton administration identified a set of "National Challenges" intended to more directly benefit society in general, and prepare our nation for the development of an information superhighway and the coming of an information age in U.S. industry. The "National Challenges" target the development of a civil information infrastructure, digital libraries, education, energy management, environment, health care, manufacturing, national security, and public access to government information.

The past few years has brought a thousand fold increase in the performance of telecommunications technologies. The NII promises to deliver approximately 10 megabits per second to all homes, businesses, and schools, a one thousand fold improvement in performance over currently available 10 kilobit per second modem connections. This development in communications technology promises to enable many new business opportunities, community databases, and large scale digital information services for schools.

In New York State, plans to develop an upstate supercomputing corridor between Syracuse, Rome, and Ithaca was developed over 1991-1992. NYNEX then began to build a wide-band, high-speed telecommunications link between the upstate participants of the Supercomputing Corridor at Syracuse University, Cornell University, and The U.S. Air Force Rome Laboratory. The first public demonstration of NYNET was performed in October, 1993 in a public meeting of the Congressional Committee on Space, Science, and Technology at Rome Laboratory. A recent demonstration of multimedia information on demand over NYNET was performed for First Lady Hillary Clinton during her visit to Syracuse University in April, 1994.

The NYNET ATM gigabit network now links Rome, Syracuse, and Ithaca in upstate New York, and several sites (SUNY Stony Brook, Grumman, Brookhaven National Laboratory, Cold Springs Harbor Laboratory, Polytechnic University, Columbia University, and NYNEX Science and Technology Laboratory) in down state New York (Figure 1).

The first six schools participating in the Living Textbook Project have direct links to NYNET, these schools include Fowler High School in Syracuse, N.Y., Rome Free Academy in Rome, N.Y., Whitesboro Middle School in Whitesboro, N.Y., and The School of the Physical City, The Dalton School, and Public School 126 in New York City.

InfoMall Model

InfoMall is NPAC's program for technology transfer of HPCC technologies to industry, small business, the community, and education [4]. InfoMall is funded by New York State and consists of over 50 members; one third large businesses, one third small businesses, and one third university, government, and community organizations (Fox et al., 1993)

InfoMall is designed to provide "one stop shopping" for information technologies, technical expertise, business support, and links among virtual corporations. InfoMall is based on the analogy of a retail shopping mall providing consumers easy access to a broad range of consumer goods and services (Figure 2). The components of InfoMall include:

- *InfoTech* which gathers, evaluates, and integrates the best available HPCC research technologies, and deposits them in the *InfoWare* warehouse

- *InfoTeam* software teams made up of small businesses or small groups inside large corporations which integrate and develop new software products
- *InfoMarket* which links software developers and consumers. InfoMall includes HPCC vendor organizations, market organizations providing computer services, consulting, and system integration
- InfoMall stores provide essential services and infrastructure such as training and consulting, HPCC facility testbeds to prototype and deploy new software products, and business support.

The Living Textbook project will deliver multimedia applications in a high performance computing and communications environment. Following the InfoMall model of HPCC application development, the Living Textbook project exploits the New York State Supercomputing Corridor, the NYNET gigabit network, as well as many related technologies such as high end personal computers, web browsing software tools, and digital video technologies.

This project requires our team to collect, integrate, evaluate, and develop systems of core enabling HPCC technologies for information analysis, access, and dissemination. These core enabling technologies will include parallel databases, mass storage, integration software, ATM network protocols, compression, parallel rendering, collaboration services, image processing, and three-dimensional geographic information systems.

InfoMall is based on small business partnerships, and the Living Textbook employs this same model of technology development through partnerships with WorldView Information Technology Corporation of Cortland, New York, and ReFlex I/O and TravelVenture of Syracuse, New York.

WorldView will provide three-dimensional authoring software to support a network distributed, interactive journey of New York State (described below). This partnership with WorldView allows our project team to dramatically speed up the software development cycle and deliver a product in the course of weeks rather than months. WorldView will work with NPAC to link via NYNET a sophisticated user interface (redesigned for kids) running in the classroom with parallel databases, and parallel rendering engines at NPAC.

ReFlex I/O of Syracuse, New York is a computer animation company developing sophisticated special effects for commercial advertising and movies. ReFlex will work with NPAC to develop a classroom interface to The Living Textbook Project built on top of standard web technologies .

TravelVenture is a small business startup developing World Wide Web accessible travel services. TravelVenture will provide the Living Textbook project with tourist and travel information and images for use in the journey of New York State.

Additional partners of NPAC and the Living Textbook project currently include NYNEX, the U.S. Air Force Rome Laboratory, AskERIC, The Center for Analysis and Prediction of Storms at the University of Oklahoma, the Onondaga County Public Library, and Syracuse Language Systems.

InfoVision Technologies and Applications

Deployment of the NII depends in large part on private industry investment to connect the approximately 100 million end users to the major trunk lines. Many observers expect that partnerships will evolve from the media, entertainment, telephone, cable communications, computing, and the video game industries to provide the first digital information services. The initial applications are likely to be movies on demand. customized news services, and interactive television. These applications represent large markets (e.g., the video game industry is approximately $25 billion per year), and if successful, could justify the capital investment required to build the NII. Once in place, the NII could then be exploited to deliver innovative information processing intensive applications in business, research, and education.

In a 1990-1993 survey, we identified information processing as the most promising opportunity for applying HPCC technologies in industry (Fox, 1992). In a classification of information processing applications, we identified four important classes: information production (e.g., simulation), information analysis (e.g., data mining), information access and dissemination, and information integration (e.g., decision support in business) (Fox and Mills, 1994). The problem of information access and dissemination forms the framework for NPAC's InfoVision program. InfoVision stands for Information, Video, Imagery, and Simulation on demand (Mills et al., 1994).

NPAC currently has a set of projects underway for developing InfoVision applications (e.g., financial simulation, credit card data mining, multimedia kiosks, community information systems, movies on demand, text retrieval) and technologies (e.g., parallel databases, networking hardware and software, user interfaces, image processing). InfoVision may be considered a prototype of the NII, with the Living Textbook project as an InfoVision application in education.

As noted above, the tremendous performance improvements in computing and telecommunications make the NII possible. The future NII promises to deliver a high speed (10 megabits/second) interactive link to some 100 million desktops in our homes, offices, and schools. Our InfoVision model of information access and dissemination links by high speed network a data rich, central Infoserver environment (most likely a hierarchy of servers) with a relatively computing rich but data poor home, office, and school computing environment.

A home technology push is an important aspect of developing the NII. Information technology products such as virtual reality peripherals, CD-ROMs, powerful personal computers, and large disks must be mass produced for the consumer market in order for them to become cheap enough to be universally available. Equal access to the NII, especially in educational settings is a very important policy issue.

Information on Demand in Education

Our short term technological goals include a set of prototype multimedia information on demand applications based on NPAC's computing facilities and delivered over NYNET to the three upstate schools in the project. These demonstrations feature:

- Video on Demand: a video library of approximately 100 hours of VHS quality material, this video material will be searchable by online text indices, and available on demand over the NYNET network. Potential sources of video material include large industry content providers such as Reuters News Service, as well as dozens of community based organizations such as museums, local television stations, and the public library system. Figure (3) illustrates NPAC's World Wide Web server (http://www.npac.syr.edu) and the visit of First Lady Hillary Clinton to NPAC's video on demand laboratory. Figure (4) a prototype video on demand application based on CNN Newsource video clips. A searchable text index accompanies the digital video clips.
- New York State–the Interactive Journey: an interactive journey of New York State geography with links to spatially located multimedia databases. For example, a student could navigate the Adirondack Mountain region in a real time terrain rendering environment, stop at Lake Placid, and view video, image, and text databases describing the 1980 Olympic Games, or navigate the lake plain region of Western New York and video footage of Niagara Falls. Figure (5) illustrates the Living Textbook web page (included in NPAC's web page under research projects in education) and a representation of the terrain, map information, and images in the interactive journey.
- Collaboration technology for teaching and learning: based on a related telemedicine project for linking rural health care facilities with university hospital medical specialists. Collaboration technologies provide interactive multimedia communications, with shared databases. Figure (6) illustrates how a university based surgeon in Syracuse might share a medical consultation with an Ogdensburg based general practitioner.
- a set of related educational applications such as a network based "text on demand" application for searching AskERIC's online database (Figure 7), foreign language teaching programs, network distribution of multimedia materials from educational publishing houses, scientific simulations of Grand Challenge applications such as a tornado forecast model modified for teaching science illustrated in Figure (8).

Summary

We are in the first month of a multi-year project to deliver innovative, multimedia educational software applications in a high performance computing and communications environment. The NYNET wide area gigabit testbed network is among the first such networks connected to K-12 schools. We have a unique opportunity to develop state of the art applications in education and to demonstrate some of the future possibilities of connecting classrooms to the NII.

We will use our InfoMall partnership model of combining enabling technologies, technological and educational expertise, and state of the art facilities to develop the Living Textbook project. We propose our set of InfoVision information on demand applications and technologies as a prototype of the future NII, with the Living Textbook as a leading example of InfoVision applied to education.

The client/server model of InfoVision is ideally suited to delivering digital information services over high speed networks from centralized information servers. We expect that this model is well suited to teaching and learning approaches based on a two-way interactive information flow supporting bottom up learning and innovation rather than top down teaching.

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paper

Distance Education for Doctoral Students: An Overview of the National Cluster Format for Students in the Doctoral Program for Child and Youth Studies

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Abstract

The use of telecommunications to provide graduate education at the doctoral level is discussed. An overview of delivery techniques is provided, as well as a description of the training provided for students who elect to participate in this format. A study is underway to identify degree of change in computer expertise, degree of computer use in pursuing their studies, and what effect, if any, the use of technology has had on the students' career status as well as their professional/personal interaction with others. A copy of the survey instrument is attached.

Introduction

While many still consider the term *distance education* to be an avant garde and possibly somewhat suspect form of educational delivery, this is a delivery concept that has been used with increasing success for over 300 years. Accounts of early correspondence courses, the earliest form of education at a distance from the teacher, can be found in the March 20, 1728, *Boston Gazette* (Battenburg, 1971) and in the delivery of Isaac Pitman's shorthand courses in 1840 England (Dinsdale, 1953). Rumble (1986) identifies organizations such as Chautauqua, the International Correspondence Schools, and later offerings by traditional schools such as Illinois Wesleyan and the University of Wisconsin as instrumental in helping distance education for the adult learner to become a significant factor of the educational scene in the United States.

The addition of technological media in recent years has fired the debate concerning the appropriateness of distance education. Can the student receive maximum benefit and adequate learning from instruction in which interaction with the instructor is partially or wholly mediated by a technological device? Moore (1968) would decidedly say yes. His discourse on tutoring provides as its major insight the discovery that traditional school methods are unavoidable inadequate because they are applied to many people at once, ignoring any individual differences in background, culture, or learning styles. Indeed, Carroll (1963) contended that homogeneous grouping was actually an impossibility due to individual learning rates and capacities.

Like it or not, the computer has precipitated the entrance of an age of learning that is fundamentally independent. The value of individualization is realized when a student can engage in learning at any time or in any place that may fit the individual's own unique needs, whether at home, at work, or in a center for learning.

Almost half of Nova Southeastern University's 16,000 students are enrolled in field-based programs. These programs are delivered in a variety of ways. They range from regional cluster locations where students meet once-a-month for all-day Saturday classes with a professor flown to the site by the University, to the student working at home using a personal computer and modem to communicate electronically over a regular phone line. The Ed.D. Program in Child and Youth Studies (CYS) has been a pioneer in exploring ways of delivering education in non-traditional ways to non-resident students. This program, and its predecessor, the Doctoral Program in Early and Middle Childhood, has used the regional site format for the past 12 years, and the computer-assisted format for the past 4 years.

The computer-assisted cluster format utilized by CYS, referred to as the "National Cluster" approach, uses a combination of the standard cluster format balanced with electronically delivered interaction. National Cluster students meet twice-a-year for a 3 to 5 day period to interact with the professor responsible for a specific study area. During the following 3 to 4 months, students and faculty interact through a variety of technological resources and online tools supported by telecommunications.

Technologies Used by National Cluster Students

Providing graduate education for a student who resides at a distance from the source of that instruction is more than simply getting information from the institution to the student. Effective education must provide the student with a variety of formats for stimulating activity, a variety of materials with which to interact and a variety of feedback resources between the instructor and the student. Variety is a major key to enriching the distance delivery system, and meeting the different learning styles of individual students.

Successful communication is perhaps the most important overall factor to be addressed if distance education is to be successful. There must be an effective substitute to the faculty/individual interface available when the student actually attends classes on the campus of the institution with an opportunity to meet with the instructor on a daily to weekly basis. Providing that variety of instructional methods and materials, developing unique and effective communication systems, and continually evaluating the process are critical to the continued delivery and effectiveness of the field-based programs in graduate education offered by Nova Southeastern University (NSU).

Various forms of technology are used to bring instruction and learning opportunities to the students. These include the use of such familiar tools as audiobridge, videotapes, audiotapes, the telephone, and electronic mail (e-mail). In addition, NSU utilizes three facilities specific to its university-wide mainframe that include electronic library access, a bulletin board, and the Electronic Classroom. While most of these technologies may be familiar to the reader, the Electronic Classroom bears some explanation.

Perhaps the most unique feature of Nova's online delivery system is the ability to simulate an actual class setting while the students participate from their homes located almost anywhere in the world. In 1985, Nova staff created the "Electronic Classroom." Utilizing the Unix operating system, it provides an electronic forum in which the teacher and students interact simultaneously. Two-thirds of the screen is allotted to the teacher to display previously prepared material, or to enter questions and comments in real time. One-third of the screen displays the names of students who have logged into the class. The use of that portion of the screen is given to a student when "called on" by the teacher. Thirty or more students can interact simultaneously with their faculty and classmates using the computer screen as their "virtual classroom."

Additional delivery techniques are being examined for feasibility with the National clusters, some of which may have possible impact on the regional clusters, as well. One of the most important new techniques is compressed video. A Nova Southeastern University Masters in Education program has recently been most successful in providing a class on early childhood education where-in students in Davie, Florida, Las Vegas, Nevada and Phoenix, Arizona, simultaneously. The interactive telecourse equipment includes television screens, remote-controlled cameras, and audio reception that is sound-activated. An inset screen allows students at one location to see themselves as well as another location on camera simultaneously. The screen display can move between sites automatically as students begin to speak, and facilities exist to show graphic material such as charts, maps or photos without interrupting the on-screen picture.

Another interactive technology that is being explored allows two persons to view the same document simultaneously on each or their computer monitors, each with the ability to enter or delete material, with the added advantage of audio contact. This "audiographics" approach over regular telephone lines is being offered by several companies. Future possibilities include expansion of such software to provide multipoint access, allowing three or four persons to share the same electronic environment.

Student Training

No student interested in joining a National Cluster format has been expected to meet any computer skill prerequisites to date. While it is obviously to their advantage to come with some computer skills, no one has ever been denied entrance on that basis. Instead, the very first student on-campus instructional period includes one and a half days in an intensive training program designed to provide students with the understanding and practice necessary to perform successfully online when they return home.

This first session consists of an overview of telecommunications in general, accessing their personal accounts, introduction and practice in using some of the basic Unix commands, practice in using the online electronic mail facility "Pine," and its accompanying editor "Pico," using the University's bulletin board program, and participating in the "Electronic Classroom" (ECR) environment. During the week following the instructional period, each student is expected to get online from his or her home computer and participate in an ECR session. The session provides review and reinforcement of the skills learned in the on-campus telecommunications sessions, as well as assuring that each student's modem setup is correct and that they can connect with the university through the Tymnet, Internet or commercial system that they have selected.

Two additional days of telecommunications training are provided for National Cluster students; one day during their next return to campus, the second day of training during their second year in the program. Training during these sessions takes them into advanced Unix commands, and review/reinforcement of the Pine and Pico programs, the instructor mode in an ECR session, using the online text assessment package called Writer's Workbench, conducting online research using the University's Electronic Library facility, and an opportunity to explore the Internet.

The Study

The first National cluster of CYS doctoral students began in February of 1991. The second and third clusters began in February and October of 1992, the fourth and fifth clusters in February and October of 1993, and the sixth National cluster in October of 1994. At this point the first and second National clusters have completed their three-year program of study. This has prompted us to begin asking several questions about the delivery methods presently being used with National Cluster students. A survey has been developed through which we will assess the influence that technology, especially telecommunications, has had on their ability to complete their course of study, their career and/or work status, and their personal interaction with friends and colleagues. In addition to the survey, personal and phone interviews will also be conducted.

The first area of interest to the researchers is to determine the students' level of computer experience at the beginning of the program, and what change, if any, has taken place by the completion of the program. Questions will be posed asking the students to assess their individual expertise with application programs, programming and programming languages, familiarity with telecommunications, and their personal access to computer equipment at the entry and at the end of their three-year program of study. Comparisons will be made between groups and between members within each group.

A second area of interest is the degree to which the computer was used in pursuing their course of study. Questions will seek information on how often and to what degree students used the Unix system programs, e-mail, the online bulletin board, the Electronic Classroom, and the online research capabilities.

The third area to be investigated in the survey is the degree to which their involvement with technology has had an effect (if any) on their career status. Concurrently, the survey will ask what level (if any) of transfer of technology information to the individual's work place was contingent upon their use of technology in their doctoral program.

The final area of concern will be the effect (if any) of the use of technology on professional/personal interaction with others. Questions will cover the students use of the system, as a way of keeping in contact with friends and colleagues, as well as uses in pursuing career networking contacts. A copy of the survey to be completed by students, as well as a copy of the questions to be asked in personal interviews, are included in the appendix.

Discussion

The computer-based, distance education component of the Ed.D Program in Child and Youth Studies is still in its infancy. Relatively small numbers of students and faculty have participated in the program to date. However, the impact made on these students appears to have already been significant. Indeed, the approach being used has become the starting point for other programs as they begin to move into the use of high tech delivery techniques. Bugs still need to be worked out of the delivery and training system. The research upon which we have embarked should begin to provide important information to help us make revisions that are indicated in the future.

Certain advantages to the electronic approach have already been noted. In one instance, a student on the west coast sent work by e-mail to his adviser on the east coast and received the adviser's review within 24 hours. The student then made the necessary corrections and two days later sent the revised work back to the adviser. The adviser was attending a conference, but had brought along a laptop computer with a modem. The student received approval the following day. Normal time for this process using regular mail would have taken at least an additional 10 to 12 days.

National Cluster members appear to communicate with faculty and each other more frequently than students in the traditional site-based clusters. Certainly, ease of communication is one element in the success of this approach. We must also consider that, because the program is new, and students recognize that they are receiving different and specialized treatment, we may be experiencing elements of the "Hawthorne" effect that will disappear with time.

Nova Southeastern University recognizes the urgent need to provide better access to education for adult learners, especially as the gap between the necessary job skills and the education of the adult population increases. The increased mobility of our society adds another dimension to that problem. The National Cluster format of the Child and Youth Studies doctoral program is but one example of the various distance education graduate degree programs available through NSU. It is hoped that our research will provide information that will allow us to offer that education in ways that continue to be appropriate and successful.

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Appendix

Telecommunications Survey
Personal Interview Questions

NATIONAL CLUSTER TELECOMMUNICATIONS SURVEY

Please darken the box before the statement that is closest to your response to that item.

Part I. Computer Experience Background:

1. What were your technical/computer abilities prior to entering the CYS National Cluster?

- ☐ Had never used a computer
- ☐ Had used the computer for simple, limited applications.
- ☐ Had used the computer for word processing and other computer application programs
- ☐ Had a fairly solid background in computer applications and computer programming.

- ☐ Was quite proficient in the use of the computer for various tasks including the use of one or two programming languages.

2. What was your familiarity with telecommunications prior to entering the CYS National Cluster?

- ☐ Had never used telecommunications
- ☐ Had used telecommunications to access a commercial system (e.g., Prodigy)
- ☐ Had limited experience with telecommunications, mostly e-mail
- ☐ Was familiar with telecommunications, including e-mail and the UNIX operating system.
- ☐ Was very familiar with UNIX, e-mail, and other online programs.

3. What was your home computer capability prior to entering the National Cluster?

- ☐ Did not own a PC
- ☐ Did not own a PC but planned to use one in my work area.
- ☐ Was in the process of obtaining a PC and modem.
- ☐ Owned and used a PC with some frequency, but had not as yet obtained or used a modem.
- ☐ Owned and used a PC and modem for some time prior to entering the CYS program.

4. What are your home computer capabilities on completing your CYS program?

- ☐ Have never purchased a personal PC
- ☐ Am still using the same computer and modem with which I began the program.
- ☐ Have updated my original computer with additional hardware and software.
- ☐ Have invested in a new computer and modem since starting the program.
- ☐ Anticipate replacing my present system with the newest MS-DOS or MAC system within the near future.

Part II. Use of the Computer in your Educational Program:

1. Which online applications did you use during your course of study?

- ☐ The Electronic Classroom
- ☐ The Electronic Classroom and E-mail
- ☐ The Electronic Classroom, E-mail and the online library resources
- ☐ The Electronic Classroom, E-mail, online library resources and UNIX programs such as "Writers Workbench" and "talk."
- ☐ The Electronic Classroom, E-mail, online library resources, UNIX programs such as "Writers Workbench," "talk," "Notesfile," and the Internet.

2. How would you rate your ability to participate in the Electronic Classroom:

- ☐ Followed the online lesson, but was uncomfortable in actively participating.
- ☐ Followed the online lesson, and participated with questions/answers/comments on occasion.
- ☐ Followed the online lesson, and asked/answered several times during ECR sessions.
- ☐ Actively participated in the ECRs and reviewed ECRs from the online library.
- ☐ Was an active participant in ECR sessions and able to act as teacher in the ECR environment.

3. How would you rate your use of e-mail?

- ☐ Rarely used e-mail, preferred to use the telephone.
- ☐ Used e-mail only to contact study area or practicum faculty, or cluster coordinator
- ☐ Used e-mail primarily for contact with study area or practicum faculty and the cluster coordinator, and on occasion to communicate with cluster members.
- ☐ Used e-mail almost evenly divided between faculty/coordinator business needs and personal contact with cluster members.
- ☐ Used e-mail for a variety of contact needs, not only with study area/practicum faculty, the cluster coordinator and cluster members, but also with other online users at Nova and other online institutions (e.g., Prodigy, Online America, Internet, other Universities).

4. How would you rate your use of the UNIX system?

- ☐ Rarely if ever used any UNIX system commands.
- ☐ Rarely used UNIX commands, but able to use the "mmunix" menu.
- ☐ Was comfortable in using the basic system commands such as "ls," "who," "clear" and "passwd," as well as the mmunix menu.
- ☐ Was comfortable using UNIX commands, the mmunix menu, and "talk."
- ☐ Was comfortable using UNIX commands, the mmunix menu, "talk," and an online text editor (e.g., ex-editor or PICO).

5. How would you rate your use of online research capabilities?

- ☐ Rarely if ever used electronic research resources; preferred to use the local library
- ☐ Used Nova's electronic research resources two or three times but spent more time using local library resources.
- ☐ Used electronic research resources and local library facilities about equally.
- ☐ Used Nova's electronic research resources for the major part of my research needs.
- ☐ Used Nova's electronic research resources as well as commercial online resources to provide for my research needs.

6. What is your estimate of the average amount of time spent online during your program?

- ☐ Between 1 to 2 hours per month.
- ☐ Between 3 to 5 hours per month.
- ☐ Between 6 to 8 hours per month.
- ☐ Between 9 to 12 hours a month.
- ☐ 13 or more hours per month.

Part III. Continuing Use of Technology:

1. What is the technology use situation at your work area?

- ☐ There is no use of technology in my work area
- ☐ There is very limited use of technology in my work area, and only on an individual basis.
- ☐ There is moderate use of technology for administrative needs
- ☐ There is moderate use of technology for both administrative and client needs
- ☐ There is broad and innovative use of technology for both administrative and client needs.

2. What is your personal use of technology at this point?

- ☐ Seldom if ever use technology for personal or work area activities.
- ☐ Use technology for personal applications only on a limited basis.
- ☐ Use technology for both personal and work-oriented activities on a limited basis.
- ☐ Use technology for both personal and work-oriented activities on a frequent basis.
- ☐ The use technology has a major role for both personal and work-oriented activities.

3. Have you taken a role in promoting the use of technology in your work area?

- ☐ I have taken no role in promoting the use of technology.
- ☐ I have had a small role in promoting the use of technology.
- ☐ I have had a moderate role in promoting the use of technology
- ☐ I have had an active role in promoting the use of technology.
- ☐ I have had a major leadership role in promoting the use of technology.

4. How would you rate your technical/computer capabilities on completing your CYS program?

- ☐ Have not developed much expertise with the computer
- ☐ Use the computer on a limited basis for personal and/or professional activities.
- ☐ Have become fairly proficient with the computer, especially with word processing
- ☐ Have developed considerable expertise with the computer and various kinds of software.
- ☐ Use the computer almost daily for a wide variety of applications and programs.

5. How would you rate your telecommunications activities on completing your CYS program?

- ☐ Rarely if ever use telecommunications
- ☐ Use my Nova account or a commercial online program occasionally (once every two or three months)
- ☐ Use my Nova account or a commercial online program one or two times a month
- ☐ Use my Nova account or a commercial online program on a weekly basis
- ☐ Use my Nova account or a commercial online program several times each week.

6. Has telecommunications played a role in maintaining or promoting your relationship with other NOVA colleagues?

- ☐ Telecommunications has had no effect on my relationships with colleagues.
- ☐ Telecommunications had been somewhat instrumental in developing personal relationships with one or two colleagues.
- ☐ Telecommunications has helped me develop fairly close personal relationships with a majority of the members of my cluster.
- ☐ Telecommunications has been instrumental in developing strong personal relationships with members of my cluster and other colleagues in the CYS program.
- ☐ Telecommunications has been instrumental in developing personal relationships with Nova and non-Nova colleagues.

7. Has telecommunications played a role in your ability to network professionally with other colleagues?

- ☐ Telecommunications has had no effect on my professional network.
- ☐ Telecommunications had played a role in developing a professional network with one or two colleagues at NOVA.
- ☐ Telecommunications has helped me develop a professional network with a group of 5 to 10 NOVA colleagues.
- ☐ Telecommunications has been instrumental in developing a broad professional network of NOVA colleagues.
- ☐ Telecommunications has been instrumental in developing a professional network with both Nova and non-Nova colleagues.

8. Based upon your experiences, how would you recommend the National cluster to a colleague?

- ☐ Would never recommend.
- ☐ Would recommend only if no other option was available.
- ☐ Would recommend only for those with an established computer background.
- ☐ Would probably recommend, regardless of previous computer background.
- ☐ Would highly recommend regardless of previous computer background.

9a. Please relate at least one anecdote relating to an incident during your time in the program where you were able to support a colleague, form a personal relationship, or other event that might indicate that telecommunication is not a cold and impersonal medium:

9b. If you experienced a negative relationship or in any way found telecommunications to be cold and impersonal, please describe that event below:

10. Has the use of technology had any influence, direct or indirect in making a change in your salary, job status, or career direction? If so would you please describe.

project
Using the Internet in Teacher Education: A Fourth Grade "Adopts" Pre-service Teachers

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Key words: pre-service education, collaboration, telecommunications, Internet, technology, curriculum planning

Abstract

Introduction

The Internet collaboration between pre-service teachers in an Elementary Education Methods class at Otterbein College and fourth grade students at East Knox Elementary School is the focus of this project. It was intended to provide the elementary students and pre-service teachers numerous opportunities to exchange experience with, and insight into, teaching and learning. As a result, two professors, eighteen pre-service teachers, a classroom teacher, and twenty-one fourth graders together experienced the dynamics of exploring curriculum and communications media.

The Context

We were preparing to team teach a undergraduate, junior level methods course in an elementary education certification program. The course met twice a week, on-campus, and included 100 hours placement in an elementary classroom, and was a prerequisite for student teaching.

We chose a children's book, *James and the Giant Peach* by Roald Dahl, as a vehicle for modeling the integrated teaching of the subject areas. As we began planning with this text, we wondered if we could find a teacher who was using *James and the Giant Peach* at the same time the methods class was occurring. Ideas began to sprout: Could the methods students be keypals with some elementary students who were also reading *James and the Giant Peach?* If so, the technology objective of the course could connect with other aims of the course.

We explored the Internet for a colleague who might find our project interesting and profitable for his or her students. We found our colleague, and she enthusiastically committed to her students "adopting" the pre-service teachers.

Planning

As the time for the course approached, we became more intrigued with shaping the keypal experience as an opportunity for the college students, the future curriculum planners, to use the children as a knowledge base. The children had a perspective of school from which the future teachers could learn. Instead of requiring the college students to "teach" their keypals, we aimed to turn the tables. We began to envision a group of assignments for the college students that would place the children as the experts.

Implementation

About a month before the course began, the college students were mailed applications to the Greater Columbus Freenet, a community sponsored gateway to the Internet. Students had access to modems, one in the Education Interactive Learning Laboratory and four in a campus computer lab. Each student was expected to have his or her own Freenet account. The fourth grade classroom had already had a modem and phone line installed, and the classroom teacher had been learning to use e-mail and the Internet.

E-mail assignments included four separate activities, all intended to enable cross-generational curriculum planning and to showcase telecommunications technology. These activities were:

Getting to Know Your Keypal.
Collecting Weather Data.
James and the Giant Peach Weekly Question.
James and the Giant Peach Math/Science Extensions.

"Getting to Know Your Keypal" involved informal communication between the college student and his or her assigned keypal The two student sites also collected temperature and cloud condition data for four weeks. With this information, students could compare daily weather data from two different geographical locations. Could students in Bladensburg forecast the weather based upon data from Westerville, or vice versa? For the weekly *James* question, the fourth graders had to pose a character or plot question to their college keypals. The biggest responsibility for the college students was to develop a math or science extension from the *James* book and then submit the extension idea to the keypal for evaluation and feedback. With their teacher, the fourth graders had to develop criteria for evaluating the activities. In other words, the fourth graders had to decide, "What makes something fun or good or useful for learning?" In addition, the fourth graders selected one or two of the activities to try in their classroom.

Evaluation

The college students maintained an e-mail journal in which they recorded their correspondence with their keypals. Each journal reflected the initial contact, the weekly questions and the literature extension. As college level assignments, we expected our students' journals to describe e-mail transactions in the context of: curriculum and instructional planning, and instructional evaluation. The fourth graders also maintained an e-mail journal, to be evaluated by their teacher for communication skills appropriate to that grade.

project
The Teacher Education Internet Server: An On-line Resource for Educators

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Key words: technology, teacher education, Internet, gopher, World Wide Web

Abstract

The Society for Information Technology and Teacher Education (SITE) has established a Teacher Education Internet Server (TEIS). SITE is a non-profit association of teacher education programs affiliated with the Association for Advancement of Computers in Education, and publishes the Journal of Technology and Teacher Education.

The Teacher Education Internet Server is designed to provide resources in support of both preservice and inservice teacher education. The server offers a range of different capabilities, including both an Internet gopher and World Wide Web (WWW) services. With the rapidly evolving capabilities of the Internet, the Teacher Education Internet Server provides a site at which teacher education programs can explore ways in which the Internet can serve as an instructional resource and support links to K-12 technological initiatives.

A variety of archived documents are available on the Server, including text and word processed versions of the Technology and Teacher Education Annual, the Journal of Technology and Teacher Education (JTATE) Abstracts, and issues of Interface, and educational technology newsletter for teacher education programs. A series of Teach-IT modules (instructional materials on various subjects in educational technology) are available for downloading. IBM and Macintosh educational software is obtainable from the server including some of the more popular graphical-user-interface Internet tools and excellent K-12 multimedia examples provided by the University of Maryland and other programs.

Now beginning its second year of operation, the Teacher Education Internet Server is evolving into a resource with a greater focus more on specific educational content areas. With this in mind, SITE is enlisting a cadre of teacher educators to serve as "curators" for specific areas of the server. Forums are currently being established in reading and language arts, mathematics, international education, and other content areas. These forums have been designed as a place in which educators can share ideas and information about the uses of technology in specific disciplines. It is hoped that they will provide guidelines for ways to integrate technology into methods classes, compare ways of using technology in field experiences, and discuss ways to use technology to enhance content-area learning.

As use of the Internet by teacher education programs continues to grow, the Teacher Education Internet Server will offer an electronic clearinghouse for teacher educators, classroom teachers, preservice teachers, administrators, researchers, students, and others interested in the use of technology in the field of teacher education. In addition to resources housed on the server itself, links to both K-12 networks and community networks offer the opportunity for collaborative efforts that transcend traditional boundaries.

project

Teachers' Stages of Concern towards Internet Integration

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Key words: Internet, teacher training, attitudes

Abstract

This presentation will address the attitudes of education students taking an introductory course on the Internet, and their confidence in being able to integrate this brave new world of technology into their teaching. The course instructor will discuss the outline and syllabus of the class, touching on its development and implementation. One of the students of the class will offer a review of literature concerning educational uses of the Internet, an application of the SoCQ instrument as it relates to this study, and an explanation of the research design and results. Looking at student attitudes in innovation adoption is relatively new in general, and Internet implementation is new in particular; therefore, these kinds of data will be valuable in assessing course objectives, learner outcomes, and curriculum development.

Background

Historically, the introduction and broad availability of new communication technologies have been shown to ultimately impact the educational system in some manner. Recent public accessibility to the vast assembly of resources available on the Internet has quickly revealed its inherent educational potential, and is rapidly influencing education on a broad scale. Swift acceptance of the Internet as a potential instructional tool has opened the door for its integration into the classroom Requisite to this, however, is the instruction of educators in the use and incorporation of this new communication tool. It was this instructional need that encouraged the development of a computer-mediated communication (CMC) course designed specifically for educators.

Design of the course, Computers and Telecommunication in Education, centered on providing educators with the fundamental skills and knowledge base needed to successfully integrate and use CMC in their educational settings. Content was divided into progressive levels and delivered in the following three phases: (1) Internet Hierarchy and Access Skills; (2) Communication Infrastructures; (3) Curriculum Integration. The progression from one phase to the next provided a mechanism for gradually acquiring an overall understanding of communication networks and the basic CMC skills prior to attempts at curriculum integration.

Rationale

The introduction of this new communication technology into education carries with it additional hurdles beyond those associated with the delivery of Internet-specific instruction. With each phase of the course, educators were presented with novel CMC situations that created different levels of individual concern regarding the use of the new innovation. Identification and understanding of these concerns is critical in the adoption and integration of the Internet in education. Thus, throughout the semester, the course provided a unique opportunity to assess individual concerns in each of the three phases of instruction.

One of the most widely used instruments for assessing teacher concerns related to innovations is the Stages of Concern Questionnaire (Hall, Rutherford and George, 1988, and with roots in the Concerns Based Adoption Model Project). In addition, one of the most potentially powerful tools available to educators today is the Internet. The Computers and Telecommunication in Education class, taught to graduate students majoring in Education at WVU, had a primary focus to teach telecommunications rudiments not as ends in themselves, but as tools to use in curriculum development. To this end, the research presented here uses the Stages of Concern instrument to measure the various stages of concern of the participants as they progressed through the course and considered their own curricula.

Design

The use of the Internet has continued to grow logarithmically in the last few years, and as educators see the benefit of its power, it is easy to become more technologically excited than pedagogically sound in teaching telecommunications basics. The results of this study should offer some insight into the reception of this innovation, the integration of this tool, and the implementation of formative and summative evaluation measures into curriculum refinement and development of Internet classes designed for educators.

The course addressed: communication software, network topologies, telnet, ftp, e-mail, infrastructure, and integrating telecommunication into the existing curricula. Instruction was designed to be platform non-specific, so that users of IBMs or Macs could access the same tools, as could users with hard-wire or dial-up connections.

The study employed a repeated measures design, looking at the seven stages of concern at the beginning, middle, and end of the course to measure any changes across the semester.

project

Metacognitive, Multisensory and Motivational: Technology to Enhance Vocabulary Acquisition

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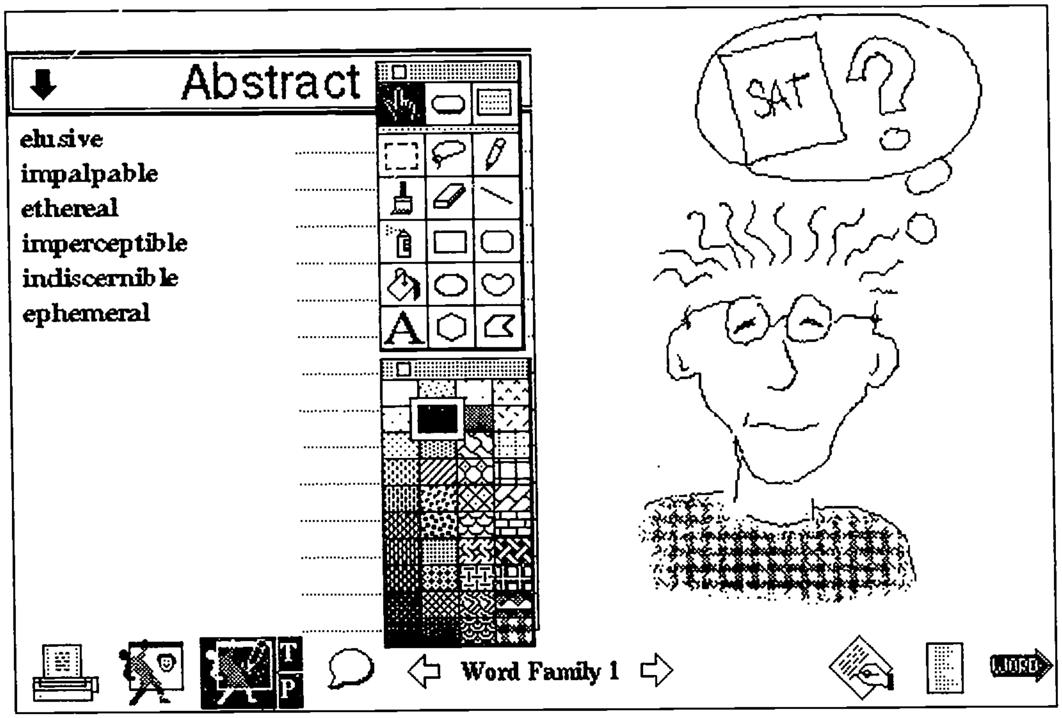
Key words: vocabulary, SAT's, learning style, learning disabled, visualization, interactive

Abstract

Teachers today must not only deal with a more culturally diverse student population, but also must teach students with multiple, distinct learning styles. This project describes an innovative software program that provides students with alternatives to traditional text-based study of vocabulary, essential for improved reading comprehension and higher scores on the SAT's. Using *HyperCard*, text, graphics, and sound provide multiple ways to learn and something for every student's learning style.

Preliminary findings of the Harvard Graduate School of Education Teaching for Understanding Project suggest that true understanding must be performance-based. Instead of lear ng by rote, students should be encouraged to generalize and apply their knowledge. Rather than memorization of meaningless word lists, *World of Words* teaches for understanding through categorization, association, and visualization. Vocabulary is categorized into word families that highlight samenesses and differences. Associations of meaning and connections are made as words are defined in sentences and, in turn, accumulated into story contexts. Drawings of the story encourage students to visualize meaning. The goal of the program is to increase the amount and longevity of learning by making vocabulary meaningful and relevant.

To engage students and increase the number of their associations, vocabulary is presented with a continuing theme (music) and stars a multicultural character (Luther). Since the program was initially developed for learning-disabled adolescents, all vocabulary words and program text, as well as self-initiated text, can be read by the computer.



World of Words engages the imagination to improve students' understanding of word meanings.

Given the non-sequential interface of the program, activities can be customized to meet the needs of the individual. All students, including such diverse populations as the gifted, the ESL student, and the learning disabled, can interact with the material by typing, drawing, and comparing their impressions with the program's information. In short, this project demonstrates how interactive software can provide motivational tools for actively developing all students' vocabulary skills.

project
NewtonWorld: An Artificial Reality for Physics Education

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Key words: virtual reality, visualization, science education, interface design

Abstract

With support from the U.S. National Science Foundation and the National Aeronautics and Space Administration, we have begun the design of *ScienceSpace*, a series of artificial realities that explore the potential utility of physical immersion and multisensory perception to enhance science education. One objective of this project is researching whether sensorily immersive constructivist learning can remediate typical misconceptions in the mental models of reality held by many students. Another is studying whether mastery of traditionally difficult subjects is enhanced by immersive, collaborative learning-by-doing. We began our design of *ScienceSpace* with artificial realities that exemplify Newtonian mechanics and dynamics. *NewtonWorld* is an artificial reality in which motion is constrained to one dimension as entities of variable mass collide, with learner control over the magnitudes of objects' coefficient of restitution and internal friction.

Designing NewtonWorld

The physical interface to *NewtonWorld* is typical of current high-end virtual reality. The hardware used is a Silicon Graphics Onyx RE/2 reality engine, coupled with a Virtual Reality, Inc. EYE-GEN3 head-mounted binocular display; a Polhemus FASTRAK magnetic orientation and position sensing system with a 3-Ball sensing unit (similar to a 3-D mouse); stereo sound; and a custom vest that delivers haptic sensations. This physical interface enables us to immerse the student in 3-D microworlds using the visual, auditory, and tactile senses.

The software interface consists of a 3-D generic representation of objects in motion. A large grid contains an enclosure created by two rows of columns that form a corridor with walls at each end. Two balls can move in one dimension along the corridor, rebounding when they collide with each other or the walls. The equal spacing of the columns and the lines on the floor of the corridor aid learners in judging distance and speed. Signs on the walls indicate the presence or absence of gravity and friction. *NewtonWorld* enables learners to directly experience and manipulate the factors critical to understanding Newton's laws, conservation of momentum and energy, and reference frames.

Students begin their guided inquiry in a world without gravity or friction, allowing them to perceive physics phenomena that are otherwise obscured by these forces. They can launch and catch balls of various masses and can view the collisions from several viewpoints. These activities provide an immersive experience of counter-intuitive phenomena. By instructing students to make predictions about upcoming events, directly experience them, and then explain what they experienced, we encourage them to question their intuitions and refine their mental models. Once they understand relationships under idealized conditions (pure Newtonian dynamics), they can "turn on" friction or gravity.

To illustrate an activity a student might undertake, imagine that the student is inside a ball that has an initial velocity relative to the corridor. Neither gravitational nor frictional forces are activated, and objects have a perfect coefficient of restitution (i.e., the balls will rebound with perfect elasticity and will not transfer kinetic energy to heat). The walls at the end of the corridor have infinite mass; the student (as a ball) has a unitary mass of 1.

Initially, the student is asked to answer the following questions: (1) If you launch a ball equal in mass to the ball that you are within, what will be the subsequent behavior of both balls? (2) What will occur if you "catch" the other ball when the two masses are moving in opposite directions–or in the same direction? (3) If instead, you launch a ball whose mass is not equal to the mass of the ball you are within, will the balls' behaviors be different; if so, how? (4) What rules can you derive that predict the balls' dynamics in other similar situations?

Students are asked to describe what they observed, determine whether it supported their predictions, and refine their predictions. After completing a series of related activities, students are encouraged to synthesize what they observed by describing and explaining relationships among important factors. Ultimately, our goal is for students to be able to generalize their insights concerning the phenomena they experienced in *NewtonWorld* to a variety of analogous real world situations.

society session

On Target: Anchored Instruction, Advanced Multimedia Production Skills, and Inservice Education

An AECT Session

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Keywords: multimedia, anchored instruction, inservice education, teacher education, staff development

Although the framework of anchored instruction, developed by the Cognition and Technology Group at Vanderbilt (CTGV), can be used in almost any content area, educational technology instructors are finding it to be extremely effective when teaching students how to use a variety of technology tools. This approach can be defined as an attempt to help students become actively engaged in learning by situating or anchoring instruction in interesting and realistic problem solving environments.

The first part of this session will provide background information about anchored instruction, describe it in some detail, and discuss some of its applications. The second part will describe how the Instructional Technology Resource Center at the University of Central Florida and how it has adapted it to teach inservice teachers to use a wide variety of advanced multimedia components. The rationale behind the decision to move to this approach will also be discussed.

society session

A Research Agenda for Topics and Methods in Educational Technology Identified by Technology-using Educators

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Keyword: educational technology research, research methods, research agenda, research reviews, survey of technology-using educators

In recent years, research on the impact of technology use in education has come under fire from researchers such as USC's Dr. Richard Clark, who hold the view that no instructional medium or technology resource has any unique ability in and of itself to raise achievement or improve student attitudes. Dr. Clark and others say that results of past studies serve to support their position that factors OTHER THAN technology uses (e. g., the teacher's actions) are the deciding factors in whether or not any instructional activity will be effective. They also hold that no technology resource makes contributions that could not be made in some other, cheaper (e. g., non-technology) way.In light of growing support for this position and increasing criticism of current research methods, the ISTE Research Committee conducted a panel presentation at the 1994 National Educational Computing Conference in Boston entitled, "Toward A Research Agenda In Educational Technology." The panel noted several directions that future research might take. This year, the Committee extended its work by reaching out to the educational technology-using community for additional opinions and comments. Committee members developed a survey to gather data from technology users in the field on what topics and methods they perceive should be addressed in future research. The survey was placed on the Teacher Education Internet Server at the University of Virginia and sent to selected networks and contacts in other locations. Technology-using educators were invited to respond to it and give their opinions on directions for future educational technology research.

This presentation will describe results of this survey in four areas:

*Information on persons completing the survey
*Reactions to a question on the usefulness of research
*Opinions on areas that future research should address
*Opinions on research methods that should be emphasized

In addition to the summary of survey data, presenters will also give a synthesis of past recommendations for educational technology research agendas and will submit their own tentative agenda for future research based on survey data and their research review. This tentative agenda will be combined with feedback from session attendees, ISTE members, and others to form ISTE's recommended agenda for research topics and methods in educational technology.

project

The Information Highway as a Tool for Professional Development

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Key words: mathematics, inservice, online

Abstract

Teachers Take Responsibility for Own Professional Development

After setting demanding standards for themselves (*The Professional Standards for Teaching Mathematics of the National Council of Teachers of Mathematics*), mathematics teachers have placed their own professional development high on the agenda for mathematics education reform. Through a collaborative effort of the National Council of Teachers of Mathematics (NCTM) and the Public Broadcasting Service (PBS), a teacher-designed program in which teachers take charge of their own professional development has emerged. It is the Middle School Math Project of PBS MATHLINE.

This model of professional development differs in several distinct ways from the traditional inservice models. It is available to teachers at times and locations convenient to them. Teachers access the program whenever and wherever they choose–from home or from school, before or after school, or on weekends. The program provides teachers sustained support throughout an academic year as they engage in the arduous task of changing teaching practice. The program is structured to focus on the NCTM Professional Teaching Standards; however, there is flexibility within the local learning community of teachers to reach the group's learning goals in ways that are best for the group and its individual members, and to tailor activities to meet local needs and to address district and state issues.

A Professional Development Model Made Possible with Converging Technologies

Video, e-mail, online communities, and videoconferencing contribute to the unique design of PBS MATHLINE's Middle School Math Project. Teacher-participants:

- Use a set of 25 videos of practicing classroom teachers in action to view Standards-based practice. Teachers view the videos as often as they need to focus on the teaching Standards featured in each video. Video is delivered via satellite, broadcast, or cable and is taped for later use.
- Are linked with 25-30 other teachers in a learning community of their own, and are linked with all other participants across the nation via electronic mail and plenary conference sessions in a distributed network of servers at local public television stations. Each learning community is facilitated by a practicing teacher who has been trained in online facilitation skills.
- Interact with each other in live, national videoconferences distributed via satellite to local stations where they gather face-to-face to hear and question each other in pursuit of excellence in teaching.

The Findings

Early indications are that teachers believe that ongoing, online communication with peers greatly diminishes their sense of isolation from other teachers. Some teacher-participants indicate that the privacy of the learning community permits them to ask for help and admit lack of knowledge or skill in a non-threatening environment. Some teachers believe that the quality of their online interactions is superior to interactions in face-to-face inservice sessions because there is time to reflect on the thoughts of others as well as their own responses before sharing them with the group.

The barriers to getting online appear to be the same for participants in this program as for any other program. Few telephones, slow modems, antiquated computer equipment, and little technical support available on-site are still problems. A small group of participants received powerbooks, wireless modems, and cellular air time. The portability of this equipment from room-to-room within a school and between school and home is giving teachers far more flexibility and added convenience in accessing their learning communities.

Peer facilitation assures that the learning community remains active and engaging for participants and that the learning mode is that of a cooperative group rather than the model of single authority with a group of students.

panel

Technology in a Recreated Environment: Lessons from the ACT Academy

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Key words: technology, restructuring, constructivist

Abstract

In the fall of 1992, the McKinney Independent School District received a $5.5 million grant from the federal government. The purposes of the grant were to create a school of the future that broke the mold of traditional education and to take the innovations at the school into the other schools in the district.

The ACT Academy is a result of the federal grant project. It is a school that serves 250 students ages 5-18 in a multi-aged environment. The learners represent a vertical slice of the McKinney ISD student population that is based on race, age, gender, socio-economic status, and special education classification.

Eleven full-time learning facilitators provide instruction and use technology as a tool to leverage learning and provide real-time data connections. Each staff member at the school and every student in the 12-18 year old team have their own portable computers; in the 7-11 year old team there is one portable computer for every two students; the 5-6 year old team use "fixed" stations. In addition, students and staff have access to multimedia computers, printers, CD-ROMs, laserdiscs, VCRs, camcorders, still video cameras, distance learning, cable TV, online services, and telephones.

This technology supports the Academy's curriculum. The curriculum is based on the belief that knowledge is actively constructed by learners on a base of prior knowledge, attitudes, and values. What the learners bring to the experience–their notions and ideas–is honored and they are given opportunities to modify and strengthen these ideas based on new experiences.

An existing elementary school in the district was chosen for the Academy site and has undergone extensive renovation. The design of the building reflects the philosophy of the school and contains both open and closed learning spaces for maximum flexibility and use. The plan also allows for the portability of computers and other technologies. There are over 400 data drops located inside and outside the building for access to the network.

The innovations in use at the Academy are being shared on a formal basis with the other schools in the district. Teams of teachers from each of the other ten schools have participated in extensive training and follow-up to learn about and implement these innovations. The long-term strategy is to make on-going changes in the district with the ACT Academy serving as a laboratory school.

The panel, consisting of members of the core ACT project team, will discuss the processes used to determine the type of technology at the school, the training of ACT and district staff, the use of the technology by students and staff, and long-range goals of technology in this innovative environment.

panel

Report on "Live from Antarctica"–Your "Passport" to Electronic Travel to the Frontiers of Science

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Keywords: science, Internet, interdisciplinary, telecommunications, multimedia

Abstract

This "virtual" field trip to Antarctica was accomplished by a rich blend of activities available through postal mail, online and on air. The common objective was to enhance students' understanding and appreciation of the exciting world of science through cross-curricular and cross-modality experiences. Classroom activities that preceded the virtual travel involved creating land puzzles to explore continental shift and tectonic theories, designing ice stations for the South Pole, and creating international treaties for the future.

The "Live" satellite programs were broadcast over PBS in the winter of 94-95 and provided the transportation to places so remote that few humans have ever traveled. The project's central theme is the co-evolution of this unique continent, and the life-forms that have adapted to it: the birds, plants and dinosaurs of ancient times, and the life forms of present day. Students had an opportunity to work closely with other students and with the extensive team of researchers and educators who facilitated this project.

This panel will explore the experience from the different perspectives of:

- A teacher who taught her kids live from the South Pole.
- A teacher using the "Live from Antarctica" materials.
- The executive producer of the "Live" programs.
- A designer of the online environment.
- A technology coordinator.

- A curriculum developer.
- An educational researcher.

Each member of the panel represents a unique part of this team and will be able to describe how their work contributed to the development of innovative design for education.

Students used e-mail and network tools to read electronic "Field Journals" written by researchers in the Antarctic and left questions to be answered by the Antarctica Research team. They accessed weather and climate data placed online by the field researchers. They searched a database providing ever-expanding information on Antarctica to accomplish their projects.

Through this program, students learned how scientists investigate the geology and climate of Antarctica and collect clues to the history of the place and movement of continents. The students saw a very different biology of Antarctica from "then"–through fossil remains from when Antarctica was a tropical forest and dinosaurs roamed, to "now"–with Emperor penguins and Weddel seals above and below the ice. They saw how astronomical research at the South Pole help scientists look back to the very origin of the Universe and how it provides the most current research on the ozone hole. The students also learned how to collect, analyze and share information through extensive writing, as well as sketches and drawings. In addition, they were encouraged to think about the future of this global laboratory.

But the students also learned how to collect, analyze and share information. They did this through extensive writing as well as sketches and drawings. Teachers on this panel will be sharing the work of students who took part in this electronic field trip.

And finally the panel will be discussing the next Passport to Knowledge adventures— Live from the Stratosphere or Live from the Hubble Telescope.

paper

Identifying Effective Knowledge Building Activities for Learning Computer Software

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Key words: learning, software, computers, strategies, knowledge-building, teacher-education

Abstract

This study looked at knowledge building activities (KBAs) in the domain of computer software. Thirty-six adults were asked to think aloud while learning a series of tasks in a common spreadsheet package. A detailed analysis of 3,061 KBAs revealed that directed search, trial and error, and careful observation had a strong impact on learning. Pace of learning and systematic testing played a more moderate role. Practical recommendations are offered to educators of computer studies.

Introduction

The exploration of knowledge building activities (KBAs) originates from task-analysis in human factors engineering (Drury, Paramore, Van Cott, Grey, & Corlett, 1987) and involves breaking down tasks into smaller components and specifying the flow of those components (Brooks, 1991). A partial list of KBAs that have been identified in a variety of domains includes defining terms (Bransford, Vye, Adams, & Perfetto, 1989), planning (Miyata & Norman, 1986, Riley, 1986; Voss, 1989), searching (Schauble & Glaser, 1990), questioning (O'Malley, 1986), and a mixture of successful strategies (rehearsal and review, monitoring, unpacking implicit assumptions, summarizing, considering alternatives, questioning, clarifying and predicting) (Bereiter & Scardamalia, 1989; Brown & Palinscar, 1989; Collins, Brown, & Newman, 1989).

A number of investigators in the area of education and cognitive science have argued for more research on the knowledge building process. Chi & Bassok (1989) maintain that there is a need for more explicit examples describing the conditions surrounding KBAs. Glaser (1990) and Glaser & Bassok (1989) note that while considerable advances have been made in the areas of memory organization, problem solving, and characteristics of understanding, the knowledge acquisition process has not been examined extensively. Furthermore, few researchers have offered a detailed analysis of knowledge building characteristics in a natural setting (Ceci, 1990; Siegler, 1989).

Research on KBAs has been noticeably absent in the computer ability literature. For the most part, studies have relied solely on a paper-and-pencil format to gather information about knowledge of using computers. This relatively straightforward strategy has produced a wealth of well-organized, albeit conflicting, information (Kay, 1989, in press) offering little understanding of the dynamics of human-computer interaction.

The primary purpose of this study was to examine knowledge building activities used to learn new computer software. The specific objectives were to (a) describe the principle KBAs in the computer knowledge acquisition process, (b) examine the extent to which these activities were associated with successful problem solving; (c) demonstrate how the results can be used to advance knowledge and theory; and (d) provide meaningful suggestions for educators of computer studies.

Research Design

Sample

The sample consisted of 36 adult volunteers (18 male, 18 female): 12 beginners, 12 intermediates, and 12 advanced users, ranging in age from 23 to 49 (M= 33.0 years), living in the greater metropolitan Toronto area. The criteria used to determined ability levels included years experience, previous collaboration, learning, software experience, number of application software packages used, number of programming languages/operating systems known, and application software and programming languages known. A MANOVA showed that beginners, intermediates, and advanced users had significantly different scores in the expected direction on all seven criteria ($p < .005$).

Procedure

Subjects' computer activities were videotaped for 55 minutes, with the camera focused on the screen, while they attempted to learn a common spreadsheet package (Lotus 1-2-3, Version 2.2) on an IBM 80286 clone. Subjects were asked to do as many of the following tasks as they could: (1) move the cursor, (2) enter rows and columns of numbers, (3) enter data, (4) insert blank rows and columns, and (5) move and/or copy rows or columns of data. The standard procedure was to introduce the subject to a task and encourage self-directed learning. Each subject was asked to think out loud while learning. Every effort was made to encourage subjects to get "unstuck" on their own. Unlike typical protocol analysis, subjects were given calculated "hints" when they were unable to proceed.

Data Collection

The first 50 minutes of each of the 36 videotaped sessions was transcribed verbatim. Verbal expressions and sounds, as well as critical keystrokes, were included in the transcriptions. Transcription analysis revealed that 3,061 learning episodes involved some sort of knowledge building activity.

Each KBA was assigned an influence rating based on (a) how much was learned and (b) time lost or gained. If no knowledge or understanding was lost or gained, a score of 0 was given. If a small piece of the task was solved or misconstrued a score of +1 or -1 was assessed respectively. If a significant piece of the task was learned or misconstrued, a score of +2 or -2 was assessed. Finally if a substantial amount of time (15-20 minutes) was gained or lost, in the process of learning or misconstruing, a score of +3 or -3 was given. A detailed coding scheme was used to ensure the reliability of influence ratings.

Next, an estimation of effect for a specific category of KBA was calculated using the average influence rating for that category, the percentage of subjects involved, and the total number of observations made. For example, if the KBA category "seeking information" showed an average influence rating of 1.2, was used by 50% of the subjects (n=18), and accounted for a total of 45 observations, the estimated effect score would be 27 (1.2 x .50 x 45).

Main Variables

The main independent variables were based on five principle KBAs identified in the protocol data: (a) actions (e.g. pressing a key, playing, exploring), (b) seeking information, (c) processing information, (d) style (e.g. going at a fast or slow pace), and (e) combinations of learning activities. Within these categories, a number of sub-categories were identified and are presented in Table 1. The main response variable was the estimated effect score.

Results

Description of Principle KBAs

Seeking information (48%) and specific actions (36%) were the two most prolific KBA categories. Main activities based on style (9%), processing of knowledge (5%), and combinations of activities (1%) were seen much less often . Trial and error, searching (specific and broad), and observing were the top sub-categories of learning observed. Subjects' pressed any key, repeated their actions, performed systematic tests, asked for help, used deduction and changed their pace of learning with a moderate degree of frequency.

Table 1: Type and Frequency of Knowledge Building Activities

CATEGORY	# of Obs.	% of Category	CATEGORY	# of Obs.	% of Category
ACTIONS			KNOWLEDGE PROCESSING		
Trial & Error	608	54%	*Deduce*	106	64%
Press Any Key	127	11%	*Reflect*	42	25%
Repeat Action	114	10%	*Compare*	18	11%
Sys. Test	114	10%	*TOTAL*	166	5%**
Exploring	63	6%			
Anchoring	62	5%	STYLE		
Playing	25	2%	*Fast-Pace*	118	41%
Circling	15	1%	*Slow-Pace*	101	35%
TOTAL	1128	36%**	*Double-Check*	61	21%
			Evaluate	11	4%
SEEK INFORMATION			*TOTAL*	291	9%**
Search Specific	566	38%			
Search Broad	454	31%	Combining KBAs	32	1%**
Observe	351	24%			
Ask for Help	108	7%			
TOTAL	1479	48%**			

Note: ** Percent of all KBAs

Estimated Effect of KBAs on Learning

The highest effect score came from attempts to seek information (990.9) and actions subjects made (699.4). Searching for specific information produced the single highest effect score (600.0) for a specific learning activity, followed by trial and error (486.4) and observing (358.0). More modest effect sizes were seen in broad searches for information (140.7), a slow and fast pace of learning (100.3 and -115.1 respectively), and systematic testing (99.6). Notable negative effects were produced by pressing any key (-55.8) and going at fast pace (-115.1)

It is interesting to note the highest mean influence scores were not necessarily produced by those activities with the highest effect scores. In fact, combining KBAs showed the highest mean influence ($\underline{M}$=1.56) followed by change of pace ($\underline{M}$=1.27 & 1.25), double-checking actions ($\underline{M}$= 1.21), and systematic testing ($\underline{M}$=1.21). Two of the highest estimated effect activities, specific searches and observing had relatively high mean influences ($\underline{M}$=1.06 and 1.02 respectively). Other relatively high influence activities included comparing ($\underline{M}$=1.00) and asking for help ($\underline{M}$=1.06). A complete set of estimated effects for main and sub-categories of learning activities is presented in Table 2.

Table 2: Estimated Effect as a Function of KBAs

CATEGORY	n	% of Subjects	Mean Influence	Estimated Effect
ACTIONS				
Trial & Error	608	100%	0.80	486.4
Systematic Testing	114	78%	1.12	99.6
Repeat Action	114	92%	0.53	55.6
Exploring	63	86%	0.79	42.8
Anchoring	62	69%	0.74	31.7
Playing	25	33%	0.36	3.0
Circling	15	28%	-0.47	-2.0
Press Any Key	127	72%	-0.61	-55.8
TOTAL	1128	100%	0.62	699.4
SEEK INFORMATION				
Search for Specific Info.	566	100%	1.06	600.0
Observing	351	100%	1.02	358.0
Search Broad	454	100%	0.31	140.7
Ask for Help	108	78%	1.06	89.3
TOTAL	1479	100%	0.67	990.9
KNOWLEDGE PROCESSING				
Deduce	106	92%	0.72	70.2
Reflect	42	69%	0.81	23.5
Compare	18	36%	1.00	6.5
TOTAL	166	100%	0.77	127.8
STYLE				
Slow-Pace	101	86%	1.27	110.3
Double-Check	61	78%	1.21	57.6
Evaluate	11	17%	0	0.0
Fast-Pace	118	78%	-1.25	-115.1
TOTAL	291	97%	0.19	53.8
COMBINING KBAs	32	33%	1.56	16.5
ALL KBAs	3061	100%	0.60	1836.6

Finally, an analysis of KBAs as a function of ability showed advanced users to be more capable with respect to trial and error, observation, searching for information, and double checking their answers. Paradoxically, they experienced more difficulty than beginners or intermediates when they attempted to go too fast. Estimated effects for all learning activities as a function of ability are present in Table 3.

Table 3: Estimated Effect as a Function of Learning Activity and Ability Level

Learning Activities *(from Resources)*	Beginner Est. Effect	Intermediate Est. Effect	Advanced Est. Effect
ACTIONS			
Anchoring	7.4	14.2	10.7
Circling	-1.0	-0.5	-0.5
Exploring	18.3	15.6	9.7
Press any key	-23.9	-17.3	-14.2
Repeat an action	15.6	14.2	25.9
Systematic test	30.7	45.0	24.7
Trial & Error	146.3	143.5	197.8
SEEKING INFORMATION			
Ask for help	29.3	26.5	32.5
Observe	110.7	108.9	138.8
Search Specific	71.8	128.5	194.9
Search Broad	20.6	34.3	42.3
KNOWLEDGE PROCESSING			
Comparing	0.3	3.0	4.2
Ded[illegible]g	24.9	30.0	15.8
Reflecting	8.6	5.5	9.2
STYLE-RELATED			
Double-check	10.0	16.4	33.8
Evaluate software	-0.1	0.0	0.5
Fast-Pace	-16.2	-44.9	-54.0
Slow-pace	33.7	37.5	38.0
COMBINATION	0.5	1.5	21.0

Theoretical Implications

Identification of KBAs for computer knowledge acquisition has proven to be a useful procedure yielding a mixture of traditional and unique behaviors. KBAs observed in this study that were noted previously in other domains included searching (Schauble & Glaser, 1990), monitoring or observing, and review (double checking) (Bereiter & Scardamalia, 1989; Brown & Palinscar, 1989; Collins, Brown, & Newman, 1989). Traditional KBAs, such as rehearsal, unpacking of implicit assumptions, summarizing, considering alternatives, clarifying, and predicting (Bereiter & Scardamalia, 1989; Brown & Palinscar, 1989; Collins, Brown, & Newman, 1989) were not seen frequently in this investigation. Some knowledge processing activities and strategies, though, such as deduction, reflecting, and comparing were observed occasionally, with modest effects on learning.

Influential KBAs, seemingly indigenous to the computer environment, included *trial and error* and *systematic testing*. Less powerful KBAs, also unique to software use were *anchoring* (always coming back to the same spot) and random, rapid *pressing of any key*. In addition, pace of KBAs, categorized under style, appeared to be important in learning. *Fast key pressing, quick searching* or *hasty observations* lead to mistakes and a negative effects on learning. Slowing down on the other hand increased learning effectiveness.

The nature of the domain in this study may have partially determined the nature of KBAs expressed. Computer software is set up to naturally try keys, and offer instant feedback, usually with minimal repercussions. A trial and error strategy can be useful for providing new information and constraints to guide future actions and learning. While the mean influence of trial and error activity is only moderately high, instant feedback makes it a useful strategy, when employed frequently and with a certain amount of prudence. Aimless key pressing or rushing on to the next key has a definite negative effect on learning, primarily because the subject can neither see nor cognitively digest what has happened. Systematic testing and taking the necessary time to observe and interpret feedback, is an optimal approach. Exhaustive searches of the manual or on-line help, or careful planning and deduction, may not appear worthwhile given the relative efficiency of trying specific keys in a constrained and systematic manner. The potential for considerable time loss and absence of immediate feedback, makes the trial and error strategy somewhat inefficient for non-computer software domains.

The quality of searching seems to be fundamental to success in learning with computers. Specific searches were more than four times more effective (600 to 141) and three times more efficient (1.06 to 0.31) than broad searches. Specific searching is characterized by searching for meaning or specific phrases, whereas broad searching involved general scanning and page turning. It is reasonable to assume that a more specific search strategy is linked to ability level and more specifically to one's understanding of terminology and concepts. Advanced users have a better idea of what to look for, whereas a beginners, are sometimes forced to search broadly, because they do not know where to focus their efforts.

The key KBAs noted above were instrumental in distinguishing advanced user from their less able counterparts: trial and error, observation, searching for information, and double checking their answers. Somewhat unexpectedly, advance users have an Achilles heel–they attempt to go too quickly and their learning suffers as a result.

One final observation: although the number of times subjects' combined strategies was minimal (n=32), the mean influence of this KBA was the highest observed. Ultimate success with learning new computer software may rest on combining the strategy of slowing down, with careful observation, searching as specifically as possible, and trying keys in a systematic manner.

Suggestions for Educators

The findings in this section suggest several clear guidelines for educators of computer studies. These include:

- A trial and error strategy appears to work well.
- The effectiveness of trial and error is increased by using a more systematic approach. Pressing any key randomly is unlikely to help learning and will moderately impede progress.
- Taking time to observe not only key strokes, but what is on the screen and in the book appears to be highly related to success.
- When searching a manual, on-line help, or a menu, specific searches are four times more effective and a three times more efficient than broad searches (e.g. turning pages, scanning). Activities supporting the labeling of new actions and concepts might support a more specific search technique.
- Deduction, reflection, and comparing do not appear to play a important role in short term learning of new software.
- A combination of the above strategies may be the most effective way to improve learning with computers. In other words, each additional piece may increase a student's overall chances of success.

Caveats

Several cautions should be noted with respect to the results of this study. First, the rating system focused on short-term learning–the conclusions do not necessarily apply to long term gains. Second, only one software package was assessed–different software areas might require different KBAs. Finally, while over 3000 observations were made, the sample size (n=36) was relatively small and localized.

Summary

Knowledge building activities play a prominent role in computers and learning. While certain KBAs observed, such as searching, monitoring, and review were observed previously in other domains, KBAs such as trial and error and systematic testing appeared to be unique to the computer environment. KBAs noted in other subject areas, such as rehearsal, planning, unpacking assumptions, and summarizing played a negligible role in this study. It was suggested that the nature of the computer software domain may have effected the frequency and quality of KBAs observed. An examination of all learning activities indicated that a slow, deliberate, trial and error strategy, coupled with observation, and more focused searching techniques would be an optimal approach to learning new software.

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paper

Money Isn't Everything: Prospects and Problems in Achieving the Aims of the Computer Revolution

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Key words: innovation, implementation, policy-making, strategies

Abstract

Technology is used by less than half of American teachers. Some say that funding increases will fix the problem. But American schools' earlier attempts at innovation show that funding, while necessary, may not be sufficient. Developing savvy in handling change, establishing a shared point of view, documenting changes in students' learning, and other factors are also required.

Introduction

An examination of technology in schools shows some troubling signs. Critics of planning and implementation say that the computer revolution is stalled or off track (Borall, 1992). The enthusiasm and energy that characterized the first few years of the revolution have fizzled in many school districts and researchers tell us that less than half the teachers in the United States use computers (Anderson, 1993). Some say that federal infusions of money are needed to solve the problem and create a climate for the wide-spread, systematic implementation of technology.

In fact, for many of us who have observed the computer revolution and have had an opportunity to compare that revolution to earlier efforts to change American education, the current scene seems bleak. An infusion of federal monies, while necessary, does not seem sufficient to promote increased implementation. Other factors are at work and compromise our efforts to use technology in sites that are in trouble or haven't gotten started. The slow adoption of technology or the failure to implement in a systematic and comprehensive way echo problems that earlier innovations faced: New Math, the Comprehensive School Mathematics Project (CSMP), the School Mathematics Study Group (SMSG), and other attempts to innovate mathematics teaching; Elementary Science Study (ESS) and other attempts to innovate science teaching; Man, A Course of Study, as well as other efforts to innovate social studies teaching; Head Start's and Follow Through's efforts to prepare disadvantaged students for the rigor of elementary school classroom; programmed instruction (both through print media and mainframe computer-delivered instruction); and Open Education. Problems with those projects occurred in spite of huge infusions of federal monies, support from professional communities, and a national consensus that the skills addressed by the programs were important—conditions that apply to the technology revolution.

Looking backward

Several factors affected attempts at innovation during pre-computer days. In some cases, the innovations ran counter to the beliefs-at-work of educators responsible for implementation or to the beliefs of the community-at-large; the evaluations were inappropriate or failed to satisfy criteria set forth by educators and the community; the innovations required training that school districts could not afford—even though federal monies had been provided to the districts; the training called for instructional strategies that were unfamiliar to or antithetical to some educators' philosophies and practices; initial successes in implementation were difficult to sustain—either because of lack of continuing funds for staff development or shifts in school districts' goals or changes in governmental goals; the inherent tendency of institutions to perpetuate themselves in the "way it's supposed to be" tradition was at odds with many of the innovations' demands for a different way of organizing schools and classrooms. Let's take a look at a few of the innovations that were regarded as important and received the support of the federal government but have disappeared or exist in reduced and troubled circumstances.

The New Math ran counter to the beliefs-at-work of many teachers, parents, and administrators. New Math was trying to teach sophisticated mathematics concepts while teachers and parents wanted the traditional "1 + 1 = 2 and 2 + 2 = 4" curriculum. In addition, the training demands of New Math implementation were greater than the available resources of school systems. So teachers were handed textbooks and told, "Go to it, " without fully understanding what "it" was, how "it" should be taught, or why "it" should be taught at all.

Similar problems occur today. Although many software packages have attempted to address a host of problem-solving strategies, many teachers do not believe in problem solving and prefer to administer worksheets accompanying textbooks. Although software is available to help students work with geometric constructions, many teachers prefer the textbook approach. Although software is available for students to experiment with heat, light, and other phenomena, many teachers prefer to teach these concepts from the textbook. One reason for teachers sticking to business-as-usual is the dearth of visual models for how teaching with computers can be accomplished in classrooms. Another reason is the lack of compelling data from evaluations—both personal stories of how learning was enhanced and large-scale studies of the impact of those tools on a wide range of students. The trend is similar to the NIMBY trend we see in communities—"Not in my backyard, but okay for you, fellow teacher, if you want to risk your class and your reputation." Commitment to technology will only come when computer educators can say how they do what they do and how it succeeds.

Problems with evaluation hindered efforts to gain acceptance for New Math. Large scale evaluation projects were relatively new and the wide range of evaluation techniques available today were not yet in place in the early 1960's, and, for the most part, standardized tests were used as outcome measures. Standardized tests were not sensitive enough to detect differences attributable to the New Math's instruction. Although New Math evaluators did devise their own tests based on New Math goals, those tests were not convincing to decision-makers (school district superintendents, school board members, parents, teachers, even students) skeptical about the New Math's value. Consequently, an oft-heard refrain "Will it get my child into Harvard?" was heard throughout the land. This skepticism about using non-traditional test data persists. Little of the New Math's reform efforts persists on a widespread, systematic basis, although the roots of the National Council of Teachers of Mathematics' *Standards* can be seen in the New Math. But computer-using educators hear a similar refrain today—both from their colleagues and from the community members who believe using computers amounts to "play." Again, the lack of compelling stories about how technology is used in a meaningful way and what impact it makes diminish the possibility of a comprehensive spread of technology.

Developers of the Comprehensive School Mathematics Project (CSMP) had the advantage of seeing the problems associated with the New Math. They attempted to build a program that would show the lessons learned from the New Math's problems. As careful as the model builders and evaluators were, they couldn't overcome a critical factor—individuals charged with carrying out the innovation on a day-to-day basis may not implement the project as planned. For example, in evaluating the impact of the CSMP, Herbert (1984) showed differences in the problem-solving performance of students from one classroom to another—even though they all had the same ability levels. Differences in student performance from one classroom to another were often attributable to the ways teachers implemented the program—some teachers didn't teach it at all and others deformed the curriculum to a drill in "basics." This in spite of an enormous and well-crafted staff development program.

The phenomenon of differential implementation is not unknown in American classrooms, especially in districts where a major criterion for acceptance of an innovation is the "It had better get my child into Harvard" syndrome. No innovations are adopted wholeheartedly in those districts unless school staffs believe using the innovation will not jeopardize students' standardized test performance. Even when money is available for staff development, the intended goals may not be realized because of belief-at-work conflicts. So money for staff development will not automatically promote greater technology use. Teachers' belief systems must often be changed if technology is to win whole-hearted support.

Commitment of another sort was also a problem for CSMP. Just short of completing the full cycle of development, field-testing, evaluation, and wide-scale diffusion, the federal government decided to terminate funding at the level it had originally committed to. The result? A loss of faith on the part of many adopters. We know that the fickleness of funding in the past has caused many innovation-oriented teachers to eschew new innovations. "Once burned, twice shy," they say. And with good reason. If teachers were to jump to every innovation that came over the schoolhouse transom, they would be schizophrenic by now. But efforts at wide-scale technology use must confront teachers' past experiences with fickle funders.

Follow Through, a federally funded program designed to help post-Head Start students, recognized differences in teachers' philosophies-at-work and presented a choice of 7 models for adopting school districts. Each model was based on a different philosophy of education: two models were based on positive reinforcement (i.e., behaviorist principles), one model was based on the developmental model of Jean Piaget, one model was based on the English Infant School, and three were "drawn from Piaget, Dewey, and the English Infant School model."

Initial attempts to evaluate Follow Through were compromised by poor evaluation designs. Sites adopting different models were lumped together, even though the approaches to teaching and learning were fundamentally different and would be expected to produce different types of outcomes. As a result, skeptics said Follow Through did not deliver on its promises.

A wedge of skepticism was established. Stallings and her colleagues (1975) then designed an evaluation that took into account the planned variation in Follow Through and looked at several factors, including the fidelity with which individual classrooms implemented the specific model chosen by their school district and the intellectual achievement of students. The evaluations included measures such as the Metropolitan Achievement Test, Raven's Coloured Progressive Matrices, an Intellectual Achievement Responsibility Scale, as well as ratings of "desired child behavior" that included measurement of independence, task persistence, and question asking—factors deemed important in one or another Follow Through model.

Whether the belief that young children deserve an edge, or the flexibility of the model choices, or the weight of data were appealing factors, Follow Through persists, although Marshall (1980) found, in a study of Follow Through classrooms in an urban school district several years after adoption, that over time the physical environment remained as envisioned by the model developers, but structure-of-the-program factors and teaching-strategies-to promote-learning activities deviated from the model resulting in progressively lower scores in desired outcome measures each year. So implementation and intended outcomes are difficult to maintain and the CSMP finding of moving toward "traditional" methods also occurred with Follow Through. It is interesting to note that within the last few months members of the U.S. Congress have recommended a long look at Follow Through to remedy perceived problems with implementation—a concern generated by a series of on-going questions about Follow Through's current implementation and impact. It seems it is difficult for teachers to maintain the developers' vision. In part lack of training is the problem; in part there is a clash with philosophies-at-work. Similar difficulties face teachers deciding on whether or not to join the computer revolution. Follow Through was lucky in the sense that it was designed to redress the neglect of urban students and occurred in a political and economic climate very different from the climate that prevails today. Will the vision that fueled Follow Through be marshaled to jump start and sustain technology use across the country? Or will the prevailing political winds eviscerate the overall goals of technology adherents?

Let's look at one more innovation attempt. Title III of the Elementary and Secondary Education Act (ESEA) was designed to help school districts develop staff development programs, changes in school organization, or changes in the way subjects were taught. In reviewing the success of the projects the Rand Corporation conducted several case studies to assess how classroom organization changed. According to the Rand researchers, "Our most arresting finding was how little change in teachers, social context, or student performance could be related to the project. There were changes, but they seemed more episodic, faint, and dispersed than expected." (1975) Do we hear echoes of problems identified in recent studies of technology use? One of the problems was that schools had difficulties in creating teams, in supporting change, in changing what they had done that didn't work, in overcoming morale problems, and had no coping mechanisms for change. So innovation faltered because the schools couldn't surmount the internal problems—organizational, psychological, logistical—that affected attempts to do something new. The issues that had divided them before continued to divide them. A lack of savvy about moving forward caught them in a whirlpool of implementation failure. According to the Rand researchers:

Only three projects changed teacher attitudes toward their work and place of work, but all projects could claim some changes in instructional techniques among some of their staff. Those changes were all in the direction of better, i.e., more behaviorally indicated, instruction . . .. In successful projects, perhaps as many as a third of staff in as many as half of the project schools had changed as much as half of their instructional practice.

Only three projects—but all received federal monies to support change. Change, where it occurred was small, in spite of external funding. So we shouldn't be surprised at the difficulty in promoting technology-based change.

On a more pessimistic note, the Rand researchers said that at another site, "the next most successful project," there were changes in only ten percent of the schools. Rand researchers attributed successful changes to the leadership skills of the project directors. With different leadership, the results at the sites could have been different—i. e., if less dynamic leadership had been on site, less change might have occurred. Remember that the Rand studies looked at non-technology-driven innovations, so the complicating factor of dealing with hardware and software—with its various interfaces—wasn't even a contributing problem in those studies showing problematic change efforts. This information should be a cautionary verse for any teacher or administrator who believes that increased funding will make the needed difference and provided the necessary boost to technology infusion.

Looking forward

Perhaps we think that we are wiser now, that we have learned from the innovations we have just discussed. But those innovators thought that they had learned from earlier attempts at innovation! And we shouldn't think that additional government funding, while necessary, may be sufficient to jump-start the revolution. The problems of spreading the use of technology cut across every income level, every state, and every type of school are manifold. Problems with demonstrating the impact of technology on students, problems in achieving consensus on how computers should be used, and problems in conducting staff development occur in technology-based settings and are unlikely to be solved by money alone. Leadership—especially from the top down—is often lacking. So it is possible that a national directive with associated funding, while necessary, may not be sufficient to meet the challenges pointed out by critics and commentators on the computer revolution.

Although we may have learned how to conduct more sophisticated evaluations and we may have developed better instruments to measure change, if the conditions supporting change are not present—and, in fact, if the conditions run contrary to the goals of change—caution, not optimism, is the watchword for the computer revolution. The presentation of a national agenda for school-based computing may reap the benefits of Follow Through. But then again, the dreams of computer visionaries may be as ephemeral as the dreams of the developers of SMSG, CSMP, ESS, and other projects.

Even more disturbing, failure to sustain the vision for computers in the schools may create an "I told you so," backlash, a backlash that says technology doesn't make a difference, a backlash that says spending money for technology is a waste and is accompanied by a re-direction of funding away from technology at the elementary or secondary school level. The responsibility for sustaining the technology revolution calls for many conditions. First is a commitment on the part of the federal government and other funders. Previous attempts at innovation have been compromised by short-term funding, by fickleness in funding, and by a zig-zag course of funding—this aspect is important this year, that aspect will be important next year. Other types of support—visual models of how teaching occurs in classroom settings, materials for teacher development, a variety of strategies for innovative ways of delivering staff developm. ~t, administrator support, materials that make a clear-cut link between instructional uses of technology and the curriculum as it is and will be—are needed.

Conclusion

Team work is an important component of any success story. As long as school districts expect one or two teachers to bear the brunt of the innovation, implementation, and evaluation process, we won't see the technology revolution move ahead. The entire school district—including parents and other stakeholders—must be involved. In this respect a history of success with innovation makes a difference. Schools and school districts that have been successful with other reform efforts will have an easier time pulling together for technology than school districts that are in disarray. Savvy plays a role here. If some school districts haven't been successful with innovations, maybe there's someone who has just emerged as a good leader; maybe a funding crisis has passed, or a new group of parents are willing to pitch in. Maybe the "veterans" of earlier efforts at innovation learned a few lessons that could make a difference this time around. But it's important for schools and school districts to realize that if change was chaotic in pre-technology times, it isn't going to be easy to cope with the complex demands imposed by technology planning, implementation, and evaluation.

Saving the best, and most important, for last, it is crucial that schools have an educational vision for technology. To be successful schools—and all within the school—must have a point of view about what to do with technology. Too often schools say money is the missing ingredient in the technology plan when, in fact, it's the lack of point of view—how will we use the technology and what do we expect it to do for our students?—that causes problems. No amount of money from the federal government will overcome the lack of an educational vision.

Given the funds targeted at introducing, expanding, and institutionalizing technology in schools—over $10 billion dollars in federal and private funds, some say—and the increased bureaucracy attached to the disbursement and supervision of these funds, it behooves us to take a caution from the past while planning for the future. We can't be sure that $10 billion allocated will ensure success. The report of the expert panel for the review of federal education program in science, mathematics, engineering, and technology, for example, in criticizing federal management of programs already in place said, "The Federal Government cannot continue to spend large sums of money without knowing if its programs are accomplishing their established goals—or if these goals address national needs in SMET education." (1993) The money must be targeted at problems identified while supplying solutions based on what we can learn from the cautions of the past. We must monitor what we do as we do it to ensure we are spending wisely and well this time around. Above all, we must pay attention to the complex impact the culture of the schools will exert to resist change.

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project
K-12 Telecommunications Projects Overview

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Key words: telecommunications, Internet, online projects

Abstract

SCHLNET

Available as Usenet or e-mail files for a fee. The administration provides assistance to teachers interested in starting new projects. Listings to the call. groups (except call.general) are monitored and approved before being posted.

Sponsor: Global Schoolnet Foundation (Formerly FrEdMail Foundation).
Al Rogers, President <arogers@bonita.cerf.fred.org>

- For general requests for project partners: call.general, call. ideas
- For projects in specific disciplines: call.subject headings
- For age specific student forums: stu.high, jr.hi, stu.elem
- For student-generated projects: stu.subject headings
- For teacher-generated projects: proj.channel.1,2,3, or 4

Academy One

Available through an NPTN affiliate server, by contract with NPTN, or by e-mail. Projects are sponsored by volunteer facilitators chosen by an Advisory Board. Some projects are on-going, others run for specific periods of time, and a few are offered as one-shot special programs. Each project is designed for a specific age group from kindergarten through twelfth grade and focuses on a specific curricular area.

Sponsor: National Public Telecomputing Network (NPTN).
Linda Delzeit, Project Coordinator, <linda@nptn.org>

- For teacher contacts and project proposals: Learning Center/Collaboratory
- For student contacts: Student Lounge/E.club
- For curriculum-oriented projects: Learning Center, Science Center
- For general interest projects: Student Lounge, Special Events

KIDS-95

Available by e-mail listserv subscription to <listserv@vm1.nodak.edu> with the message "get kidlink projinfo". Participation is limited to students 10-15 years old and their teachers.

Sponsor: KIDLINK, an informal volunteer organization.
Odd de Presno, Project Director, <opresno@extern.uio.no>

- For teachers: kids.kidlink, kidleadr, or kidplan
- For students (age 10-15 only): kids.kidcafe, kidresponse
- For responses to the monthly topic: kids.kidforum
- For post a description: kids.kidproj

K12net

Initially available only on FidoNet (a free low-tech network consisting of 26,000 bulletin boards maintained by volunteers throughout the world), but now available in Usenet and e-mail format on Internet as well.

Sponsor: Council of Coordinators.
Jack Crawford, founder <jack@rochgte.fidonet.org>

- For teacher contacts: chat/teacher, sys/projects
- For age-appropriate student contacts: chat/senior, /junior, /el
- For curriculum-based projects: ed/particular subject area
  sys/channel.1,2,3,4,5,6,7, or 8

EDU.EASTWEST

A mailing list forum for student and teacher discussion of issues concerning relations between the former USSR and the West. Used also to establish contacts for socially-oriented projects among schools. Runs on the Peacenet network, maintained by APC (Association for Progressive Communications.)

Sponsor: TERC.
Dr. Boris Berenfeld, founder <boris_berenfeld@terc edu>
E-mail to the listserv <ew-req@gnosys.syle.ma.us> with the message "subscribe EDU.EASTWEST" followed by your Internet address.

Global Laboratory Project

A mail-list and conference collaboration involving 300 high schools in 20 countries in student-based investigations around environmental issues. Low-cost instruments provided by TERC. A highly structured program in which clusters of eight schools collaborate in conducting projects such as air quality, alkaline snow, nitrate studies, water quality, and tracking pesticides. An important feature is periodic online communication between students and professional scientists

Sponsor: TERC and the National Science Foundation.

Dr. Boris Berenfeld, Co-director<boris_berenfeld@terc.edu>

Runs on Econet, maintained by the Institute for Global Communications (IGO).

I*EARN (International Education and Resource Network)

A mail-list collaboration involving 400 schools in 20 countries assisting youth to make contributions to the health and welfare of people by using telecommunications. Six U.S. "centers" oversee projects in area schools. An annual project is the publication of a Global Literary Magazine, *A Vision* , sponsored by Maurine Ackerman of Coldspring Harbor High School (<coldspring@igc.apc.org.>). Another project concerns collaborations between students in Israel and other countries, using ORT, Israel's educational network (<ortisrael@igc.apc.org>).

Sponsor: The Copen Family Fund, Inc.

Peter Copen, President <pcopen@igc.apc.org>

Runs on networks maintained by the Association for Progressive Communication (APC) and its United States affiliate, the Institute for Global Communications (IGC).

E-mail to <beth@copenfund.igc.apc.org> for information.

Mathmagic Project

Grade-level teams from two schools pair up to solve mathematics problems collaboratively, communicating via e-mail. The general section is for teachers to exchange ideas and compare notes on the project. Only formally registered teams may participate, although "open" teams may observe. There is a modest charge for each registered team.

Sponsor: Mathmagic Foundation, El Paso.

Alan Hodson, Coordinator <alanh@laguna.epcc.edu>

E-mail to 'majordomo@forum.swarthmore.edu' with the message "subscribe mathmagic-X-Y-open, where "X-Y" is replaced by K-3, 4-6, 7-9, 10-12 or general.

SYNERGY : CROSSWIRE

One in a series of visual art collaborative projects. You send an original, but unfinished, image with a short text description. This "starter" image is manipulated by another participant. "Manipulated" images may be further manipulated until they become "finished" images. Finished images are stored and then displayed indefinitely in a computer file for all to see.

Sponsor: University of Nebraska at Omaha.

Ed Stastny, Director <ed@cwis.unomaha.edu>

E-mail to the director.

project

Curriculum Exchange Projects with Sister Schools through Telecommunications

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Key words: telecommunications, electronic exchange, instructional technology, K-12 instruction, educational technology

Abstract

Finding contacts in cyberspace: listservices and bulletin boards

To subscribe to most listservs, send a message to the listserv, leave the subject line blank, and in the body of the message, type:

SUB (name of list) (your name)

You will receive an E-mail message notifying you that you have been added to the list. You will also receive information about the list. This information should be saved so that you can refer to it later, especially when you want to unsubscribe.

Here is a list of a few of the listservs available for education:

Kidsphere. To join Kidsphere or the parallel list for children only, "Kids," write Bob Carltiz at joinkids@vms.cis.pitt.edu. Also, ask about the Kidsphere "Teacher Contact Files." Be ready for LOTS of messages.

List: CNEDUC
Address: LLISTSERV@TAMVM1.TAMU.EDU
Description: K-12 Networking, academic computer networking

List: EDNET
Address: LISTSERV@NIC.UMASS.EDU
Description: Education Network, K-12 and adult networking

List: IECC
Address: IECC-REQUEST@STOLAF.EDU
Description: International E-Mail Classroom, K-12 networking

List: K12ADMIN
Address: LISTSERV@SUVM.ACS.SYR.EDU
Description: K-12 administrators

List: KIDSNET
Address: KIDSNET-REQUEST@VMX.CIS.PITT.EDU
Description: K-12 students

Exchange Projects and Activities

The following examples are meant only to "spark" creative thoughts. Much like any suggestion for classroom implementation, it is best to filter what you can use, customize the project for your particular needs, add whatever you need to meet curriculum objectives, and follow the guidelines presented at the end of this section.

- Keypals—electronic "penpals."
- Water acidity projects— rainwater or stream water is collected at different sites, tested for acidity, then examined for patterns over time and distance.
- Tele-election projects—students "voted" electronically and their candidate choice patterns were compared with the national returns.
- Global Grocery List project—students compare prices of 15 standard items (such as rice, sugar, eggs, and unleaded gasoline), then attempt to deduce reasons for price differences.
- Tele-Olympics—students at many different schools conducted Olympics-style athletic events, then submitted the statistics generated to determine the winners for each "virtual event."
- The Eratosthenes Experiment—students from all around the world re-enacted Eratosthenes' geometric procedure that allowed students to estimate the circumference of the Earth by measuring the shadow angle of a stick placed vertically in the ground at noon on the day of the autumnal (or vernal) equinox.
- Electronic mentoring—Internet-connected subject matter specialists from universities, business, government, or other schools can serve as electronic mentors to students wanting to explore specific topics.
- Tele-FieldTrips—Internet-connected teachers and students are encouraged to share observations and experiences made during local fieldtrips to museums, historical sites, parks, zoos, etc. with teachers and students from other cities, states, and countries.

Tips and Guidelines

Getting Started

Teachers should establish online links with discussion groups and potential teacher partners long before they initiate a project. Just "listening" to what others have to say in chatgroups over the superhighway will provide insight. Get comfortable with networking. Shop around cyberspace for listservices and bulletin boards that fit classroom needs.

Project Planning

Start small and plan in excess. Excessive planning helps when unexpected events arise, and starting small leaves teachers and students hungry for more. The most successful projects are simple and direct, requiring limited response time from other participants. Classroom situations vary immensely.

Set a start and finish date for electronic exchanges. In calculating the time-frames for responses, note that it might take up to two days for a message to get to all recipients of a list service. This is especially true if moderators filter every message. Allow adequate time for the duration of the project. Successful teachers suggest making the first announcement six weeks before the starting date, then again two weeks before the starting date. Develop a project calendar in advance with specific entries on what should be happening each day and stick to it.

Preparing to Implement

One way to begin the exchange activity is to send a message asking for participants (a call for participation) to all subscribers over bulletin boards and mailing lists. Another way is to establish an agreement to exchange with individual partner teachers or schools electronically. If your preference is to exchange projects with partners, decide which and how many partner teachers or schools would be best for your project. Partners need to be as dedicated as you are. If you choose to use a call for participation, be ready for the gambit. Be sure to arrange a way for participants to receive project feedback from you and your students. Offer to send them your findings, a copy of your final product or even pictures of the project and students.

An exchange project should have a definite purpose and focus. Follow the template below:
Title of Project:
Subject:
Grade Levels:
Time: (from date to date)
Project Goals or Objectives:
Project Description:
Number of Participants needed:
Project Coordinator: Your name, electronic address, School, Address, Telephone Number
How to Register for Project:
Name of contact person:
E-mail address (es):
School:
School address:
Voice phone #
Grade:
Subjects:
Number of students:

project
Strengthening the Curriculum through Telecommunications: Process & Implementation

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Key words: curriculum, telecommunication projects, science

Abstract

If we were to travel to a new world that had a different atmosphere and gravity field than our own, we would need to learn how to walk all over again. And none of us, I imagine, would resist assistance from our peers in the process of putting one foot before the other so we could navigate freely.

So it is with education today. We have traveled to a new world; many call it "cyberspace." As we bring the Internet into our classrooms, we need to re-examine how we build the curriculum–we need to figure out all over again how to walk.

Many educators, researchers, and policy makers refer to the "tool" use of technology, yet computers and telecommunications bring much more to the classroom than simpler tools like pens, pencils, and protractors. Online access adds a complexity and a richness to the classroom; an additional dimension that demands careful planning and preparation.

The example I will use to illustrate the steps of integrating telecommunications into the curriculum is the Wetlands

Project, a project my 7th-grade science students tackled this year as part of an extensive unit on ecology.

Step 1–Identify Long-range Objectives

Like Alice's Cheshire Cat and Dorothy's Scarecrow caution, we need to know our destination before we embark. The SCANS report released by the Department of Labor asserts that education should provide students the competence to use resources, information and technology; that students must learn to work with one another in teams and that they must have a solid foundation of basic, conceptual, and personal skills.

Step 2–Identify Content Scope and Sequence

Establish end-unit outcomes for students consistent with the general goals and objectives described in the curriculum frameworks and are appropriate for the learning styles, ability levels and interest of your students.

Student Outcomes:

(Please note that these include content, process, and technical objectives.)

At the end of the unit, students will be able to:

1. Describe a "typical" wetlands ecosystem.
2. Identify several species of waterfowl.
3. Describe the life cycle of migratory birds, including morbidity and mortality resultant from avian cholera, avian botulism, and lead poisoning.
4. Identify members of typical wetlands food chains.
5. Explain the importance of conservation legislation.
6. Describe a variety of perspectives re: land and water use in the wetlands area.
7. Explain the impact of changing the pH or temperature of water in the wetlands.
8. Calculate the approximate energy available to migratory birds from the natural food source in the area.
9. Identify the main migratory paths in the Western Hemisphere.
10. Compare and contrast the local wetlands to a distant wetland (the telecommunications component).
11. Create and utilize a database.
12. Prepare and present a multimedia report.

Step 3–Inventory Your Resources

For any project, resources include text and electronic reference materials, online resources, computer hardware and software, and expert mentors.

Step 4–Select a Telecommunications Project Structure

The Wetlands Project students explored WWW and found an article about Whooping Cranes on a Nebraska home page. They also gathered data about the flora and fauna in the various habitats from the partners who were also studying a wetlands ecosystem.

Step 5–Launch the Project

Set the parameters of the project. Decide how long you want it to last and determine what kind of information you want from your classroom partners. Then, post this data in a brief invitation to participate.

Here is the wording of the Wetlands Project Invitation: "7th grade science students seek partners for ecology study of Wetlands Migrating Waterfowl. The project runs from October 1994 to January 1995. We will be posting a question per week and exchanging data about a field study at a nearby Wildlife Refuge. Please respond to TerrieG@aol.com by September 15, 1994 if you are interested in participating."

Step 6–Classroom Management

Whether you have one computer plus one modem in your classroom, or several workstations, managing the project will be a challenge. Grouping the students for specific tasks during the data collection phase of the project works fairly well. In the Wetlands Project, students were assigned specific partners. Each group of students was then responsible for maintaining a folder with the messages from that partner. To keep the entire class informed, we used a butcher-paper chart as an on-going database. It was easy to see which partners faithfully answered the question-of-the-week.

Step 7–Assessment

Integrating telecommunications into the curriculum is like assembling a mosaic; the artist needs to step back to see the whole picture. Assessment provides us with perspective, and can be undertaken at several levels. Student mastery of the content can be measured through performance as well as by objective tests. Student work through the process can be evaluated by observation, and by self- and peer-assessment questionnaires. Student products can be evaluated according to class-designed performance standards and rubrics.

Step 8–Don't Travel Alone

Remember the buddy system. It is best to enlist the support of your site administrator; let him/her spread the word around the community and the district about what a great job your students are doing. Having parents "in the know" will prove to be a great benefit. Parents are usually excited to learn that their children are collaborating with students from across the nation. Share your project with a trusted colleague or two so you can get input and feedback. Ideally, you will be able to develop a relationship with the teachers of your partner classrooms and share your observations of how the project is working

project
The Global Education Telecommunications Network–Criteria for Successful E-Mail Projects

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Key words: e-mail projects, telecommunications, curriculum projects

Abstract

Introduction

Seven years ago the School of Education of the City College of New York developed the idea for an electronic mail network that would link ten schools in New York with their counterparts in London. Today the Global Education Telecommunications Network (GETN) Project links more than 75 schools in New York with schools in 25 countries around the globe. Our network is centered around inquiry-based projects developed by teachers who meet through the network. Teachers negotiate with one another and identify ideas for projects that will best meet the needs of their students and fulfill their responsibilities to their curricula.

Giving teachers the opportunity to design their own activities has led to the creation of many innovative projects. These, in turn, help transform often dull classrooms into places where children are actively engaged in authentic work that they own and share with their partners abroad. While individual projects are important for GETN's success, even more important is what teachers are learning as a result of participating in the network and in the graduate courses that support the network.

City College not only created GETN, it continues to provide the ongoing support necessary to sustain GETN's network. This support includes courses for participating teachers, on-site technical training, online managing and monitoring of projects, recruiting new participants and sponsoring annual conferences.

Findings From Early Experiences

Teacher training is of primary importance if telecommunications programs are to be successful. Projects are more likely to succeed if teachers are comfortable with both the technical and curriculum aspects of the program. Teacher-training programs should include courses that prepare teachers to use the computer in the classroom, both as a word processor and as a telecommunications instrument.

Principal and supervisor orientation must also be provided to insure understanding and support for school-wide telecommunications projects. With this support, it is easier to gain the time necessary to accommodate telecommunications as an integral part of the curriculum. a sense of ownership by the entire school community increases the likelihood of success for any project.

Educational e-mail projects also need careful coordination and management. In GETN, a university faculty member is designated to coordinate the program, providing curriculum support for individual school projects and collaborating with the primary and secondary schools to establish international links for the participating classes. In addition, dissemination of project information, such as evaluation reports, the development of training manuals, the creation of new links, and the preparation of user lists should be part of the coordination.

Finally, if e-mail is to be effective, projects should be designed with specific goals, activities and outcomes, compatible with age/grade level and subject/topic area. Teachers can be achieve this by talking online before any project begins. In the GETN program, the most successful projects had extensive student participation in the planning process. A project timeline that sets specific deadlines for data transfer, and beginning and ending dates should also be prepared. Once the projects are complete the results and evaluation of the experience should be shared.

The teachers who participate in GETN projects agreed that there were several pedagogical reasons for implementing telecommunications into the existing curriculum. They concluded that telecommunications facilitated several education objectives including: increased international understanding, the encouragement of respect for cultural differences, highly motivated learning through the timely sharing of information with a real audience, attaining technological skills whose uses extend beyond the classroom, learning in a content-integrated environment, a genuine opportunity to engage in inquiry-based learning, and the enrichment of the school curriculum.

Assessment of a Telecommunications Project

Education programs are traditionally assessed by the knowledge and skills students acquire and/or by changes in their effective behaviors as a result of learning activities. Although it would be possible to assess some telecommunications activities in terms of cognitive achievement, the goals and characteristics of telecommunications programs more properly point to

assessment focusing on both teacher and student attitudes and the learning process. A traditional program evaluation may be inappropriate in a non-traditional program.

Involving students in meaningful learning activities via telecommunications strengthens instruction dramatically. Student are more motivated to read materials that they get from colleagues abroad and are excited about responding to them. They know that their work and efforts will reach a receptive peer audience. Written work shared through computer networks can be easily read, revised, and reprinted. Instruction in academic subject areas is brought to life through student-to-student dialogues.

Telecommunications is now beginning to alter the approach to education; as the technology advances, telecommunications will play a key role in bring the latest information to students. Within the next few years, with increased technological support and with increased familiarity by educators, student learning will be enhanced and enriched through active involvement in real projects, resulting in personal satisfaction and improved achievement.

project
Hypertext as a Curriculum Dissemination Environment

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Abstract

The Education Program of the Lawrence Livermore National Laboratory is investigating the use of massive hypertext documents as a means to disseminate science curricula developed at the Laboratory.

Hypertext is an electronic environment that presents large amounts of information in a non-linear style; selections are connected in a web of links, rather than being bound in a fixed sequence. Hypertext lends itself to exploration through the free interplay of the links in the web. It captures the user in an evocative way, due to its interactive nature. Hypertext can provide a springboard for group research and collaboration. It is an excellent tool for research, because its interconnectivity allows the user to follow a predesigned path or one that meets the user's individual learning needs.

During the summer of 1994, the presenters developed a hypertext web on the topic of fusion energy. This web covers a history of fusion energy research at the Laboratory with emphasis on approaches to magnetic and laser fusion. The web contains nearly 100 small documents, called lexia, interconnected by an almost equal number of links. To disseminate this curriculum, the Laboratory will make the web available on its educational server.

This presentation will give a description of the history of hypertext, followed by a discussion of the fusion project. Time permitting, there will be a demonstration of the ease with which a hypertext web can be created. The audience will be urged to take an active part in this demonstration.

This project is not now, nor will it be a commercial product or venture, though it does make use of a software product that is on the market.

The Education Program is an educational outreach program of the Lawrence Livermore National Laboratory. The Laboratory is managed by the University of California, under contract to the United States Department of Energy.

project

Point Systems to Portfolios: Assessment in Today's Multimedia Classroom

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Key words: portfolios, multimedia, assessment

Abstract

There are hundreds of new multimedia products. Although many hours are spent on developing exciting new learning environments, parents, teachers, administrators, and students are still asking old questions such as "What did Susie score on the exam?", "Will I get credit for this?", "But how will they do well on the standardized test?" This session focuses on old as well as emerging questions and concerns about student assessment. It provides suggestions for evaluating single projects and units, as well as more global options for assessment. The unique concerns when dealing with multimedia environments and higher-order thinking skills will also be addressed. The session will provide examples of alternative assessments with specific multimedia projects.

project

Observing Young Children in a New Animation Environment

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Key words: young children, animation, interactions, imaginary play

Abstract

When young children engage in imaginary play, they are building on their cognitive, emotional, and cooperative skills. Our challenge was to build an animation environment to foster children's imaginary play. At various stages in its development, we observed young children (ages 4 to 7) as they played with this electronic play environment.

This environment differs from animation programs in that it is based on "real-time" animation rather than the "filmmaking metaphor." The characters start with a simple click, no frame by frame placement. Children can change a character's animation "on the fly" by placing behavior objects in its path. When the character goes over the object, it performs that new behavior. Children can also change a character's behavior more immediately, by clicking directly on the character with a behavior object. In addition, the children can control the character's path and its interactions with other characters. The overall effect is to generate an ever-changing, life-like imaginary playground rather than a specific result.

Shaping interactions in this animated world is a new construction tool for young children. Our observations and discussions with the children helped give us insight about how children manage a "live" environment. The following are some of our observations.

Children easily integrated cause and effect relationships, and could use them effectively. For example, a banana peel representing the "fall down" behavior was used repeatedly. A mood changer "happy or angry" also was used often. There was a difference between the mood changer and the banana peel. The mood changer had an immediate effect on the character's behavior, but it also continued to effect its interaction with other characters. The children did not see any relationship between this indirect effect and interactions. We subsequently simplified interactions between characters.

Behavior objects that children preferred were not always those preferred by adults. For example, children loved magnifying and shrinking the animated characters out of proportion. In an early field test, we thought this was a result of the rela-

tively small size of the characters. We doubled the original size in a later field test, and the children still loved magnifying out of proportion, and shrinking so they could barely see the characters, creating "ants."

Children ignored, or seldom used, behavior objects with no obvious and immediate effect. In addition, they enjoyed behavior that had no connection to the real world. For example, they liked seeing people walking in the sky. But they quickly grasped which things were meaningful and treated them logically. Thus, if there was a chair in the scene, they wanted the character to sit down. If there was an open door, they wanted to character to go in. If a character could fly, they put them in the sky.

The children's feedback helped us tailor the design of the interface and icons to this age group. Discussion will focus on the individual differences in learning styles, approaches to problem solving, and the children's perception of their creations.

project

A Longitudinal Investigation of ESL Acquisition in Native American Adolescents Using Computer-assisted Instruction

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Key words: language arts, special populations, Native American, ESL, computer-assisted instruction (CAI)

Abstract

English language acquisition problems for Native Americans are well-documented. These problems are especially acute for adolescents who are at-risk. Historically, the most successful language acquisition programs have been those that featured one-on-one tutoring. Unfortunately, the growing number of Native Americans needing such services has far outnumbered the available tutors. Consequently, technology has been viewed as an option for these services. Recognizing this, in 1990, the State of Arizona established 24 computer-assisted-instruction (CAI) labs with the Principles of Alphabetic Literacy (PALS) technologies–all of which serve Native Americans. As one would expect, such a large-scale intervention model invites many questions. For example, How effective are these services? Who benefits the most from the services and who benefits the least? Under what conditions are the services beneficial? To answer these and many more questions, a large scale investigation (N=250) was completed for the years 1990–1994. It focused on Native American adolescents who participated in CAI for ESL acquisition in the Arizona PALS labs. Of specific concern to the investigation were: reading achievement (comprehension, phonetic analysis), gender, schooling, referring agency, completion rates, and total hours of participation.

The Stanford Diagnostic Reading Test (SDRT, The Psychological Association, 1988) was selected by the Arizona Supreme Court as the standard assessment instrument for the Native American adolescents in the PALS labs. Two scores from the Stanford Diagnostic Reading Test (Form G for the pretest, and Form H for the posttest) were collected. Raw scores of reading comprehension and phonetic analysis were for adolescents. Only these two subtests were selected by Arizona Supreme Court for use.

This investigation has resulted in ten major findings.

1. Most adolescents who are enrolled in the PALS program successfully complete the program. Over seventy percent of the odolescents studied successfully completed the program.

2. The largest percentage of referrals for adolescents are from schools.

3. Overall, adolescents averaged ten percent gains for both reading comprehension and phonetic analysis for an average of one hundred twenty hours of participation.

4. Referral agency was the predominant factor in respect to performance gains on the reading comprehension and phonetic analysis subtests of the SDRT. Self-referred adolescents had the highest gain scores, followed by school-referred then court-referred adolescents. Self-referred adolescents also tended to take less time to complete the PALS program than both school-referred and court-referred adolescents.

5. No gender bias was found in the gain scores for Native American adolescents.

6. High school adolescents had similar gain scores to junior high adolescents. No relationship was found between the grade level and entrance scores on reading comprehension and phonetic analysis.
7. The Total Hours of Participation did not influence the average gain scores for adolescents. However, higher entrance scores for reading comprehension were found to be related to longer hours of participation.
8. Those adolescents with the most to gain (i.e., the lowest entrance scores) tended to have the largest average gains on reading comprehension.
9. Older adolescents tended to take more time than average to complete the PALS program. The age of the adolescents, however, was not found to be related to their entrance scores.
10. Finally, an unexpected relationship between vocational school and the participants in the PALS program became apparent. This relationship indicates that Native American adolescents in vocational school: (a) tend to be older, (b) tend to be in higher grades, (c) take longer to complete the program, and (d) are more likely to be school-referred, or court-referred.

project

Designing Students Oriented Technology-based Learning Environments for ESL Students: A Focus on Haitian Students

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Key words: educational technology, learning environments, language, Haitians, students, ESL/bilingual, video

Abstract

The Telecommunications, Education, Career enHancement Project (Project TECH) was created by the Center for Urban Youth and Technology under the auspices of the Institute for Urban and Minority Education at Teachers College, Columbia University. Project TECH is a student oriented learning environment with a specific foc on English as a Second Language students from Haiti. This is a discussion of the program and research involved in creating and implementing these programs.

Introduction

While the debate on multicultural education lingers in the area of curricula and public school policies, inner city public schools continue to be flooded by many immigrant children, seeking knowledge and opportunities that will allow them to participate actively in impact on the way people organize their thoughts and interact with one another (Wagner 1992; Mehan 1989; Higgins 1988), the learning needs of immigrant children cannot be adequately met, through learning English-as-a-Second Language (ESL). However the combination of innovative educational practices that can guarantee their academic success and achievements in the Information Age must also be taken into consideration. Whether these children are enrolled in English Immersion programs, Maintenance Bilingual programs or others, the fundamental question is: With the increasing demands for different kinds of job skills, how well are minority children being prepared and equipped to compete in the 21st Century? The problem is that many ESL and bilingual programs continue to follow traditional curricula that don't reflect the learning needs of immigrant children and the expectations that society has of these children. Steps must be taken to solve this problem through innovative educational programs.

Background

Creating student oriented technology-based learning environments has been a goal of the Institute for Urban and Minority Education (IUME) at Teachers College, Columbia University since the early 1980's. In the early to mid 1980's several programs were funded to have technology based programs developed for urban youth. Creating these programs with a focus on the student, their needs, their concerns, and their goals, was an important aspect of the programs. The program development had to respond to the technology, the population of the students, their culture, and their language.

The importance of developing these concepts and concerns evolved during a collaborative effort between Brandies High School, Boys of Yesteryear, Inc. (BOYS), and Institute for Urban and Minority Education (IUME), Teachers College, Columbia University. The TCCDP, was requested to work with a large Haitian High School student population. We recruited 25 students for the seven month (October '87–May '88) program.[2] A Haitian stu 'ent from Brandeis was hired to serve as an interpreter for the students. Teachers received ESL and Bilingual training to unders..nd the needs of this population. Haitian students were introduced to the program and asked if they wanted to join. Parents were also contacted and informed about the program and what was expected of their children.

Haitian students found the program very interesting because it provided them with an opportunity to practice their English on video and have it played back to them for corrections and clarification. They used the computer to learn how to type and write in English. They produced a newsletter in Creole and English for their parents and friends to show them the type of work that went on at TCCDP. The educational effort was on basic skills development and allowed them to create video and written productions.

In 1991, IUME formed the Center for Urban Youth and Technology (CUYT), which housed the Telecommunications, Education, Career enHancement Project (Project Tech). Community Board #9 in Harlem, New York requested that CUYT develop an educational program, to focus on the needs of their large Haitian middle school student population in the Harlem area.

Project Tech

Project TECH is an after-school program at Teachers College designed to respond to some of the educational needs of linguistically disadvantaged children, before they become potential drop-outs at the High School level. Participants in Project TECH are provided with many opportunities to take active part in a wide range of activities. The majority of the participants are young Haitian Bilingual students in grades 7 to 9 from Intermediate School 43 in West Harlem. They are almost evenly distributed with a fairly equal number of girls and boys. Their skills in English, photography, videotaping, graphic art, print media and sound are combined under the control of computers to enhance teaching and learning.

The program operates from Monday to Thursday between the hours of 3:00 p.m. to 5:00 p.m. The participants learn to use Mac and IBM computers, CD-ROM, CD players, laser printers, scanners, and various software programs. Some of the software packages are designed to teach ESL, math, and problem-solving skills. The students create newsletters, video tapes, *HyperCard* stacks, and correspond with other students in Gambia, West Africa.

Conclusions

To paraphrase McLuhan (in Bowman 1991; p. 10), today's world is a "Global Village" where people are linked together by electronic technology. The concept of an "electronic village" is no longer a dream, especially when communication through electronic mail and fax machines becomes as ordinary as the use of the telephone, and when there is an Information Super Highway in the making. It is hoped that immigrant children will be equipped to take advantage of the Information Super Highway and other communication networks, that have already begun to have an impact on their lives.

Student oriented learning environments must be planned and designed with the needs of the students as the central theme. Using the technology has provided tools that youth are familiar and comfortable with. The technology excites them. It provides them with new ways of accessing information, discussing ideas, working as a team, and problem solving in a non-threatening environment.

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project

An Instructional Design for ESL Course in the Intensive English Communication Program at Penn State University

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Key words: instructional design, ESL, instructional technology

Abstract

This project is an instructional design for ESL learning in the Intensive English Communication Program at Penn State University. The purpose of this project is to provide an environment that facilitates learning in a more effective manner through the systematic arrangement of the instructional events and the appropriate utilization of instructional technology.

This project has three components: (1) video program--"What's In The News" (2) In-class activities. (3) Supplementary courseware. Following are the short descriptions of each of these.

1. "What's in the News" is an award-winning weekly 15-minutes television series that present current events and topical issues to students in the 4th through 6th grades. It is produced by WPSX-TV in conjunction with Penn State's College of Education. This video program has been singled out for excellence by the Public Broadcasting System, the Central Education Network, Action for Children's Television, and the National Council for Social Studies. Due to the strong informative nature of this video material and its clear presentation along with comprehensible vocabulary, "What's in the News" shows a great potential for use in a pre-academic learning institute like IECP, where students are preparing their English competence and knowledge of U.S. culture before they enter the full-time academic learning situation (college or graduate school) in the United States. The merits of using this program as an instructional material for ESL pre-academic adult learners are:
   A. The updated information perfectly meets the students' needs for understanding the culture and current society of the United States.
   B. Teachers may change either original presentation speed or the adjusted presentation speed, whichever is appropriate for intermediate ESL learners.
   C. Diverse topics allow teachers to choose the ones that most interest their audience. It is easy to generate discussion and involve all students by eliciting different perspectives on one single issue.
   D. The news format of this program make it ideal for academic presentation in terms of appropriate presentation manner and formal verbal expression.
   E. A news column accompanies each video program. The news column, together with the video program, provide a inspiring context in which students can learn and use English meaningfully.
2. In-class activities are anchored to, and elaborate on, the content of the video component. The in-class activities component incorporates a reported successful instructional method-- cognitive apprenticeship, which involves modeling, scaffolding, coaching , fading, articulation, reflection, and exploration. In addition, emphasis is given to the emotional issues as well as cognitive issues. Teacher guides and supplementary material are available.
3. Supplementary courseware–Hypertext Interactive CD-ROM provides availability of in-time assistance on a personalized basis, ample practice, and easy access for extra information. The resource part of this courseware includes a vocabulary bank, collection of idioms, grammar and sentence patterns, phonetic rules and demonstration. The practice part of this courseware lends itself to four kinds of skills–reading, listening, pronunciation, and writing. Students have easy access for in-time assistance through different paths. Throughout the whole courseware, four kinds of notebooks are available: a notebook for the students to write about what they have learned; another to record their difficulties; a third, to list their strategies for dealing with difficulties; and a notebook they can use to gather the information extracted from the resource part. By using notebooks, students are prompted to use metacognition to monitor their own learning process and make decisions about choosing appropriate learning strategies. In addition, this device is helpful for teachers' assessment and diagnosis of students' progresses and needs.

This pilot project demonstrates the importance of instructional design in teaching English as a second language. It incorporates multiple forms of media that motivate students and enrich the learning environment; it provides individualized support and extended practice opportunities. As an optimal endeavor, it helps students become better learners.

project

Making Connections: Using Information Technology as a Vehicle for Restructuring Curricula

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Key words: educational partnership, computer applications, performance-based objectives, multimedia presentation

Abstract

Newly established Pennsylvania Outcome Based Education guidelines mandate that high school seniors be required to demonstrate competency in a range of areas including technology, critical thinking and communications. To meet this challenge, an interdisciplinary team of university professors and high school teachers worked collaboratively to design and implement an outcome based Senior Capstone Project that would afford students the opportunity to develop and demonstrate the outcomes required by the state. The project, which involved high school seniors in the research and development of a multimedia presentation of the history of the school and its historical relationship to world events, developed a range of competencies and restructured the roles of both teachers and students. It also afforded rural secondary teachers the opportunity to explore new methodologies across and within disciplines and to use information technologies as a vehicle for restructuring Social Studies and English curricula. It enabled students to develop knowledge of and an appreciation for the interconnectedness of disciplines along with the necessary research and technological skills to prepare them for today's world.

The optimal outcome of the project was the development and implementation of an instructional model using technology to redefine the traditional roles of teachers and students as active partners in the learning process. Believing that technology was the key component in fostering this change in the traditional roles of teachers and students, an interdisciplinary team of high school teachers requested assistance from members of the university community in the accomplishment of their goal.

Project Objectives

College professors with expertise in historical research, pedagogy and computer applications assisted secondary teachers in expanding the high school curricula and in assuming new roles as classroom facilitators. The secondary faculty met as an interdisciplinary team to define project goals:

A. Skills

1. To use technology to collect, analyze, organize, evaluate, and communicate information and ideas.
2. To develop analytical skills by practicing problem solving and decision making
3. To develop interpersonal skills through training in interviewing techniques and oral presentation
4. To develop communication skills through writing and editing a documentary
5. To develop historical research skills by gathering data about the school's history and integrating it into the context of national history.

B. Attitudes

1. To develop self-esteem through exploration of the students' own school history.
2. To develop respect for the dignity, worth, contributions and rights of others as they work cooperatively with team members, faculty and members of the community.
3. To acquire an appreciation for the interconnectedness of disciplines.

College teachers, in turn, established their own project goals:

a. A closer professional relationship with the local school district.
b. An opportunity for preservice education majors to experience the relationship between learning theories and current classroom practices.
c. Additional early field experiences for secondary education majors.

The Senior Capstone Project

High school seniors, working in teams of four, are conducting in-depth research of the history of their school, exploring such areas as community and school demographics, extra curricular activities, curriculum, teacher qualifications and expectations, and career patterns. Working with members of the community (e.g. retired teachers, former graduates, former administrators and school board members, and long-time residents), the seniors are gaining a greater understanding of primary research and an appreciation for their school and community. Using high school records, university and community libraries, the historical society, yearbooks, community and school newspapers, CD-ROM, network services and personal interviews, students are gathering data on their selected subject. Student journals documenting their progress are also being kept. Video interviews, photographs and other memorabilia, collected by the students are being incorporated into their group projects. Each group is responsible for synthesizing, organizing and presenting their data in a written report at the conclusion of the first semester.

University students are also benefiting from the partnership. Students presently enrolled in English and Social Studies methods courses serve as leaders for the teams of high school seniors, thus experiencing the relationship between learning theories and current classroom practices. English majors read and comment on weekly journal entries and group reports; Social Studies majors assist students with the locating, collecting, organizing and presenting of data. Computer students assist in the high school computer lab and provide additional training.

During the second semester, students will combine their group efforts and produce a journal, hypermedia presentation, and a permanent display of the memorabilia collected during the project. This will be their legacy to the school. The Senior Capstone Project has forged connections; information technology has served as a vehicle for restructuring curriculum which, in turn, has restructured the roles of both teachers and students.

project

Using Electronic Research Tools: Practical Lesson Plans for High School Teachers

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Key words: resource-based learning, electronic research, information literacy, teacher education, ready-to-use lessons, lifelong learning, library-skills instruction

Information literacy exists in high schools where the teachers are comfortable with, and committed to, active learning. Today's learners must be able to locate information from electronic as well as from print sources. In our information-rich culture, modern technology affords new ways of accessing data. Active learners who can discover, select, and use information in all of its forms in purposeful, independent research have learned how to learn: they will be lifelong learners. After they leave high school, these individuals will continue to find the information needed to make decisions, solve problems, and perform tasks.

One way to develop information-literate high school students is to encourage resource-based learning, that is, learning that actively engages students in using various electronic and print resources to acquire knowledge. High school teachers who are convinced of the value of resource-based learning go beyond basic library skills instruction to incorporate different research activities into regular classroom lessons as an integral part of learning.

In our presentation we demonstrate activities developed by a high school librarian and classroom teachers that require students to handle information meaningfully. Students are actively involved in the process of identifying the kind of information they need to address a problem, locating and accessing the information, analyzing and evaluating the content, deciding how to organize and use the information, and effectively communicating the outcome. Our presentation includes examples of the types of lessons that result from this resource-based approach to learning. Our proven classroom activities involve students in the use of library resources, electronic and print, as a part of instruction in various subject areas. Our lessons cover all areas of the traditional high school curriculum and involve word processing, databases, telecommunications, and hypermedia; some plans are appropriate for interdisciplinary instruction.

Each of our teacher-tested, practical, ready-to-use lessons for teaching information-handling skills to secondary students begins with information for the instructor identifying the subject area and specific topic for which the lesson was designed, strategies for presenting the lesson, electronic and print resources needed, the intended outcome of the lesson, and alternate lesson ideas. Each plan includes a comprehensive handout for students. We share sample plans with conference participants and provide a model for developing other resource-based learning activities.

project

Using World Wide Web Servers in Support of Social Studies and Art Curricula

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Key words: social studies, art, Internet, web, Erie Canal, K–12, ceramics

Abstract

Introduction

During the 1994–95 school year, the Central New York Regional Information Center (CNYRIC) at the Onondaga/Cortland/Madison Board of Cooperative Educational Services in Syracuse, New York has been working to support local K–12 school districts in the creation of hypermedia-based dissemination models for local cultural materials. These models have led to the creation of two World Wide Web servers.

It is the goal of each project to create a "community" based upon the Internet, a community that is involved with learning, with the creation of materials in all modalities, and with a mechanism for disseminating the most unique and interesting cultural resources of that community. One way to define the virtual community is by looking to our schools as indicators of where that community resides in reality, and then connecting cultural resources to th e schools.

Two local Syracuse City-based cultural institutions, the Erie Canal Museum and the Everson Museum, have shared pertinent holdings as part of the project. Also, some materials that support both art and history were supplied by the New York State Historical Association. The shared materials comprised unique visual and textual materials that are supportive of curricular goals in elementary State history studies and secondary art studies. As a result, personnel at the CNYRIC have worked to create two World Wide Web servers to contain and disseminate these materials for educational purposes.

The first World Wide Web server, housed at the CNYRIC, is often referred to as the "Erie Canal Project," though its scope is larger. (Address: HTTP://WWW.CNYRIC.ORG)

The second World Wide Web server, housed at the Fayetteville Manlius High School, is referred to as the "Art Server." (Address: HTTP://WWW.FMHS.CNYRIC.ORG)

The Erie Canal Project

The Erie Canal Project is an offshoot of an earlier attempt to create a laserdisc containing black and white photos taken on and around Syracuse and the Erie Canal from the 1860s until the 1950s and collected by the Erie Canal Museum. These photos relate to social studies curricula in grades 4 and 7 in New York. During these grades, students study their communities, both past and present.

Working with a recently retired curriculum designer, CNYRIC personnel gained permission from the Museum's acting Director to digitize the complete photo collection. Jacques Monica, the Project Manager for the Center for Educational Multimedia housed at the CNYRIC, taught 15 teachers to place the images in digital formats using 1600 dpi scanners and several formats for large and small storage requirements. Each teacher worked for 30-plus volunteer hours and received extensive instruction and experience with the scanners and *Adobe PhotoShop*. All the images were then indexed using *FoxPro* and tagged with key words organized by topics relating to the curricular activities. The resulting image collection is awaiting final copyright approval, with the plan to place them in searchable context within the Web server and upon a CD-ROM disk master.

The server also contains a section with present day photography of another working Canal project, the Chittenango Landing. This is an archaeological site that was once a drydock along the Canal. Text and digital photos taken onsite describe the life of workers upon the canal and at this site.

The Art Server

The Art Server is a result of ongoing work by Bob vonHunke, the director of the Fayetteville-Manlius CSD art program. Working with staff from the CNYRIC and the Center for Educational Multimedia, Bob had been digitizing a large number of pictures of ceramic pieces housed at the Everson Museum in downtown Syracuse, New York in order to create a CD-ROM for the museum. He had, simultaneously, been providing instruction to high school students using an art curriculum stack on a Macintosh Appletalk network. Staff at the CNYRIC suggested to Bob that he and his students attempt to disseminate his the students' work to a larger audience via a World Wide Web server.

The server was placed online with materials ported from the CD in progress. The school staff and students hope to incorporate biographies of famous ceramicists (language arts), the study of glazes (chemistry), and accesses to art objects in European institutions (Foreign Language) among other subjects.

These two projects, only the beginnings of numerous school-based projects in New York State, are designed to combine three elements using a constructivist philosophy: multimedia training, multimedia production, and telecommunications dissemination. It is in these elements, placed in the hands of our educators, children, and cultural/museum staff, that we will create a sense of "community" and place that "community" upon the Internet.

project
Learning New Things in New Ways with a Computational Medium: A Report on the Boxer Project

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Key words: Boxer, computational media, component-based computing, science education, mathematics education

Boxer is a programming language and encompassing environment aimed at accommodating students, teachers, and materials developers with a broadly useful, flexible, easy-to-understand, and completely integrated set of resources. Our special concern is to ensure that everyone using Boxer, especially students and teachers, is fully enfranchised, not only to modify and combine materials supplied by others, but also to creatively build from scratch small or large interactive constructions that they find personally meaningful.

Boxer is, we believe, the first workable example of a "computational medium." That is, it is aimed at being a universal environment that many people will find constantly useful for many different activities. Boxer includes well-developed capabilities for: (1) text and hypertext processing, (2) dynamic and interactive graphics (including video), (3) handling complex data (e.g., database capabilities), and, fundamentally, (4) programming. Our model of the use of computational media like Boxer is at the basis a new literacy—like conventional textual literacy, but with a dramatically enhanced dynamic and interactive capability. Unlike many other media models, we presume "writing" is as important as "reading," and we feel it is indispensable that users can construct and reconstruct the medium, as well as use what others have constructed for them.

Work on Boxer began about a dozen years ago at M.I.T. and has continued since 1985 at U.C. Berkeley. We have taught many experimental classes, from elementary through high school, in subjects including mathematics, physics, and biology. Now that Boxer is available on microcomputers we would like to bring the theory and practice behind a "computational medium" like Boxer to a broader audience, which is the intent of this project report. We will describe the theory behind, and work with Boxer in three categories.

1) **Technical aspects.**

The complete integration of programming into the working environment means that creating from scratch and modifying are as natural as using supplied applications. This, and other aspects of the system, also mean that programming is both easier to learn and almost indistinguishable from just "using the system." We contrast this with problems in modifying and extending conventional applications. Boxer is a well-developed example of component-oriented software, as represented in OpenDoc and related advancements. Independent pieces and capabilities (a graphing tool, a hypertext notebook, a data acquisition module, etc.) are easy to develop, easy to combine and interconnect, and easy to inspect and modify.

2) **Psychological aspects.** We have taught, for example, physics to sixth graders and high school students using programming as a replacement for algebra. Instead of learning that D = VT, students learn programming models for fundamental concepts. This has some important implications in terms of motivation and student engagement. Students can make interesting things with the knowledge they acquire, instead of just solving problems. But replacing algebra with programming also raises deep issues about whether this can really count as "learning physics."

3) **The view from the classroom**. A collaborating school is trying to integrate Boxer systematically into its curricula, especially in mathematics. One of the novel Boxer constructions to come out of this work is a "class book" from a course on infinity. The book contains all of the instructor's developed materials, comments on how the course was run and how it worked, and the final projects of all the students. This is an excellent model for curriculum dissemination since all of the materials included in the book are "runnable." More generally, this school is developing a set of math tools that will be the basis of a substantial portion of their mathematics instruction.

For a bibliography or individual research papers on Boxer, contact:
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1 These included the Telecommunications Career Development Program (TCCDP), and the Woman's Educational Equity Act (WEEA) project.

2 This Haitian group represented half of the total program population. The whole group comprised of Afro-American, Hispanic, Haitian, and Chinese students.

classroom demonstration
Using the Computer in Speech Therapy Classes

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Key words: speech therapy, articulation, software, computer

This classroom demonstration is an overview of how computers are used in a speech therapy setting at Otis A. Mason Elementary School (grades K-5), St. Augustine, Florida.

Through the use of a computer and a LCD panel, the presenter will demonstrate specific freeware, shareware, and commercial software titles being used in speech therapy. Emphasis will be placed on how these software programs have been adapted for use with elementary students who exhibit articulation disorders. Tips will also be shared regarding the use of this software with language disordered students.

This session will demonstrate how the computer empowers students to be actively involved in creating their own classroom and homework assignments. This empowerment allows for individualization of therapy sessions and has shown an increase in the completion and return of homework, with an end result of improved speech!

Handouts of software titles as well as student examples will be provided.

classroom demonstration

Moving Forward with Educational Technology: An Instructional Program Guide Pre-K–5, Baltimore County Public Schools

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Key words: elementary, curriculum integration, performance assessment, interdisciplinary projects, multimedia

The curriculum presented in this demonstration is a product of Baltimore County's 1994 Summer Curriculum Institute. A team of elementary teachers and administrators worked to provide educational technology outcomes and program indicators for grades PreK–5. The instructional program guide was written to provide elementary school educators with the curriculum resources to effectively integrate technology into elementary school classrooms. The guide provides flexible guidelines rather than rigid prescriptions for curriculum and focuses on using the computer as an tool in all content areas rather than as a separate subject to teach. Sample assessment tasks are provided as well as ideas for instruction for each indicator. Members of the Program Guide committee will present an overview of the Program Guide and provide examples of how the technology can be used in any content area. They will present a model for integration that includes a sample assessment task and scoring tool, ideas for instruction with curricular connections, and suggested resources. The Program Guide focuses on providing students with opportunities to use technology for telecommunications, accessing and evaluating information, problem-solving activities, student projects, and multimedia productions. Examples of interdisciplinary projects in each of these areas will be presented.

classroom demonstration

Improve Your English with Mac

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Key words: EFL, language skills, Macintosh, tool, higher-intermediate

Abstract

Advanced information technology empowers effective models of teaching and learning in a classroom of non-native speakers of English. The purpose of the project "Improve Your English With Mac" is to determine ways for teaching the four

major language skills: writing, listening, speaking, and reading, in an Apple Macintosh classroom environment for high school students.

The project involves integrating the Macintosh computer and adequate software across the syllabus of a 40-hour course of the same title. The course objectives are to teach higher-intermediate students by providing:

a. An extended background in English language.
b. Access to classroom computer use.
c. Opportunities for classroom peer communication: cooperation and competition.
d. A supervised classroom learning experience.

Upon successful completion of the course, students will demonstrate a knowledge base in the following areas:

a. academic writing
b. analyzing word structure
c. letter writing in English
d. contemporary life, customs, and cultural values in the USA
e. use of the Macintosh computer in writing, listening, speaking, and reading
f. use of the Macintosh computer in testing math skills
g. listening techniques for the TOEFL and PITMAN tests
h. reading techniques for the TOEFL, SAT, ACT and PITMAN tests

The course participants are given access to a set of different types of general purpose and educational software used to develop a knowledge base in writing, listening, speaking, and reading:

a. ClarisWorks, The Writing Center, Correct Grammar (for essay and letter writing)
b. ClarisWorks (for data base creation in analyzing word structure)
c. Einstein Jr.'s Classroom, Math Blaster Mystery, American College Test, Scholastic Aptitude Test (for math skills acquisition)
d. Asterix And Son (for speaking skills)
e. Asterix And Son, Just Grandma And Me (for listening skills)
f. American College Test, Scholastic Aptitude Test, Test Of English as a Foreign Language (for testing).

The course was tested three times (during 1994 and 1995) with students who are preparing to take college tests such as TOEFL, SAT, ACT, PITMAN. It is a result of the joint efforts of Apple Computer Bulgaria, the Faculty of Mathematics and Informatics of the Sofia University St. Climent Ohridsky, and the American Center of USIS in Sofia.

When students of EFL have access to a variety of software, they begin to need non-traditional help from the teacher. This changes the process of teaching and learning in the classroom. The teacher is no longer "a walking library" or "a concise encyclopedia," but a guide and an advisor. First, the teacher draws the students' attention to the diverse potential of different pieces of software and their pragmatic application. Next, the teacher has more time to discuss individually with each student his/her opinion as presented in an essay or letter, for example. Finally, his/her comments and help meet each particular student's need for personal invasion into his/her learning sphere. In this way, the instructor encourages the student to consider his/her own specific knowledge base in his/her progress in studying English, rather than looking at the skills and knowledge of the average student in the classroom. The teacher does not prescribe in detail the activity students must carry out in order to solve the educational task, but he/she gives only the assignment and the frame (contour) of the adequate language activity and the tools for its performance. Thus, on one hand, the computer software could be regarded as a means for the student in the process of language acquisition, and, on the other hand, it is a means for the performance of the teacher's roles. This computer-assisted performance of the roles of the main areas of the teaching-learning process is an illustration of the student-centered process of education.

A Constructive Approach to Staff Development and Educational Change

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Key words: teacher development, restructuring, laptops, Logo

Abstract

Little research exists to guide staff development in schools in which every child has a notebook computer. Since 1990, I have designed and led staff development activities for twelve such Australian schools. The work focused on inspiring teachers to lead each other in the transition from traditional methodology to universal computing. This paper is intended to motivate others to replicate and expand upon the ideas discussed within.

> *"We start from the assumption that good schools are unique. In order to be good, a school has to reflect its own community. And therefore, we offer no model. There's nothing that you just "put into place," nothing to "implement." Our research suggests that you're not going to get significant, long-term reform unless you have a subtle but powerful support and collaboration among teachers, students and the families..."*
>
> Ted Sizer, *Educational Leadership* interview. February 1995.

A CASE STUDY

In 1989, Methodist Ladies' College (MLC) in Melbourne, Australia embarked on a learning adventure still unparalleled around the world. At that time the school made a commitment to personal computing, Logo, and constructionism. The governing principle was that every child in the school (grades 5-12) would own a personal notebook computer to use anywhere and across the curriculum. Their ideas and work would be stored and manipulated on their own computer. Ownership of the notebook computer would reinforce ownership of the knowledge constructed with it. The personal computer is a vehicle for building something tangible outside of your head - one of the tenets of constructionism. By 1994, 2,000 teachers and students had a personal notebook computer.

Personal computing in schools not only challenges the status quo of computers in schools, but creates profound opportunities for the teaching staff. Schools often take computers too seriously by hiring special computer teachers and scheduling times at which students may use a computer, that they trivialize their potential as personal objects to think with. Computers are ubiquitous and personal throughout society, just not in schools.

The challenge of getting 150 teachers to embrace not only the technology, but the classroom change that would accompany widespread and continuous LogoWriter use is enormous. Thus far the school's efforts have paid off in a more positive approach to the art of learning on the part of students and teachers.

A Critical Choice

The laptop initiative inspired by Liddy Nevile and MLC Principal, David Loader, was never viewed as a traditional educational research experiment where neither success or failure mattered much. Personal computing was part of the school's commitment to creating a nurturing learning culture. Steps were taken to ensure that teachers were supported in their own learning by catering to a wide range of learning styles, experiences, and interests. It was agreed that personal computing was a powerful idea more important than the computers themselves. What was done with the computers was of paramount importance. LogoWriter was MLC's primary software of choice. (MicroWorlds recently replaced LogoWriter)

Although educational change is considered to occur at a geologically slow pace, the MLC community (parents, teachers, students, administrators) has evolved impressively in just a few short years. The introduction of large numbers of personal computers has served as one catalyst for this "intellectual growth spurt." MLC teachers routinely engage each other in thoughtful discussions of learning, teaching, and the nature of school. While similar conversations undoubtedly occurred prior to the introduction of personal computing, today's discussions are enriched by personal learning experience and reflections on the learning of their students in this computer-rich environment. Traditional curricula, pedagogy, and assessment are constantly being challenged. One teacher even suggested that mathematics no longer be taught. Such an idea would have been unthinkable in a conservative church school ten years ago.

Schools routinely spend a fortune building fortresses, called computer labs complete with special furniture.[1] The personal computing experience at MLC has been different. In less than four years, 1600 children and teachers had personal computers and approximately 40 teachers in one school had made LogoWriter part of their repertoire. Given the changes, identified by the teachers themselves[21], that have accompanied classroom computer use, this initiative would have been cheap at twice the price.

Challenging Our Notions of School

The act of asking every parent to purchase a notebook computer for their child[3] was not nearly as courageous or challenging as the way in which MLC has chosen to use computers. MLC chose to guide its thinking about personal computing by the ideas of "constructionism" and by viewing the computer as "material." Constructionism is the idea of Jean Piaget and extended by Seymour Papert to mean that learning is active and occurs when an individual finds herself in a meaningful context for making connections between fragments of knowledge, the present situation, and past experiences. The person constructs her own knowledge by assembling personally significant mental models. Therefore you learn in a vibrant social context in which individuals have the opportunity to share ideas, collaborate, make things, and have meaningful experiences. After the first year of using laptops, the seventh and eighth grade humanities teachers asked for history, English, geography, and religious education to be taught in an interdisciplinary three-period block. This scheduling modification allowed for students to engage in substantive projects.

The computer as material metaphor contends that children and teachers are naturally talented at making things. The computer is seen as an intellectual laboratory and vehicle for self-expression - an integral part of the learning process. In this context, a gifted computer-using teacher is not one who can recite a reference manual, but one who can heat-up a body of content when it comes in contact with the interests and experiences of the child. This teacher recognizes when it might be appropriate to involve the computer in the learning process and allows the student to mold this personal computer space into a personal expression of the subject matter.

Staff Development

While every teacher is expected to use technology in appropriate ways, their learning styles are respected and catered for via a range of professional learning opportunities. In-classroom consultants such as myself, visiting experts, conference participation, peer collaboration, university courses, courses offered by the school's community education department, and residential whole-learning experiences all accompany the common after-school workshop. MLC recognizes two outstanding LogoWriter-using teachers by reducing their number of classes and asking them to assist other teachers in their classrooms. It is common for one teacher interested in sharing a recent insight to voluntarily offer a workshop for colleagues. Teachers have stated that sharing ideas with colleagues and the residential events have been their most rewarding staff development experiences.

Teachers at MLC were introduced to computers by being challenged to reflect on their own learning while solving problems of personal significance in the software environment, LogoWriter - the software the students would be using. I would argue that educational progress occurs when a teacher is able to see how the particular innovation benefits a group of learners. These teachers come to respect the learning processes of their students by experiencing the same sort of challenges and joy. The teacher and learner in such a culture are often one-and-the-same. Other teachers find the enthusiasm and pride of their colleagues infectious. MLC is using LogoWriter to help free the learner to express herself in unlimited ways - not bound by the limits of the curriculum or artificial (school) boundaries between subject areas.

Students at MLC have used LogoWriter across the curriculum in numerous and varied ways. A student designing a hieroglyphic word processor, a longitudinal rain data grapher, or Olympic games simulation must come in contact with many mathematical concepts including randomness, decimals, percent, sequencing, Cartesian coordinate geometry, functions, visual representations of data, linear measurement, and orientation, while focusing on a history topic. An aspect of ancient Egyptian civilization was brought to life by first drawing Egyptian urns and then designing pots that portrayed contemporary Australian life. Their teacher remarked at how traditional pencil and paper artistic skills no longer created an inequity in personal expression. A sixth grade girl was free to explore the concept of orbiting planets by designing a visual race between the planets on the screen. The more the student projects blur the distinctions between subject areas, the more the curriculum is rethought. Fantastic examples of student work abound.

STAFF DEVELOPMENT INNOVATIONS

Many schools find the task of getting a handful of teachers to use computers at even a superficial level daunting. MLC expects their teachers to not only be comfortable with thirty notebook computers in their classroom, but to participate actively in the reinvention of their school. In such progressive schools staff development is no longer a technical act of pouring information into a teacher's head or training them in a few technical skills. Staff development should help teachers fearlessly dream, explore, and invent new educational experiences for their students. Staff development experiences must embody powerful ideas and provide teachers with the opportunity to discover the learner inside and to fall in love with learning. Such a teacher will also love teaching.

I have been fortunate to use the following three staff development strategies at MLC and schools inspired by its example.

• In-classroom Collaboration

Several Australian "laptop schools" have used the in-classroom approach to staff development I developed working in the Scarsdale, NY and Wayne, NJ public schools. This collaborative form of teacher development places the "trainer" in the teacher's classroom to observe, evaluate, answer questions and model imaginative ways in which the technology may be used by the learners. The collaborative spirit and enthusiasm engendered by the "trainer" motivates the classroom teacher who feels more comfortable taking risks when a colleague is there to help. Since this professional development occurs on the teacher's turf implementation seems more viable. The fact that it occurs during school hours goes a long way towards eliminating teacher objections.

Two more unique staff development formats I developed at MLC are worthy of a more detailed discussion. Both model constructionism by providing meaningful contexts for learning, an emphasis on collaborative problem solving and personal expression, and by placing the learner (in this case teachers) at the center of their learning experiences. Each values and respects the professionalism of the teacher by acknowledging the knowledge, skills, and experience they each possess. Hopefully teachers recognize the respect afforded them so the idea that "kids know stuff" will become a basic element of their teaching.

• Residential Logo "Slumber Parties"

Without first-hand experience, constructionism, child-centered learning, and collaborative problem solving are abstract to teachers. The promise of such learning environments will never be realized. How can we expect teachers to teach in ways they never experienced as learners or were trained to employ as teachers? How could teachers create environments nurturing collaboration and construction of knowledge when the teacher has never seen such a classroom environment?

Armed with this observation I asked the school principal to organize a residential Logo "slumber party." The residential aspect of these workshops is critical to creating the desired hot house of learning. As the "Head Counselor" I was able to draw upon my own learning experiences gained from years of participation in Dan and Molly Lynn Watt's Summer Logo Institutes.

Teachers leave the pressures of school and home behind for three days to improve their computing skills in a carefully constructed environment designed to foster opportunities for peer collaboration, self expression, personal reflection and a renewed enthusiasm for learning. Most teachers believe that learning occurs best in a social context. These learner-centered "workshops" stress action, not rhetoric. The workshop leader serves as a catalyst for collaboration and creates opportunities for personal reflection and connecting such "learning stories" to teaching.

The residential experiences model constructionism by allowing teachers to learn in an environment that values collaboration between colleagues of differing backgrounds and opportunities to appreciate the learning styles of others. The emphasis is on doing. The teacher's excitement naturally leads to informal discussions of teaching and classroom transformation. These connections are powerful when they come from the teacher's own experience - much like the types of learning opportunities we desire for students.

The following is a sample schedule of the slumber party developed at MLC and replicated at several other schools.

Slumber Party Format

Project Brainstorming

Before we are even sure that every teacher can turn on the computer we ask them to identify LogoWriter projects they wish to work on for the next three days. The projects may be collaborative or personal - curriculum-related or having nothing to do with the subject they teach. This brainstorming session assures teachers that they will be able to change their minds, but stresses that they must "get busy."

First, I ask for project ideas and write them on the whiteboard. Second I ask, "Who wants to work on this project?" People may put their name next to as many projects as interest them. We then go for a snack to clear our minds and informally discuss the ideas with colleagues. After the intermission, participants realize that there are too many projects for the number of participants. They almost immediately start combining similar projects and rejecting others. I make such connections and deletions on the whiteboard. Finally, I ask for a volunteer to be the "beacon" of the group. This is the person that marks the place for the group form and has no leadership responsibilies.

Many of the projects are certain to change and people will go in and out of different groups. However, the brainstorming provides a strong springboard for getting started.

Powerful Ideas

Each day begins with a discussion of a related education issue and often a philosophical discussion. Such topics might include: The history of Logo and your role in technological innovation (what the school has already accomplished); Process approaches to learning or share a personally profound learning story. The final day's topic, "What does this have to do with school?" seeks to have teachers reflect on their recent learning experiences and make connections to their role as teachers.

Problem Solving Off the Deep End

One or two problem solving activities of a two or three hour duration are organized to demonstrate how complex open-ended problems may be solved via collaboration and the sharing of expertise. Teams of teachers may explore an experimental mathematics problem; draw a LEGO TC logo invention at random (build and program an ATM machine that dispenses $1 and $5 bills, build and program a coin operated bartender that pours drinks and only accepts quarters, design a working LEGO clock; or competitive challenges such as, build, program, and control a LEGO machine to place poker chips in the opposing team's goal in under two minutes.

These experiences often result in an awareness that not every problem has one correct answer or is even solvable. The teachers gain an appreciation for how much can be learned through such a problem solving process and how these activities usually require more than 45 minutes of class time.

Such "slumber parties" are organized on a regular basis in an attempt to enlarge the pool of teachers comfortable with similar learning philosophies. Since the primary goal of the workshop is to support a learning community, teachers and administrators are encouraged to participate in these workshops more than once. Participants in these workshops also gain appreciation for the power and expressive potential of LogoWriter. They are reminded that their colleagues are creative, imaginative learners like themselves. Math teachers are often surprised to see their English teacher counterparts explore complex mathematical relationships while math teachers explore French or geography.

This model of professional development has been replicated on several occasions at MLC and several other schools. The teachers' own assessment of learning outcomes derived at the "Logo slumber parties" makes the cost of sending fifteen teachers to the Hilton for three days inexpensive when compared with the cost of a never-ending series of two-hour after-school workshops from here to eternity.

• Build a Book Programming Residential Workshops

The teachers found that kids could go a lot with a little Logo, but expressed a need to learn more formal programming techniques. I was concerned with finding a format that would enhance the teachers' programming fluency without lecturing and traditional instructionist computer science pedagogy.

My solution to this challenge was inspired by Chip Healy's book, *Build a Book Geometry*. The book chronicles Chip's experience as a high school geometry teacher who spends the entire year encouraging his students to write their own geometry text through discovery, discussion, debate, and experimentation. The book provides an exciting model for taking what teams of students know and can articulate about a concept and then giving them challenges built upon their understanding or misunderstanding. The responses are then used to elicit a set of issues to be responded to by another team and so on. Throughout this process each team is encouraged to keep careful notes of hypotheses, process, and conclusions and to share these notes with the other teams during the process of writing the class book. I sensed that this wonderful approach to constructionism could be used to "teach" complex programming issues in two days.

Healy's ideas inspired a format that addressed the areas of confusion and needs of each teacher through collaboration, discussion, problem solving, and journal writing. Before the two-day residential workshop I asked each participant to identify three LogoWriter programming issues that they did not understand or needed clarification. I then assembled the teachers into three teams of varying ability, subject, and grade levels.

When the teachers arrived at the workshop they were placed in their groups and handed four questions to which they were asked to solve - to the best of their ability. The questions were split between ones requiring definition and others application. Care was taken to ensure that a team containing the author of a question was not given that question. Teams were allowed to trade one question each with another group if they were unable to solve a particular problem. No group did.

The three groups spent over four hours each answering the questions and explaining numerous programming (and often mathematical issues) to each other. This exercise stressed the most important component of cooperative learning, interdependence.

The teams were asked to keep careful notes of their programming processes, questions, and discoveries - in addition to answers to the problems. These collective notes would be included in the class book. A LogoWriter page containing complicated tool procedures were available. Each group eventually found ways to use some of the tools in their problem solving. They even annotated the tools for later use.

When each group had answered all four questions to their collective satisfaction, each teacher met with a member of another team and explained what each team accomplished. The peer teaching took a substnatial period of time.

Emerging questions were then explored through projects, designed by the leader, that would utilize their increasingly sophisticated skills. We were able to deal with issues of programming elegance by simplifying strategies commonly employed by teachers and students. Seemingly complex issues associated with multiple turtles, recursion, list processing global vs. local procedures, data representaion and inputs became clear.

Teams were asked every few hours to collect individual notes in a team file. Two hours at the end of the workshop were devoted to assembling each team's notes on one disk. This disk was viewed as a powerful "personal" reference source the teachers could use back in their classrooms. The amount of learning that was achieved in two days and the enthusiasm of the participants is evidence of this approach to is evidence of the efficacy to this approach to teacher development. This approach to learning, be it in a classroom or staff development workshop, is economical in both dollars and time when you consider the return on the investment. Schools routinely spend a lot more time teaching concepts in bite-size chunks while leaving real learning to chance.

SUGGESTIONS FOR SUCCESS

• **Work With the Living** Schools have limited technological and teacher development resources and they should be allocated prudently. Good teachers who have yet to recognize how computer technology may enhance their teaching are not evil. If a school focuses its energy and resources on creating a few successful models of classroom computing each year, the enthusiasm among teachers will be infectious. When fifteen teachers in a school or district joyfully use technology more teachers are likely to find a comfortable path towards implementation. The most recalcitrant of teachers will recognize that they are in the minority. A selection of models must be offered to teachers of differing backgrounds and subject areas. The school should be cautious not to create negative models of computing use.

• **Stay on Message** School administrators need to articulate (and believe) a very clear philosophy regarding how the new technology is to be used and how the culture of the school is likely to change. Communication between teachers and their administrators has to be honest, safe, and comfortable. Administrators need to constantly clarify the curricular content and traditions the school values, as well as, the outdated methodology and content that may be eliminated. Teachers need to trust their administrators to support them through these transitional periods.

• **Work On Teachers' Turf** Those responsible for staff development should be skilled in classroom implementation and work along-side the teacher in her classroom to create models of constructive computer use. It is important for teachers to see what students are capable of and this is difficult to do in brief workshop at the end of a long work day.

• **Off-site Institutes** Schools must ensure that teachers not only understand the concepts of collaborative problem solving, cooperative learning, and constructionism - they must be given the opportunity to leave behind the pressures of family and school for several days in order to actually reexperience the art of learning with their colleagues. Off-site residential "whole learning" workshops can have a profoundly positive effect on a large number of teachers in a short period of time.

• **Provide Adequate Support** Nothing dooms the use of technology in the classroom quicker than not supporting the teacher who worked hard to develop new skills. Be sure that the school does everything humanly possible to support the teacher's efforts by providing the technology requested, maintaining it, and by providing access to a working printer and a supply of blank disks.

• **Practice What You Preach** Staff development experiences should be engaging, interdisciplinary, collaborative, heterogeneous, and models of constructionist learning.

• **Share Learning Stories** Teachers should be encouraged to reflect on significant personal learning experiences from their lives and the staff development experience. They should share these experiences with their colleagues and discuss the relationship between their own learning and their classroom practices.

• **Celebrate Initiative** Teachers who have made a demonstrative commitment to educational computing should be recognized by being freed of some duties in order to assist colleagues in their classrooms, encouraged to lead workshops, and given access to additional hardware.

• **In-School Sabbaticals** Innovative teachers should be provided with the school time and resources necessary to develop curricula and conduct action research in her/his school.

• **Assist Teacher Purchases of Technology** Schools should help fund 50-80% of a teacher's purchase of a personal computer for use in school and home. This act demonstrates to teachers a shared committment to educational progress. Partial funding gives teachers the flexibility to purchase the right personal computer configuration. The school may offer an annual stipend for upgrades and peripherals.

• **Make Abundant Technology Available** A teacher in a school with hundreds of computers quickly recognizes that the school values classroom computing. Teachers become quickly frustrated by not having access to appropriate technology when and where it is needed.

• **Cast a Wide Net** No one method of staff development works for all teachers. A combination of traditional workshops, in-classroom collaborations, mentoring, conference participation, and whole learning residential workshops must be available for teachers to choose from at their own pace. Teachers should be made to feel comfortable growing at their own rate. Therefore, a variety of staff development options may need to be offered regularly.

• **Avoid Software DuJour** The people responsible for paying for school computing are made to feel guilty by the media and other administrators if they do not constantly do something "new" with their computers. Unfortunately newness is equated with lots of software. It is reckless and expensive to jump on every software bandwagon. Using narrow skill-specific software has little benefit to students and undermines staff comfort with computing. Choose an open-ended environment, such as MicroWorlds, in which students express themselves in many ways that may also converge with the curriculum.

• **Never Satisfied - Only Gratified** Staff development must always be dedicated to continuing educational excellence.

Although most US schools can dream of only a handful of computers, the reality of what is happening in schools all over Australia requires serious consideration. Professional teacher development must accept the eventuality of universal computing in order for schools to have a relevant future. If we desire to restructure schools then we must recognize that the only constant we can depend on is teachers. Our schools will only be as good as the least professional teacher. Staff development must enhance that professionalism and empower teachers to improve the lives of their students. Our children deserve no less.

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[1] Grasso, I. (1993), *Reflections of a Learning Community*. Melbourne, Australia: MLC.

[2] Each MLC teacher interested in owning a personal notebook computer receives a substantial subsidy from the school towards the purchase of a computer. The school decided against fully funding the computer for two reasons. 1) The teacher had flexibility to purchase the computer that met his/her specific needs and 2) Teachers were being asked to make a personal commitment to personal computing. Each year a $400-$700 stipend has been available to teachers interested in upgrading their hardware or purchasing peripherals.

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NOTES

classroom demonstration

A Musician's Minimalist Method of Mastering Programming

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Key words: music, workbook, Pascal, CS1

Abstract

Instructing Beginning Music Students

Every music instructor knows the value of scales and etudes–the building blocks of concertos and symphonies. But no audience expects to attend a performance based solely on scales (unless it's Vivaldi). And every music critic can discern whether the performer has progressed beyond the mechanics of music, to understanding the flow of the music.

Instructing Beginning Computer Students

Similarly, the programmer must have a thorough understanding of arrays and parameters, but must be resourceful enough to select the correct tools to accomplish the task at hand. Imitating some rudimentary programs provides the understanding. But this is a two-edged sword: providing examples sets an unalterable course for one's first years of coding. Only the innovative will be able to break the mold cast by the first experience. This is why Dijkstra claimed, "Teaching FORTRAN to an undergraduate should be a capital offense." I disagree.

Most students are content, even challenged, to learn and modify the current norms. The occasional genius (like Beethoven and Stravinsky) will break the mold, and provide new paradigms for us to imitate. When students follow the traditional classroom path, a genius who can adapt the old ways into new glories (like Bach and Mozart) will still surface occasionally.

Method book/Textbook/Workbook

Consider the 8-year-old beginning flute student. She has a flute, and a 32-page method book. This book does not contain everything she will learn over the next three months, but it provides a logical progression of skills she needs to acquire. The teacher may supplement the method book with etudes or scales, as needed by the student. After several weeks, the student completes Method Book I and moves on to Method Book II. Supplemental material may still be assigned by the teacher, and the student will eventually move on to greater accomplishments.

Now consider the 400-page textbook purchased by beginning computer students. The manuscript was written by an expert, reviewed by an expert, selected by an expert, to be used by a student. The expert understands the material, and easily assimilates the words into a well-ordered mind, which already contains the compartments needed to categorize the concepts. But the student may be struggling to erect a framework, wondering where all these words and concepts fit. Important items may be lost, because the student does not yet have the perspective to distinguish the wheat from the chaff.

A workbook for the computer student can provide this perspective. Much like the flutist's method book, the workbook provides a series of exercises that build on previous skills. At opportune times, larger assignments or projects provide a more comprehensive review, and a chance for the hot-shots to strut.

No workbook can provide all the answers. A good textbook or reference book is still needed to fill in the open spaces. However, the textbook runs the risk of being overwhelming and the User's Manual is often incomprehensible. The workbook provides concepts in manageable bites, like the flutist's method book.

When I developed my workbook, I resolved one other frustration: inadvertent omissions. Before I developed my workbook, I occasionally omitted some items during the semester. No major concepts were omitted, just the handy little tricks which a mature student could learn in minutes, given proper presentation. With my workbook, I can include those little delectables, and present them when the students are busy with the final project.

Smorgasbord & Fire

Mastering music or programming is like eating a smorgasbord–you cannot do it all at once. You cannot even view the entire range of possibilities in a single glance. Therefore, you sample representative portions.

The smorgasbord of computer skills will not be learned in a single semester. However, the one-semester course can provide a representative sampling, and open the doors for a student to continue learning.

The traditional classroom can be an effective medium for imparting knowledge. As long as the instruction connects with each student, success is possible. Short quizzes and groups projects are the easiest methods I have found for establishing student connections. Using small groups to grade the quizzes often solves problems before the problems become an impediment.

My Acerbic Teaching Philosophy

I took my years of experience teaching music, bridge, baseball and juggling, and developed unique approaches to teaching computing. I have had numerous successes and failures. Naturally, when I learn from a failure, it becomes the basis for a future success.

My most effective techniques are the tried-and-true:

- Learn the name of each student as quickly as possible.
- Follow a 15-second lecture with a 15-second quiz.
- When possible, respond to a question with a leading question.
- When possible, help the students teach each other.
- Occasionally, force the student to stretch.
- Occasionally, allow the student to feel smug.
- Cut no slack on class policies (during the first few weeks).
- Let them know failure is a certainty, if they do not produce.

Practice makes IM-perfect: Probasco's Perspective

- Practice makes permanent.
- Poor practice produces poor performance.
- Perfect practice probably produces near-perfect performance.
- Poor planning produces poor programs.
- Proper planning produces usable programs.

classroom demonstration

A COMPEL Interactive Computer Presentation of Student Solutions of a Lab Exercise in Computer Science

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Key words: multimedia, computer science, teacher education

The Intended Audience

This computer slide show was prepared for:

1) High school, junior college, and college computer science educators.
2) Educators interested in using interactive computer presentations to present and generate discussion of student work.
3) Educators interested in seeing the capabilities of COMPEL, an easy to use, yet powerful, presentation package.

The Classroom Activity

This is an interactive computer slide show written in COMPEL, a Windows multimedia presentation package from Asymetrix Corporation. The title of the slide show is "The *IsTriangle* Function: Solutions Seen in Lab". I used this slide show in an introductory computer science course to present and generate discussion of student implementations, both correct and incorrect, of a specific function that was part of a closed laboratory exercise. I provided students with audience notes, and printouts of the most important slides, so they could concentrate on and participate in the presentation without the distraction of taking notes.

The Learning Experience

My goals in preparing this computer slide show for classroom use were to:

1) Improve the students' understanding of functions and selection structures.
2) Display the wide variety of correct and creative implementations that students had produced for one specific part of the lab assignment, the *IsTriangle* function.
3) Encourage students to volunteer explanations of their successful implementations, and to offer insights into how they arrived at them.
4) Illustrate the flaws in the (anonymous) incorrect solutions.
5) Provide better students with ideas for improving their own implementations of this and other parts of the lab assignment.
6) Encourage less capable students by providing them with the implementation of one part of the lab and ideas for completing the rest of the lab.
7) Promote constructive exchanges of ideas among students on future labs.

mixed session

Initiative to Develop Education through Astronomy

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Key words: astronomy, science, middle school, CD-ROM, space telescope, HyperCard, Macintosh

Abstract

The Exploration in Education (ExInEd) program at the Space Telescope Science Institute has developed the infrastructure, technologies, and procedures to produce Electronic PictureBooks (EPB), which are educational software for the Macintosh computer. The content of EPBs is supplied by individuals and organizations in the space community. In this way, ExInEd creates opportunities for researchers to use their expertise to enhance education at all levels.

There are ten current EPB titles. According to feedback we have received, all EPBs–and particularly the successful Gems of Hubble–please a broad audience, including teachers and students. EPBs have been favorably reviewed in print.

Thousands of EPBs have been distributed free over the Internet, online services, and bulletin boards, including SpaceLink. EPBs are also distributed on media-floppy disks and CD-ROM by AURA, the non-profit Association of Universities for Research in Astronomy, Inc. Gems of Hubble has also been implemented in a touch-screen kiosk display at the Adler Planetarium and the London Museum of Science.

Electronic PictureBooks are show-and-tell "edutainment." They have a serious–but unstructured–educational purpose. Browsing their exciting images and informative captions, children and adults receive the message that science is fun, that learning is a process of exploration and discovery, and that these activities can be enjoyable and rewarding. For students, EPBs provide occasions for learning by sparking interest and curiosity. However, EPBs are potentially more useful to teachers in the structured environment of the classroom if they are customized and enhanced specifically for classroom use–a supposition we are attempting to verify in the case of Gems of Hubble.

Gems of Hubble is a *HyperCard* stack that includes 55 HST images with captions by Dr. Steven Maran. Its cards (screens) introduce, display, and explain the astronomical images, and provide navigational tools permitting the user to explore by topical area or in picture sequence. All EPBs run on any color Macintosh computer. Gems of Hubble takes up 5 MB of computer hard disk space, but compresses to half that size for electronic distribution.

To prepare Gems of Hubble for effective and appropriate classroom use in the 6th to 8th grades, we are proceeding with the development work in the following stages:

1. We are selecting which pictures and captions to keep and which to delete. Currently, some pictures are simply over the heads of students at this age, and it would be counter-productive to include them. For example, spectrograms and the caption are too difficult in concept for many middle schoolers, as they would be for many adults.
2. We are changing the content and wording of the remaining captions to be more accessible to the students. The new language is a bit less adult. Some terms would be hypertext leading to definitions or further explanations.
3. We are producing introductions for each of the categories (sub-indices), which will explain to the students what these categories are, what they are comprised of, and what is significant about them in astronomy, to bring meaning to the individual examples.
4. We are writing a list of terms for a hypertext glossary, and are composing the definitions and explanations.
5. We are writing a brief teacher's guide to the software and classroom projects and exercises, keeping in mind the standards recommended by the NSTA and AAAS for this age group. These projects will often be interdisciplinary and multidisciplinary in nature.

Our approach is based on state and national efforts to define the public school science curriculum.

panel

Microsoft State Partnerships: Innovation in Teacher Training

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Key words: teacher education, partnership, multimedia, K-12, training, curriculum

Abstract

General Information

The panel, representing state departments of education, university faculty, business partners, and school district technology trainers, will present perspectives on a State Department of Education-Microsoft Partnership which has promoted teacher technology training in over 34 states.

Microsoft State Partnerships

Microsoft is currently involved with more than 34 State Partnerships, with numerous training sites in each state. They are producing compelling software for the classroom, geared to academic settings with activity cards, posters, and teachers' manuals. Current concerns for Microsoft include equity access for children in rural areas, the need for professional development, and networking opportunities between schools.

Partnership Implementation in West Virginia

In 1992, Microsoft Corporation and the West Virginia Department of Education (WVDE) joined in a partnership to provide multimedia software and staff development to West Virginia schools. The intent is to make learning come alive, to extend the boundaries of the classroom, to provide high quality tools to teachers, and to enrich the school environment.

To participate in the partnership, the individual school sites agree to send two lead teachers to a workshop provided by the WVDE; these teachers then provide staff development for the faculty at their schools. The schools also provide the hardware and sign a licensing agreement with Microsoft Corporation.

Surveys from all participating sites in 1993-94 indicate a high correlation between participation in the partnership and the perception of enhancement at the schools. Eighty-eight percent indicated that the partnership has influenced hardware purchases and/or has resulted in enhanced school educational technology plans.

Typical School Implementation

Morgantown High School represents a typical Microsoft Partnership implementation. Following the initial training session, the two lead teachers provided training sessions at the school. Staff development days at the start of the school year and half-day sessions during the school year provide an opportunity for training. During these sessions teachers spend hands-on time using the software with guidance from the lead teachers, share ideas for classroom implementation, and begin to become comfortable with the software.

Students access the software in the classroom and library. Teachers use the software to present ideas and concepts in whole and small group presentations. The library has noted remarkable growth in student use of technology.

Partnership Implementation in Illinois

The Microsoft Corporation and the Illinois Alliance of Essential Schools, the secondary school reform initiative jointly administered by the Illinois State Board of Education and the University of Illinois, have been working together since 1992 to provide training for teachers and facilitate innovative use of technology as a vehicle for school reform.

Through an extended partnership with the Teaching Teleapprenticeships, the College of Education, and six Large Unit District Association (LUDA) districts, the Partnership is involved in Learning Loops, a means by which the preservice teachers receive training on the same software as those teachers involved in school reform, as well as those large districts involved with teacher education.

panel

Creating Multicultural, Integrated Multimedia Applications for and by Students and Teachers

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Abstract

This panel brings together educational technologists, multimedia designers, a specialist in multicultural education and school reform, and a doctoral candidate in linguistics to discuss various aspects of the design research work conducted at the Center for Urban Youth and Technology devoted to creating multicultural multimedia programs, projects and products.

Included in the discussion will be:

- The history of multicultural multimedia developments projects,
- The role of constructivism in the design of multimedia environments,
- The current state of design activity centered around issues of creating multicultural multimedia, and
- The nature of the research being done in the area of multicultural multimedia design.

We will define multicultural multimedia as it relates to alternative epistemologies and it's role in technology development and school reform. We will look at where multicultural multimedia is today and what the potential is for the future as we move toward the experimental creation of transcultural multimedia.

> "The increasingly diverse cultures in the United States are perhaps this country's greatest strength.... But our very diversity also presents one of the most important challenges to United States schools today: to educate students-especially those who have traditionally been failed by the current system-in ways that promote greater tolerance, understanding, and appreciation of the different cultures within and beyond our own "mosaic." Educators today face a redefined agenda that must address issues of race, ethnicity, culture, history, gender, and me. Welcome to the age of multicultural education." (Bruder, 1992)

Many administrators and teachers view multiculturalism as another reform movement. Projections of student populations indicate that by the year 2010, the minority student population under 18 will rise to 62.6 million or 38.2%. It is also projected that by the mid 90's one third of those entering the work force from schools will be minorities. If these indicators are true, planning must begin now to meet the changing student population that educators and businesses will encounter.

It is in this context that Ron Herring, Executive Director of Professional Development for the California International Studies Project states, "We need curriculum material to help diverse children achieve academically." Researchers Dr. Kathy Powell and Terri Meade of the Center for Children and Technology contend that "People are dying for multicultural technology applications." Ms. Meade continues, "but it not there yet."

Powell and Meade have created an extensive report to help multimedia designers think about issues from various cultural perspectives. Dr. Powell states, "For all groups, you need to know their history, culture, language, and art. It all comes down to basic respect for one another." Powell and Meade plan to release their full report in the very near future.

These are examples of the needs and concerns that revolve around multiculturalism in education and the need for technology based software that is sensitive to the student population that it will serve. Much of the multimedia software today does not reflect the multicultural demography of many of the students and teachers in the schools and homes that they will be used in.

Mr. Bruce Lincoln (moderator and panelist) will present the state of multicultural multimedia software development in education. Dr. Bowman (panelist and co-moderator) will focus on the development of alternative student centered environments and the research done by Dr. Kathy Powell and Terri Meade. Ms. Pam Crowley (panelist) will discuss her work in the area of multiculturalism and staff development in the Tri-State area of New York, New Jersey, and Connecticut. Mr. Jean Plaisir (panelist) will discuss his work creating a technology-assisted ESL program at the Center for Urban Youth and Technology, Institute for Urban and Minority Education at Teachers College, Columbia University.

It is the hope that this panel will bring educators, students, businesses, and parents together to discuss the concerns of multiculturalism and the need for multimedia software that focuses on the culture and experiences of all peoples inclusively. The panel will discuss the need for the development of software by teams of people of all ethnic backgrounds and cultures and present the skills required to create these products. Presentations and previews of new multicultural software will be part of the program.

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paper

Teaching Structural Design In Civil Engineering Technology

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Key words: structural, design, civil, technology

General

Structural Design has been taught in Civil Engineering Technology since the program was first introduced in The College of Staten Island. This course has three prerequisites: Statics, Strength of Materials, and Structural Drawings. Traditionally, this course was taught almost as two separate parts by two different professors. One instructor use to teach the Design of Steel part, while the other took charge of the Design of Reinforced Concrete part. Each instructor use to assign a term project where the students had to design two separate buildings; one in steel, and another in concrete.

In the Spring of 1994, I took the responsibility of teaching this course. The course outline, the content, and the sequence of the topics were modified in such a way to assure that the students will fully understand and be able to apply the principles of structural design. In addition, one term project that includes both steel and reinforced concrete design replaced the old procedure of assigning two separate projects. In this paper, the course outline and the term project will be described in detail. Also, the philosophy behind their contents will be analyzed, along with a discussion of the extent of success of this revision.

Introduction

Structural Design is a course taught at the end of a two-year ABET accredited program in Civil Engineering Technology. It is a four-credit course that emphasizes the analysis and design of simple concrete and steel structures. The course meets twice a week for a total of six hours. Structural Design is a comprehensive course that involves the application of all the principles of mechanics and strength of materials. The main purpose of this course is to illustrate a unified approach to the fundamentals of structural design in Civil Engineering. Practical applications are selected to provide an understanding of the philosophy behind the code provisions.

Structural analysis concepts are reviewed to the extent that they are essential for an understanding of the design and construction situations in question. Similarities of many ideas in structural design and code provisions are presented in a simplified manner. The design of structural steel and reinforced concrete structures is presented in this course according to the latest code provisions. As a practical application, a term project is assigned to demonstrate the potential of the students to fully understand and apply the code provisions.

The problem of teaching such a comprehensive course is the selection of an appropriate textbook. This course includes several topics such as strength of materials, statics, structural analysis, reinforced concrete, and steel design. Some of these topics can be found in textbooks that were previously used in other courses. This narrowed the selection to a textbook that includes both steel and concrete design and the corresponding codes. To overcome this problem, the necessary information for the course was developed by the instructor and a full set of notes was distributed to the students to let them smoothly cruise through the course contents. The design codes were made accessible to the students by having several copies available in the department/ school library for reference.

Course Outline

The course outline was carefully designed to guide the students step by step throughout the complete design of a steel/ concrete building. This will enable the students to acquire the necessary practical experience in structural engineering practice. During fourteen weeks, the time span for the course, the course outline was designed to proceed as follows:

A. Week #1

1) Place of Structural Discipline in Civil Engineering

This section provides an introduction to structural engineering. It also discusses the constraints and restrictions that control the design of any system as well as the standards that satisfy both safety and serviceability.

2) Types of Buildings and Building Codes

This section deals with the general building codes in the USA and the steel/concrete design codes. It also provides a general idea of zoning ordinances and state regulations and their influence on structural analysis and design.

3) Types of Loads and Loads Calculation

This is a vital part that includes the definition of all types of loads acting on any structural system as well as the method of their calculation. This includes the minimum design live loads and the code allowance for live load reduction along with the different types of dead loads.

B. Week #2

1) Steel/Reinforced Concrete Term Project

The term project will be discussed in details later in this paper. Generally speaking, the students will design a real-life building including both superstructure and foundation. At this point, the instructor will review all principles for structural drawings. The students will then start drafting all framing plans and calculating all columns loads based on the information given in the previous week. Using a simple type of foundation, the isolated footings, the students will be able to draw the foundation plan showing all the necessary information including footing sizes.

The students will spend about four weeks to finish up all these tasks. During this period, the instructor will be reviewing the principles of statics and strength of materials and will answer all questions related to the project.

C. Week #3

1) Fundamentals of Mechanics of Materials

In this section a general review of the principles of statics will be emphasized. This will include the definition of all types of forces and moments, the classification of all types of supports, the study of the free bodies of forces, and the principles of internal/external equilibrium. The students should be capable at this stage to apprehend the philosophy of the normal force, the shear force, and the bending moment diagrams along with their applications.

D. Week #4

1) Geometric Properties of Sections

This section provides a general review of the properties of sections. This includes the centroid and the moment of inertia of composite sections, the radius of gyration of sections, the statical moment of areas, and the torsional constant of sections. This information is essential for the introduction to the principles of strength of materials.

E. Week #5

1) Structural Behavior of Members Under The Effect of Loads

This section provides information about the different types of stresses including axial stresses, shear stresses due to shear forces/torsional moments, bending stresses, and bearing stresses. A discussion about the properties of steel and concrete and a study of their stress-strain relationships will follow.

2) Introduction to the Leading Design Codes

This section introduces the leading design codes in the USA for the steel and concrete design. By presenting the Allowable Stress Design method for steel and the Ultimate Strength Design method for concrete, the student will understand the philosophy behind both methods. This will enable the student to easily comprehend any design code as needed in the future. For instance, the timber design code follows the allowable stress design while the steel design is geared now towards the ultimate design.

F. Week #6

1) Structural Analysis of Trusses and Frames

The main purpose of this section is to introduce the types of trusses and frames used in the different types of construction. This includes a discussion of the wind and seismic frames and bracing in structural systems. The analysis of trusses will be reviewed using both methods of sections and of joints. Also, a general discussion of the analysis of frames will be considered.

2) Study of Influence Lines

This section includes the study of influence lines and their application in structural design. The influence lines of shear and bending moments in beams and those of truss members forces will be presented along with their practical use in structural design.

G. Week #7

1) Follow-Up on Term Project

At this stage the instructor should make sure that the students are on schedule and are ready to start the design stage in the following weeks. The project is periodically monitored during the last four weeks and assistance is provided as needed. The instructor will ensure that every student has completed the necessary work to start the project; framing plans should be drafted, column loads calculated, and all beams critical shears and moments calculated. Sections and details will be provided to assist the students to finish up their work.

H. Week #8

1) Introduction to the Design of Steel Members

This week announces the birth of the design stage of this course. Although it seems that this is a late starting point for design, I think that the revision that took place is vital and will have a great impact on the students and on the way they will perceive the code's provisions.

At first, the students will learn about the different code sections and how to search for any information in the steel manual. Then, they will get familiarized with the various steel sections, their geometric and structural properties, and their practical use in building construction. The principle of shop drawings and the sequence of all the common construction activities will be discussed. The factor of safety approach will be explained and the allowable stress design will be introduced.

I. Week #9

1) Design of Steel Axial Members

In this section the students are exposed to the design and analysis of tension and compression members as per code provisions. The design of tension members is covered based on the gross and net section area. Column tables are presented for compression members with the code provisions for the allowable stresses and slenderness consideration. At this stage, The students should be capable of designing all the steel columns and axial members in the project.

J. Week #10

1) Design of Steel Beams

At first, the criteria governing the design of beams are presented. These include bending and shear stresses and live load deflection. Moment tables will be introduced along with the allowable stresses of bending in different planes. Deflection calculations will be applied using the standard beam formulas. Unbraced beams are defined and the design requirements and approach will follow. The use of design charts and the allowable stresses of unbraced beams are presented in detail. The design of composite section beams will be introduced and demonstrated using a commercial software package.

2) Design of Beam-Columns

Code provisions are provided for the design of members subjected to both axial and bending stresses. Design equations and applications are reviewed along with the importance of their applications.

3) Design of Base Plates

This section will introduce and discuss the principle of bearing and bending of plates. This introduction will help the students to visualize the principle of bearing capacity of soils and the design of footings.

K. Week #11

1) Introduction to the Design of Reinforced Concrete Members

In this section the students are exposed to the ultimate design approach. The overload and the understrength factors are presented for the different types of loading. The principle of factor of safety is discussed and compared to that used in the working stress design.

2) Analysis of Continuous Beams

Since most of the beams in concrete structures are designed and built as continuous beams, it is necessary to introduce a simplified method for the analysis of these beams. The Three-Moment Equation is a simple tool used for this purpose. The rotation of beams is introduced along with tables that show the value of rotation for several loading cases. Examples are studied to investigate the critical values of bending moments and shear forces in continuous beams.

L. Week #12

1) Analysis of Concrete Beams

In this section, the stress distribution is studied based on the working stress and the ultimate strength design methods. The location of neutral axis in concrete sections and the principle of internal moment capacity are introduced. Code provisions for the minimum and maximum reinforcement in a section are included with a presentation of the balanced condition of concrete sections.

2) Design of Rectangular Sections

This section deals with the design of rectangular sections and includes the determination of the section's width, height, and the area of steel. Two methods are presented using a step-by-step approach by assuming two of the three design unknowns. The first method assumes the area of steel as a percentage of the maximum allowable area recommended by the code and assumes an approximate relation between the section dimensions. The second method assumes both section dimensions to calculate the area of steel required. Tables and charts are provided for the second method for different steel and concrete strength values.

3) Design of One-Way Slabs

The design of slabs proceeds exactly in the same way as per the second method shown above since the slab is designed for a unit width and its thickness is determined based on the minimum code provisions. The students are exposed to the design of continuous slabs using the moment factors provided by the codes.

M. Week #13

1) Design of T-Section Beams

This section starts with the introduction of T-sections and their similarities with rectangular sections. A step-by-step procedure is provided for the complete design and investigation of T-sections.

2) Analysis of Shear in Concrete Beams

This section includes the study of shear aspects in concrete beams. The shear resistance in concrete sections is studied according to the code provisions. Shear reinforcement requirements are determined based on the ultimate shear in beams. At this stage, the students can wrap up the design of all concrete beams and slabs in the project.

N. Week #14

1) Design of Concrete Tension Members

Although concrete does not have any capacity to carry tension loads, tension concrete members do exist. The design of tension members is provided with some practical examples.

2) Design of Concrete Columns

This section ends the design stage of the project where the students will design all the concrete columns in the project. Braced and unbraced columns will be covered in details, and the effect of slenderness will be briefly explained to introduce the design and analysis of beam-columns.

3) Design and Analysis of Beam-columns

This advanced topic is introduced to explain the effect of wind, seismic, and slabs/beams unbalanced moments on the capacity of columns. Software packages are used to fully demonstrate the analysis.

Term Project

The term project is a real-life project that was selected to include all design aspects covered in this course. The following subsections provide a complete description of the project and a precise definition of all requirements.

A. Project Description

A structure is to be built to accommodate six levels of classrooms and school facilities. The floors usage and construction are described as follows:

- The basement is a 6 inch slab on grade that will support all the mechanical equipment in the building.
- The first floor includes the lobby, cafeteria, kitchen, and all offices. The structural system is a one-way slab supported on beams and girders. The whole floor is supported on concrete columns which will pick up also the steel columns supporting the floors above.
- The second floor includes the library and computer facilities. The floor construction, which is typical for all floors above, consists of a 2-inch normal weight slab on a 3-inch 19GA metal deck.
- The third and forth floors are designated for all classrooms.
- The roof is designed as an assembly area with 2 inches Terrazo finishing. A roof slope of _"/foot is shown on plan to allow for water drainage.

A set of drawings is attached to show the architectural features and structural aspects to be considered in the structural design as explained below:

- All exterior and interior columns are allowed only on lines where walls exist. - A canopy will be provided at the main entrance and is supported by two diagonal ties at column lines C and D.

- The canopy and stair roof construction consist of a 1_ inch 20GA metal deck topped with membrane and insulation and a 2 inch layer of gravel.
- All interior partitions are 6 inch light aggregate block.
- Two cases of loading will be considered to design the canopy roof; 35 psf snow load and 25 psf upward net wind suction.

B. Project Requirements

1. Select a structural system for each floor showing the location of columns and beams along with all grid dimensions. Dimensions are given in terms of "H" and "L" whose values are different for each student.
2. Give details of all the design loads calculations. Dead loads include slab construction, floor finishing, ceiling, insulation, floor beams, and partitions. Provide a *Live Load Table* showing all live loads as per code provisions.
3. Design all steel columns using the Allowable Stress Design (ASD) Method and the tributary area method. Show all columns sizes in a *Column Schedule.*
4. Design all steel beams using the ASD Method. Do not reduce girders live loads.
5. Design the first floor slab and beams using the Ultimate Design Method. Show all reinforcement in a *Beam and Slab Schedules.*
6. Design the foundation using isolated footings resting on a soil with a minimum bearing capacity of 5 ton per square foot.
7. Give dimensioned framing plans for every floor, including the basement. Show all design information, the type of floor construction, different elevations, and strength of materials used. Consider the basement elevation at 0'-0".
8. Design a typical interior base plate.
9. Detail the following conditions using an appropriate scale:
   Typical steel column to concrete column connection
   Typical section of the foundation wall
   Typical elevation of a concrete beam at the first floor

Discussion

The course outline of any subject and the type of work assigned in that course are of great importance to its success. The extent of success of any course depends mainly on the selection of the topics that will be covered in that course as well as their sequence.

The course described in this paper, Structural Design, was designed in such a way to go smoothly through the design codes in a logical sequence while applying examples from real life practice. This course ran successfully as judged by the instructor and students. The students' overall evaluation for this course was near the 95% mark. The main reason for this success is that both the course materials and the design project went in parallel during the whole semester. In addition, the amount of work involved in this project was uniform throughout the whole semester. Also, the fact that every student had the same exact project, with different dimensions and elevations, helped to unify the type of effort involved in the project. Furthermore, open discussions and various approaches taken in the project provided the students with a great deal of information and enhanced their ability of analysis.

The use of design software was limited to particular parts of the project to allow the students to have both types of experience; the design with and without computer software. Both hand and Computer Aided Drafting (CAD) were also required. Floor plans were drafted by CAD for simplicity while sections and details were hand drafted.

paper

Mental Imagery in the Teaching of Functions

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Abstract

Functional programming is traditionally taught in a manner that discourages the use of visual intuition. This paper, in contrast, describes a curriculum that addresses the concept of higher-order functions by means of *multi-modal imagery building* We discuss the mathematical importance of higher-order functions; outline the motivation behind our curriculum; and provide a case study of a fifth-grade student learning about functional arguments.

Introduction

"In mathematics... we find two tendencies present. On the one hand, the tendency toward *abstraction* seeks to crystallize the *logical* relations inherent in the maze of material that is being studied.... On the other hand, the tendency toward *intuitive understanding* fosters a more immediate grasp of the objects one studies, a live *rapport* with them, so to speak, which stresses the concrete meaning of their relations...." [Hilbert 1932]

Historically, functional programming and higher mathematics have been characterized by an almost relentlessly textual and axiomatic style of teaching; the educational tradition for these topics is largely devoid of the rich "manipulatives" and visual images that characterize much of the most creative work in basic math education [Davidson 1977; Montessori 1956]. We would like to narrow the gap between these two educational traditions by applying the results of mental imagery research to the teaching of abstract mathematics and computer science concepts. Accordingly, we have undertaken an in-depth study of an extremely important "higher-order" concept common to both higher mathematics and computer science—namely, the idea of functional data objects.

Our curriculum is designed to facilitate learning through "multi-modal imagery building." By exposure to multiple visual and concrete representations of an abstract concept, the student is encouraged to build up an increasingly complete and accurate mental image of that "target" concept. For any particular target concept, building the imaging curriculum involves (1) researching student problem areas with the concept; (2) creating a taxonomy of those problem areas; and (3) building tools that suggest visual images aligned with the cognitive difficulties of each problem area identified.

Before providing a detailed case study of how we designed and executed a curriculum for the concept of functions as data objects, it is worth motivating our interest in this notion from both historical and pedagogical perspectives.

Numbers, Functions, and Mental Imagery

"We shall see... that the "abstraction" of the number sequence from the things counted created great difficulties for the human mind. We need only ask ourselves: how would we count if we did not possess this sequence of remarkable words, 'one,' 'two,' three,' and so on? ... [O]ne achievement of our number sequence is its independence of the things themselves. It can be used to count *anything*." [Menninger 1969]

Few would argue that students have difficulty in understanding and representing functions. Indeed, similar challenges may be identified historically in the genesis of the number system: early civilization's concept of number reappears developmentally in present-day children's initial concept of number. The central challenge, both for modern children and ancient adults, lies in separating the objective and abstract nature of number from the "thing to be counted" [Menninger 1969].

While early civilizations outgrew (and children likewise outgrow) their misconceptions of number objects, the same is not true for the "objectification" or abstraction of processes. One pertinent study indicates, intriguingly, that children exhibit a linguistic reluctance towards the symbolic recognition of "active entities": in a series of interviews with Argentinean children aged 4-6 who had not previously experienced written language, Ferreiro [1978] found that the subjects intuitively believed that nouns could be described in written words (e.g., the word "Daddy" in "Daddy kicks the ball."), but the same was not true for verbs (e.g. the word "kicks" in the same sentence).

Ferreiro's results suggest, by analogy, that students' difficulties in representing a functional object may have deep roots in the characteristic verb/noun distinctions of natural language. And indeed, contrary to the adult proficiency that eventually develops over the concept of number, the object concept of function remains even today the province of the mathematical elite. The difficulty that students experience with this notion is exacerbated by opaque mathematical notation (e.g., the "prime" notation for the differentiation operator) and is confirmed by other researchers. Harel and Dubinsky [1992] propose a cognitive model in which the "object" concept of function is the most advanced stage in the understanding of functions; Cuoco [1995] has also treated this same issue as central to the understanding of higher mathematics.

It would be reasonable, then—based on these observations—to address the cognitive difficulties surrounding the understanding of functional data objects with the same types of "imagery-enhancing" manipulatives that characterize the teaching of the number concept. Nonetheless, while there is a large and growing body of research linking mental imagery and mathematical cognition [Seron, Pesenti *et al.* 1992; Galton 1883; Hadamard 1944; Kaufmann 1990; Antonietti 1991], comparatively little of this work has concentrated on the abstract domain of functional objects. This gap is particularly troubling since abstract domains of this type are precisely those in which imagery is most urgently required for understanding, as argued by Kaufmann:

"Conditions where imagery is most readily available may not be the same as the conditions where it is most strongly needed. Imagery may be most readily available in concrete tasks, but conceivably is most highly needed in abstract task-environments."[Kaufmann 1988]

Abstracting Functions as Data Objects

"In studying the action of the Analytical Engine, we find that the peculiar and independent nature of the considerations which in all mathematical analysis belong to *operations*, as distinguished from the *objects operated upon* and from the *results* of the operations performed upon those objects, is very strikingly defined and separated."[Lovelace 1842]

The "naive ontology" reflected by the above quotation from Countess Lovelace reflects a sharp intuitive distinction between "actions" and "objects", much like the distinction exhibited by the subjects in Ferreiro's aforementioned study. Indeed, the Countess's ontology parallels—with fascinating accuracy—that of the subjects we have studied [Eisenberg *et al.* 1987; DiBiase 1994]. For these subjects, data and functions are disjoint types of things. Ideally we would like students to acquire a cognitive model in which functions and numbers are two subsets of a single class of "first class data objects", whose properties are as follows (cf. Stoy [1977]):

1.) First class objects can be named.
2.) First class objects can be passed as arguments to functions.
3.) First class objects can be returned as results of function calls.
4.) First class objects can be combined to form complex data structures.

In a study of MIT undergraduates taking an introductory Scheme course,Eisenberg *et al.* [1987] documented the difficulties that students encounter in viewing functions as data objects along these lines. For instance, more than half of the MIT students interviewed reasoned incorrectly (at least at first) about the evaluation of the following Scheme expressions:

```
(define (create-subtracter n) (lambda (x) (- x n))

(define (apply-to-5 f) (f 5))

(apply-to-5 create-subtracter)
```

These results have since been confirmed by studies conducted with University of Colorado graduates and undergraduates: over half of the 40 students responding to questionnaires showed some form of misapplication of the functional data object concept. [DiBiase 1994] More important than the fact that errors occur is the fact that they are remarkably consistent in structure; we will return to this point shortly.

Applying An Imagery-Based Curriculum to Functional Data Objects: a Case Study

As noted earlier, our curriculum is designed to encourage the development of appropriate visual imagery for the concept of functional data objects. The curriculum is a 10-20 hour program of individual instruction offered to students who have ranged in age from 9 to 15; students work in weekly 1-2 hour sessions. Structurally, the curriculum focuses on three pedagogical methods:

Re-intuition

Students explore and challenge their preconceptions about the roles that objects play using "situational world analogies" (cf. Vosniadou and Shcommer [1988]) conducted through discussion and written questionnaires.

Concretization

Students use a mixture of representations—computational (programming), written (visual representations on paper and whiteboard) and concrete (hand made objects that students can touch and manipulate) to exercise skills of "objectifying" abstract concepts (cf. [Papert 1980; Montessori 1956; March 1977]).

Contextualization

Students learn to program in SchemePaint, a graphics application employing an embedded (Scheme) functional programming environment; the environment is designed to make extensive use of rich graphical programming constructs and thus to serve as a potentially interesting venue in which to learn programming (cf. [Paivio 1988; Owen 1986]).

In the remainder of this section we provide a case study of an elementary school student who undertook this curriculum.

A Case Study

BN, a 10 year old female in fifth grade, had no prior programming experience: her previous computer experience was limited to word processing and game playing. The following discussion represents her first 5 hours of learning to program in SchemePaint. It focuses on the acquisition of the notion that functions can be arguments to other functions (Stoy's property 2)- an idea which necessitates a strong object concept of function.

We began the project by spending the first hour discussing her concept of computers and active and passive entities in the non-computational world (exercising the re-intuition methodology). She viewed the computer as both an active and passive entity (Cf. [Turkle 1984]). By discussing the characteristics of people, computers, books, tables and other objects in the world, we went on to convince ourselves that objects can be named and can have properties of an active and/or passive nature. We also discussed the mathematical concept of a variable, with which she was previously unfamiliar. The purpose of focusing on these concepts in a non-computational domain was to provide a mental framework for the computational analog (Cf.[Vosniadou and Shcommer 1988; Gentner and Stevens 1983]).

BN retained this conception of objects in the world in the next session, when we extended the notion to computational objects. She was introduced to number-objects and procedure-objects in SchemePaint, and was given an explanation of how the "Scheme-engine" (i.e. interpreter) maintains and utilizes a huge table of information about these objects. This first introduction to data objects is of a written textual nature. In Figure 1, we show two example objects in the "name/object" space as they are first seen by the student:

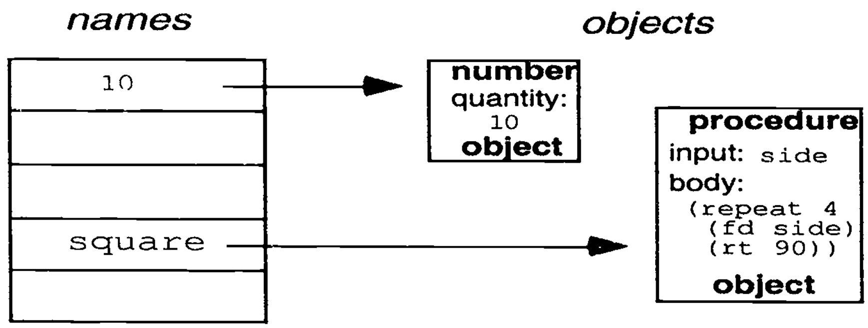

Figure 1: The name/object table

In order to elaborate the idea of how the Scheme-engine operates in the name/object space, we used concrete procedure and number objects (represented by small hand-sewn felt pillows). In virtue of their manipulability, these objects help to reify the notion that everything in the Scheme world, including procedures, have the same object-status. Further, the fact that the physical objects shared some properties (all objects are rectangular in shape and "puffy" in feel) and some different properties (color and size) helps to reify the notion that computational objects in Scheme have both shared properties (e.g. those described by Stoy, noted above) and different properties (numbers can be added, procedures can be executed, etc.).

The value of the manipulatives was clear when, during the following session, BN was asked to explain the invocation of a procedure call. Although the concrete objects were not presented for use during this latter session, BN motioned throughout her explanation as if she were holding objects in her hands. She consistently spoke about number-objects and procedure-objects as "floating around".

In the second session, BN wrote her first procedure to draw a square (thereby framing or "contextualizing" the experience within the domain of graphic arts):

```
(define (square side)
  (repeat 4
          (fd side)
          (rt 90)))
```

During the third meeting, she wrote her second procedure to make a rectangle and then, with a little mathematical assistance, a third procedure to make a hexagon:

```
(define (hexagon side)
  (repeat 6
         (fd side)
     (rt 60)))
```

Figure 2a shows the result as viewed in the graphics window.

a. b.

Figure 2:

a. The product of BN's original hexagon procedure.

b. The product of BN's revised hexagon procedure which takes a function as its argument.

During the fourth session, it was proposed to her that we might like to modify the sides of the hexagon to do other things other than just go forward. BN was shown examples of six-sided figures that had varying shapes on each side (e.g. Figure 2b. shows a hexagon-like shape in which the sides were made using a "zig" procedure rather than the "fd" procedure), and was then asked to write a procedure that could achieve this or any number of other similar effects, keeping the side length constant. She chose to write it at the dry-erase board. She worked out the problem almost entirely on her own. After five minutes of deliberating and modifying, she had correctly completed the problem. Below is a transcript of her modification process, with student-teacher interaction included:

STEP 1:

```
(define (hexagon 20)          [line 1]
        (repeat 6                  [line 2]
                (fd 20)            [line 3]
                (rt 60)))          [line 4]
```

[BN: "This isn't right. I'm just thinking"]

STEP 2: [working with line 3 for STEPS 2-4]

```
(? 20)
```

STEP 3:

```
(fd pro 20)
```

STEP 4:

```
(pro 20)
```

[At this point BN was told that she was doing well. She seemed stuck for a few minutes, and—after responding to the suggestion that she could ask for a hint—she was asked to think about how the computer would know what "pro" was.]

STEP 5: [working with line 1]

```
(define (hexagon pro 20)
```

[BN was informed that she was close, and was asked how she would use the procedure. In trying to come up with a correct invocation, she realized her mistake and completed the correct version.]

FINAL:

```
(define (hexagon pro)
        (repeat 6
                (pro 20)
                (rt 60)))
```

She was then able to explain and use the procedure correctly. Thus, after 3-4 hours of instruction on SchemePaint, BN was able to successfully and independently make use of a function as a data object without an excessive amount of mental effort.

In the last of the five sessions, BN was asked to explain the implementation details of all the procedures she had written. She was given the option to use the manipulatives to explain the invocations. She did not opt to do so, but rather motioned again as if she were holding objects. BN's explanation was correct to an adequate degree of detail, given her brief exposure to the concepts. When asked to explain using the concrete object, the explanation was again correct.

It can be concluded that BN's high-level model of procedures supports an object concept. It became clear from observing her explanations that, even in the absence of the physical objects, BN still visualized the objects very concretely as she pantomimed the physical act of gripping something. It was interesting to note that when BN was asked to write a new procedure she did not just write the Scheme code (on the board): she began by drawing a box on the board and labeling it a procedure-object (one of the other written visual representations we had discussed), then inserting the code in the box. Thus, BN had learned to work comfortably with at least two different ways of explaining the same concept, both involving some sort of object-imagery of the subject (either pictorial or physical).

Summary of Results; Future Research Directions

To date, our curriculum has been employed with ten students. Space limitations preclude the inclusion of additional case studies similar to the one above, but our observations may be summarized as follows:

a. Properties 1-3 (cf. [Stoy 1977]), represent strictly increasing levels of difficulty for students.
b. Students have trouble with anonymous objects of many types (i.e. the problem is not limited to anonymous procedural objects).
c. In trying to progress to a mental model that includes property 3, students almost uniformly mistake correct code as dysfunctional because of reports that variables are "missing" from lambda expressions.
d. Students have trouble with the lambda notation because its semantic content is obscure and suggests few fruitful analogies.

Notably, these observations apply with a high degree of consistency to all of the students that we have worked with; and they are also consistent with the informal reports provided by teachers of functional programming.

Our experience to date with an "imagery-building curriculum" for procedural objects is encouraging, and suggests a variety of fascinating questions for continuing and future research. Certainly, we would like to know whether students' correct use of procedural objects in a functional language such as Scheme can transfer to a deeper (or easier) understanding of such related abstract mathematical concepts as "function spaces". More generally we would like to extend the techniques of imagery-building to a variety of similarly abstract topics in computer science and higher mathematics—e.g., continuations, recursion, and group theory. We would hope to improve pedagogy in these topics—as in the case of higher-order functions—by starting with an identification of the problems that students have in representing abstract concepts, and proceeding to explore how those particular problems may be addressed through a rich repertoire of methods for enhancing mental imagery.

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paper

A Logic Programming Testbed for Inductive Thought and Specification

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Abstract

We describe applications of logic programming technology to the teaching of the inductive method in computer science and mathematics. Inductive inference is used in the sense of reasoning from sets of specific examples to plausible general explanations. The paper treats the feasibility of supporting inductive inference through logic programming technology, and argues that a complete logic programming system is required. We include a sample dialog, and discuss our classroom experience using the system.

Introduction

The paper describes applications of logic programming technology to the teaching of the inductive method in computer science and mathematics. Section 2 is a general discussion of the nature of inductive thought and its place in computer science and education. In Section 3 treats the feasibility of supporting inductive thought through logic programming technology, and argues that a complete logic programming system is required. Section 4 is a sample dialog illustrating the Prologb system. An overview of the Prologb language is provided in Section 5. Section 6 covers our experience using the system.

Inductive thought

The inductive method is the primary methodology of the physical sciences. The inductive method comprises two major activities. When a phenomenon is encountered, a set of particular specimens is examined, and a conjectured general pattern is formulated. The conjecture is then tested by attempting to make predictions based on it, and evaluating the reasonableness of consequences of the conjecture. If the conjecture fails any test, the conjecture is modified to encompass the new test observation. As the conjecture passes an increasing number of tests, its subjective likelihood of correctness increases. When the likelihood of correctness exceeds a certain threshold, the conjecture becomes a serious theory or model. In the physical sciences, this means that the theory is accepted, until evidence contradicting it is found, or until it is replaced by a more powerful theory that successfully explains even more observations.

Mathematics, especially higher mathematics, is often regarded as a demonstrative, rather than an inductive, science. Early in our mathematical education, we experience Euclid's axiomatic development. Geometry is presented as an exercise in pure logic, in which a small set of axioms is progressively expanded to a complete body of theory. In fact, Euclid's work was the synthesis of centuries of previous inductive, experimental geometrical discovery [2]. Polya [4] argues that the inductive method is also a vital component of modern mathematics. New conjectures are spawned by observation of specific examples, and by the mental processes of generalization, specialization, and analogy. Conjectures are then tested, resulting either in rejection of the conjectures and formation of modified conjectures, or in increasing confidence in the conjectures. In the mathematical context, the final test of a conjecture is the creation of a formal deductive proof.

Computer science is also subject to Polya's observations, because computer science is a mathematical science. Rigorous mathematical theories underlie many significant areas of computer science, such as: algorithm analysis, artificial intelligence, formal languages, graphics, language design, and database design.

With reference to "ordinary programming," there is some controversy as to the role of verification by rigorous mathematical analysis. Computer programs are typically developed through a highly inductive process of interleaved stages of design, coding, and testing. Programs are expected to always perform correctly, for all possible inputs. Since the number of possible inputs generally far exceeds the feasible number of test runs, no program's correctness can be guaranteed by testing, unless it can be argued that the chosen suite of tests will uncover all errors. At any rate, it is clear that inductive thought is prominent in programming, and that it must be supplemented, as in mathematics, by some final analytical stage.

Logic programming as a testbed for inductive thought

The ideal testbed for inductive thought would present the user with a series of specific examples. After each example, the user would have the opportunity to review the set of examples, and to form conjectures and predictions about the observed process. At any time, the user should have the ability to test any of his predictions. Finally, the user should be able to fully specify a proposed model for the process, and to observe the examples generated by her proposed model. So that many examples can be efficiently covered, the instructor should be able to quickly configure the testbed to exhibit desired behavior. Such a testbed could be used as a basis for discovery lectures, and for laboratory experiences.

A candidate for the basis for the testbed is the logic programming language Prolog. The Prolog program is a database containing logical clauses defining predicates. The Prolog system then acts as an acceptor/generator for the predicates. For example, the clauses might define the predicate orderedList(L), meaning that L is an ordered list of integers, such as [1,3,4,6]. To generate ordered lists, one gives the system the input query consisting of the predicate symbol applied to an uppercase logical variable, e.g. orderedList(X). The system then generates ordered lists one by one, as a byproduct of a theorem proving algorithm. The system can also be used as an acceptor, whereby it is given the query consisting of the predicate symbol applied to a specific object, e.g. `orderedList`([1,3,4,6]). The response to this query is "yes", or "solution found". A remarkable property of logic programming is that both behaviors, generator and acceptor, arise from one and the same logical database.

Unfortunately, the Prolog system is not adequate as a general inductive testbed. For technical reasons, Prolog uses a search strategy that is incomplete, meaning that it may fail to generate some examples, and may fail to accept certain correct examples. Correct use of Prolog system requires a certain amount of detailed knowledge of the Prolog search method. For this reason, Prolog use is generally confined to specialized courses in which the study of the search method can be justified.

We have implemented an alternative, complete, logic programming system, known as Prologb. In Prologb, all examples are generated, and all correct examples are accepted. When the system is given an incorrect example, it may reject the example or nonterminate. A theoretical result due to Church[1], stating that the general predicate calculus is algorithmically undecidable, implies that this nontermination problem is inherent in all computer-based systems that encompass predicate logic.

Using Prologb for Inductive Discovery: An Example

The following short sample dialog gives the flavor of the student interaction occurring as the system is used. In practice, more complicated situations can be explored by longer dialogs.

By running two independent copies of the acceptor/generator, the generation sequence in one window may be supplemented at will by tests in a second window.

```
1. The system asks for a query:
     Query? (or command) :

2. To generate examples, we enter
     example(X)

The successive examples generated are
     X = nil

 3. (Comment) the empty list
     X = [a]
     X = [b]

4. (Comment) all lists of length 1 or less, using objects a and b
     X = [a]     X = [a,b]    X = [b,a]    X = [b,b]

5. (Comment) all lists of length 2 or less, using objects a and b, repeats allowed
     X = [b,b,a] X = [b,b,a]  X = [a,a,a]  X = [b,a,a]  X = [a,a,b]
     X = [b,a,b] X = [a,a,    X = [b,a,a]  X = [a,b,b]  X = [b,b,b]

6. (Comment) 7 of the 8 possible lists of length three or less: missing is [a,b,a]
     X = [b,b,a,a]   X = [b,b,a,b]   X = [b,b,a,a]   X = [a,b,b,a]
     ...

7. (CONJECTURE) No list contains a,b,a as a sublist
8. Testing [b,a,b,a],
     Query? (or command) :
     example([b,a,b,a])
     no solution

9. Testing [b,b,b,a,b,b],
     Query? (or command) :
     example([b,b,b,a,b,b])
     Solution found:
```

The Prologb language

The syntax of the Prologb language is that of a subset of Prolog. For an overview, we refer to Figure 1, which contains a simple Prologb program exhibiting the behavior seen in the previous section. The program is an acceptor/generator for the set of all lists over {a,b} that do not contain the sublist [a,b,a].

```
%aba not allowed

alpha(a). alpha(b).

example([]).
example([a]).
example([b]).
example([A,B]):-alpha(A),alpha(B).

example([A,a|X] ):-example([a|X]), alpha(A).
example([b,b,a|X]):-example([b,a|X]).
example([A,b,b|X]):-example([b,b|X]),alpha(A).
```

Figure 1

The first line, starting with the symbol "%", is a comment line. The next nonblank line contains two facts stating that the symbols "a" and "b" are the two objects satisfying the predicate alpha, that is, they are the two symbols in the alphabet. The next three lines are facts stating that [],[a], and [b] satisfy the predicate example. The fourth line

example([A,B]):-alpha(A),alpha(B).

is a *rule* containing the logical connective ":-" , which means if, and, on the right hand side, the connective "," which means *and*. The identifiers starting with uppercase letters are universally quantified logical variables. Thus, the meaning of the line is "For all A and B, the list [A,B] is an example if A is in the alphabet and B is in the alphabet". The remaining rules express constraints on longer lists so that the sublist [a,b,a] may never appear. For example, the line

example([b,b,a | X]):-example([b,a | X]).

expresses the idea that any example list beginning with "b,a" may be expanded to another example list by adding a "b" at the front. Since [a,b,a] sublists are to be avoided, there is no rule permitting the addition of "a" at the front in such cases.

Experience using Prologb

We have used Prologb in several introductory and advanced mathematics and computer science courses, including Discrete Mathematics, Compilers and Interpreters, and a new course, Discrete Structures of Computer Science, which explores structural concepts in the context of exploratory declarative programming. The Discrete Structures course was one of three courses developed for a new curriculum[1] that integrates mathematics with computer science, starting with entering students' first course and laboratory experiences [5,6].

Prologb courseware has been developed in several problem domains, including formal language theory, modeling automata, semantic nets, general relations, graphs and digraphs, Peano arithmetic, and binary and modular arithmetic.

Online computer access to Prologb permits instructors to incorporate induction into classroom discussions. In general, classroom demonstrations often elicit many conjectures from the group. In the inductive context, incorrect conjectures are not "wrong answers"; they are a normal part of the inductive process. Every incorrect conjecture leads to an exploration of its consequences, and that exploration then leads to a better conjecture.

The Prologb system is also a vehicle for laboratory experiences in computer science and mathematics courses. Examination of the lab reports indicates that beginning students were able to handle simple inductive exercises, in which students are asked to enter various inputs into some prepared environment, and to then predict/explain the resulting output. In most cases, students were also able to handle programming assignments, in which the goal was the creation of a new Prologb program produce a desired result. The students were able to quickly assimilate Prologb because it is a language that simply and faithfully executes logical specifications.

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project

Knowledge Construction, Hypermedia, and Teacher Education

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Key words: hypermedia, constructivism, knowledge construction, teacher education

Abstract

Introduction

Researchers have argued that knowledge must be constructed by, not imparted upon the learner (Dede, 1992; Duffy & Jonassen, 1992; Nelson & Palumbo, 1992). In constructivism, learning is an active process in which the learner builds an internal representation of knowledge that is open to change and links. It is based on the premise that educational systems should help the learner to construct meaningful and conceptually functional representations of the external world instead of providing the educational systems' own interpretations.

Researchers also believe that computers can be used to present knowledge to students or to aid students in the construction of knowledge (Dede; Jonassen, 1993; Nelson, 1993; Nelson & Palumbo). In addition, studies illustrate how hypermedia and multimedia can be used to foster knowledge construction, logical knowledge, structural knowledge, and critical thinking (Reed & Rosenbluth, 1995; Stebbins, 1991; Thorp, 1993; Wilson, 1992).

Participants

The participants in this study consisted of 97 undergraduate students enrolled in three sections of a semester-long curriculum and instruction course at West Virginia University. Some of the subjects were omitted for certain analyses due to missing data.

Independent Variables

Three different class sections taught by the same instructor were used during this study. The first class (L/D) received normal lecture/discussion instruction on the course content. The second class (L/D plus tutorial) received lecture/discussion instruction plus a computer-based tutorial on the course content. The third class (CI) received instruction on the computer authoring program *HyperCard* and were expected to learn the content by creating a *HyperCard* stack about the course content.

Dependent Measures

Student performance was measured on two dimensions: knowledge-based performance in the form of a pretest, test and posttest measure, and knowledge maps that measured the students' representation of knowledge. The maps were scored according to the number of links and descriptive links created from one concept to another.

Procedures

Students created their pre-knowledge maps and took the pretest during the first class period, and received their specific instruction during the two weeks of the unit. At the end of the instruction, the students created their post-knowledge maps and took the test. Four weeks after the study, they took the posttest to measure retentior.

Analysis of the Data

A two-way ANOVA (instructional group x tests) with a repeated measures (tests) was performed to illustrate any differences between instructional groups and test performance. Likewise, a two-way ANOVA (instructional group x map links) was performed to illustrate differences between instructional groups and the number of pre- and post- knowledge map links. Because significant differences were found between the instructional groups on the number of pre-knowledge map descriptive links during a two-way ANOVA (instructional group x descriptive links), paired t-tests were performed on pre- and post-knowledge maps for each instructional group to determine differences in the number of descriptive links created.

Results/Interpretations

The lecture/discussion (L/D) group had the highest performance scores of the three groups. However, on the development of their knowledge maps they had significantly fewer post-links and fewer overall post-descriptive links. Although they performed well on the conventional performance tests, they did not perform as well as the other groups on the cognitive tasks involved in the creation of knowledge maps.

The lecture/discussion plus the tutorial (L/D plus tutorial) group had low, yet consistent performance scores across the three test measures. On the knowledge maps, this group had significantly more post-links than the L/D group; however, on the more demanding cognitive tasks of creating descriptive links, this group decreased from premap to postmap.

The constructivist (CI) group was the only group to increase on the retention test. Although they did not have the highest number of links, they remained consistent from premap to postmap. On the more demanding cognitive task of creating

descriptive links, this group was the only one to increase from premap to postmap.

These findings suggest that lecture/discussion instruction may promote relatively high scores on traditional performance measures. However, to promote higher performance on deeper level cognitive tasks such as knowledge map construction, utilization of hypermedia and implementation of a constructivistic approach may be more effective.

project

Marketing Your Technology Program: Planning, Positioning, and Promoting

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Key words: marketing

Abstract

Phrases like budget reduction, program elimination, reorganization, downsizing, reallocation, pink-slips, and restructuring have become part of everyday language in education. As a result, planning, positioning, and promoting you and your program has become critical for expansion and even survival in some areas of the United States.

This session could be titled "Marketing Maneuvers and Manipulation." Marketing is more than an appearance at a faculty meeting or an occasional meeting with the principal. In order to market yourself, you must market yourself and your ideas. Many technology coordinators and media specialists do not see themselves as a salesperson or promoter. However, competing for space, money, resources, means you need to plan, position, and promote. This may mean collaborating with old foes and new technology partners. This session will provide a series of suggestions for planning, positioning, and promoting you and your program.

project

Implement a Successful K-12 School District Technology Bond Project

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Key words: planning, district, K-12, fund-raising, implementation, networking

Abstract

Overview

The principal goal for this project session will be to inform a general audience of what can and what can not be done when an additional $367/student allocation is made available for the use of technology in K–12 education. Many of the practical experiences gained by the Mounds View Public Schools (a suburban Minnesota school district with 15,000 students), which implemented a successful $5 million instructional technology bond project, will be explained. Included in the session will be

comments on the district's assumptions, goals, and outcomes aimed at increasing:

1. The amount of technology available to classroom teachers.
2. Staff development and utilization related to technology.
3. Curriculum integration for technology.
4. Technology support and coordination.
5. Technology research and development.

Percentages and amounts of funds that have been available to individual school buildings, to the central office, for discretionary purchases, for hardware, and for software will be shared with the audience. A summary of the lessons learned, problems encountered, and solutions in place will also be presented. The session assumes no particular technology awareness level and is intended for education administrators, technology coordinators, students, and teachers.

Cabling and connectivity lessons

One example to be discussed will be the details as to the successful inter-cabling of every classroom in the district for file and printer sharing, single application e-mail usage, and general Internet access. Making Internet access available to all 1,500 teachers in the district was, and is, a goal. Contrary to what the general population is led to believe, fulfilling such a goal is difficult. While fantastic Internet services, such as the World Wide Web, become available to everyone, the problems of appropriate censorship of newsgroups and bulletin boards do not go away. There are solutions to these issues, but it takes risk, cooperation, and leadership to forge paths that others can follow. Lessons learned in these areas will be shared.

Specific items for sharing

Up-to-date information will be available detailing the planning assumptions and spending allocations used for Phase 1 and Phase 2 of the total bond project. This information will include a discussion of the roles for the technology staff, special interest groups, a district-wide technology committee, district administrators, and the school board of directors. The spending allocations will detail the monies planned for, and the amount actually spent for, categories such as wide-area-networking, building wiring, technology for teaching, technology for learning, district-wide site licenses, and discretionary funds for individual buildings.

Information on valuable lessons learned will be shared, including (1) working with the community's intent, (2) the changing nature of what constitutes a computing workstation (both teacher and student), and (3) the critical importance and high cost of networking. Whether to do classroom presentations via LCD panels or via the use of mounted TV monitors is an on-going issue that may not be resolved by conference time. The rationale for the decision made in Mounds View to use TV monitors will be explained.

Summary

The final results of our efforts are unknown and will not be understood for some time; however, several points are known. A major infusion of technology money into an instructional program is great, but it does not produce a permanent solution. Additional funds for capital equipment, and particularly for additional support services, must continue to be obtained for a community and district to fully utilize and benefit from their investment in technology.

project

A New Paradigm for Technology Planning: The Technology Maturity Model

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Key words: strategic planning, benchmarking, rubrics, technology integration, assessment

Abstract

Technology planning as currently practiced leaves most participants wishing for less. They wish it took less time, less energy, and fewer resources. Equally discouraging, is that those involved with technology planning hoped for more. They hoped the technology planning would produce more answers to the difficult issues that face educators.

Hopeful to capitalize upon the benefits of strong instructional technology integration, Madera Unified School District embraced a new model for technology planning in an effort to assure effective implementation. The *Technology Maturity Model©*, developed through experiences in numerous districts and implemented in Madera, provides a framework for

effective planning, implementation, and on-going assessment. Unlike most technology planning documents, this model provides strong assessment strategies and tools to support an integrated and cohesive planning and implementation effort.

The *Technology Maturity Model©* provides benchmark criteria and an assessment rubric in areas which are seen as critical through educational research. These benchmarks provide an instrument for on-going planning, assessment, and implementation. Critical to this model is not only the established equipment benchmarks, but also behavioral benchmarks providing two significant areas of concentration. These benchmarks, identified and measured through the Maturity Model rubric, provide a basis for decision-making and communication absent in most traditional planning models. With the Rubric as a foundation, also included in the model are guidelines for developing standardization, policy, assessing needs, technical support, and funding the plan.

The *Technology Maturity Model©* will be presented along with the success and failures of using this model with several California school districts. If your school or district is seeking a solid planning model for technology integration, and hope to have solid assessment designed to form the work of your school and district, this session is for you.

Documentation will be available for participants.

project
LaNIE: Louisiana Networking Infrastructure in Education

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Key Words: Internet, K–12, networking, multimedia

Abstract

Louisiana is at a pivotal junction with regard to integrating networking capabilities into the school systems. It is the only state that has received funds to implement five major programs: a Statewide Initiatives program, a Teacher Preparation Collaborative, a Curricula Frameworks Development Project (funded by the US. Department of Education), LA Goals 2000, and a National Science Foundation grant called *Integrating Educational Needs With Networking*, also known as LaNIE - Louisiana Networking Infrastructure in Education. The statewide support is evidence of the long-term commitment that institutions, agencies, and individuals within the state have made toward the reform of mathematics and science education. However, a weakness in the reform effort has been the lack of full use of technology in expanding teacher and student access through global electronic networking. Another weakness has been the lack of training in both the K–12 and post-secondary education. Completing the infrastructure and providing training are the next two major steps to getting Louisiana's educational system online. In a collaborative project, the Systemic Initiatives Program, the state department of education, and five teams including university, district and school personnel are working together to develop and pilot a statewide networking plan.

In conjunction with the LaNIE Project and the University of Southwestern Louisiana, Edgar Martin Middle School is a pilot site with an Integrated Services Digital Network (ISDN) that has been in place for the past year. The goal of the project is to "build on existing technology infrastructure demonstrating effective educational reform and deployment to wider community" by assessing the current status of the local testbed at developing a plan for expanding this model. The middle school project involves the introduction of a triad of educational media into the classroom. It involves cable television, Internet, and an in-house phone system, as well as teacher training and curriculum development.

The school is networked with ethernet connections and a media retrieval system. The teachers and students have access to the Internet as well as to videos, CNN News, and downloaded satellite programs. The library is the hub of activity relating to technology and telecommunications. Here, students have access from their classrooms to the online catalogue. They also have encyclopedias and atlases on CD-ROM. There are 16 PowerMacs in the library and the teachers can bring their students to use

the Internet for research.

With the LaNIE project, five university/district teams have been formed to develop a model(s) for a statewide telecommunications program in K–12. Each school district selected as a pilot agreed to demonstrate commitment from the K–12 administrative leadership and commit to developing a district-wide technology plan. The district also had to agree to provide release time for team members to attend meetings and ensure that school-level teams participated in the Internet course. Each district selected an elementary, middle and high school site. Each site has a team consisting of an administrator, counselor, librarian and five teachers. The university team consists of an Internet instructor, a mathematics educator, and a science educator who team-teach a course called Integrating Internet With Instruction. One of the goals of the course is to demonstrate how to use Internet resources to support standards-based, systemic reform in mathematics and science education.

An interactive collection of video, audio, and written documentation of one of the middle schools involved in the LaNIE project has been collected and produced on a CD-ROM, *Innovative Technology in Louisiana*. This will be used in the presentation of the project. Sample lesson plans developed by teachers involved in the project will also be shared.

project

Blood, Sweat, Tears and Triumphs: The Boulder Valley Internet Project after Three Years

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Key words: K–12, Internet, networking, teacher training, technology, reform

Abstract

The Boulder Valley Internet Project (BVIP) began in 1992 as a collaborative project between the University of Colorado at Boulder and the Boulder Valley School District. The project, funded by the collaborators, the NSF, the Annenberg/CPB Math and Science Project, and the US West Foundation, has as a goal the systemic use of networking in K-12 schools.

In the summer of 1992, twenty-six teachers in the district began their Internet journey. Now, several hundred teachers and several thousand students are using the network in a variety of educational (and sometimes not so "educational") ways. As a result of the project, the school district is in the process of installing T1 connections to every building. Three years of experience in the blood, sweat, tears and triumphs of Internet implementation in the K–12 arena has proved fruitful. Though relatively early in these efforts, a number of issues have emerged that appear to significantly affect the impact that electronic networks can have in reforming education and educational processes.

1. Planning and Policy

- The district level approach is proving very effective.
- There is a fundamental relationship between connectivity options, the tools they enable, and the type of curriculum that can be built on those tools.
- The true costs of networking are considerable and must be locally raised.
- The social consequences of networking have generally been positive.
- Teachers have high expectations for what this technology can bring to
- education.
- Volunteers must be managed.

2. Technology

- The definition of a basic computer must be rethought.
- For all models of physical access, having a central server is valuable.
- Conservation of interfaces is desirable but sometimes difficult.
- Dial-in access is essential.

3. Technology Management

- Central computing support is invaluable.
- Contact points in each school links the central support to the end-user.
- There are distinctive aspects to K-12 network management.
- Students can offer viable and valuable contributions to network management and support.

4. Training and Support

Note: because the majority of teachers and students in Boulder Valley currently use regular dial-up to access the

Internet, the vast majority of trainin⌐, ha⌐ been done on command-line, character based interfaces. This section is based upon that experience.

- Ongoing training and support is essential.
- Levels of connectivity and the associated tools dictate the amount of training and support required.
- District-wide training courses are very effective.
- The ideal training model is an intensive workshop followed by ongoing short sessions.
- Hands on use and thorough documentation must be part of every training model.
- Teachers can effectively train each other.
- Students as mentors and trainers.

5. Learning and Curriculum

Learning and curriculum are clearly the essence of the work of the Boulder Valley Internet Project. The technology, the training and the support mechanisms constitute the ground work that must be laid to enable teachers to focus on the application of the tool. Ultimately, we wish to look at the ways in which teachers and students can, and do, use the Internet. We have only just begun to scratch the surface of the realities and potential in this area.

Mastering the tools is challenging. Utilizing the tools is even more challenging. Teachers need support in thinking about curriculum integration. There are five general ways in which teachers use the network. These categories, generally are utiiization of resources for professional development; use of informational resources in the curriculum; using the network tools to conduct class projects; giving students access to the network as a complement to traditional research tools and using the network tools in a variety of ways to transform the curriculum. Thus far, most classroom utilization of the Internet tools and resources involves integration into existing curriculum.

- The pattern of use varies by grade level.
- The pattern of use varies by connectivity.
- Our models of learning should capitalize on the best features of the technology.
- A powerful and unique learning feature of networks is the opportunity for two way, interactive exchange of information.
- Activities should be built on the "Innernet" as well as the Internet.

6. Current Issues.

The BVSD project team, along with the National Advisory Board, has identified a number of major goals for the project. Among these goals are:

- Fostering the integration of the Internet resources into the K-12 curriculum while at the same time pushing and providing support for innovative, cutting-edge uses of the technology. We need to gain a better understanding of the best uses of the technology for rich and meaningful learning.
- Learning to use the Internet network gives students life long skills. How do we market this skill acquisition to the public?
- What is the best way to make use of the resources of the Boulder Community Network? What is the appropriate community role?
- We would like to combine our lessons learned with other districts which have deployed Internet connectivity to develop a comprehensive blue-print of issues and approaches for K-12 district wide Internet connectivity.

Dr. Ken Klingenstein and Dr. Nancy Butler Songer, both of the University of Colorado at Boulder are co-PIs on this project. Additional information about the Boulder Valley Internet Project can be obtained from the District's gopher at bvsd.k12.co.us or their world wide web home page at http://bvsd.k12.co.us. Boulder Community Network can be reached at http://bcn.boulder.co.us.

project
The "Electronic Emissary" Project: Bringing Subject Matter Experts to K-12 Classrooms via the Internet

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Key words: Internet, electronic mail, educational telecomputing, electronic mentoring

Abstract

The Electronic Emissary is an Internet-based interpersonal resource that has been online since early 1993. The Emissary is a "matching service" that helps teachers locate Internet account holders who are subject matter experts (SMEs) in different disciplines, for purposes of setting up curriculum-based, authentic educational telecomputing activities. The interaction that occurs among teachers and students face-to-face in the classroom is thereby supplemented and extended by exchanges that occur among teachers, students, and SMEs asynchronously via electronic mail. The project is supported by the Texas Center for Educational Technology (TCET), the JCPenney Foundation, and the University of Texas at Austin. Several examples of exchanges from past semesters of Emissary-arranged matches follow.

- Fifth grade students in Council, Idaho studying animal behavior received suggestions on how to improve their observation techniques from a primate ethnologist working at the Wisconsin Regional Primate Research Center.
- Ninth grade students from San Angelo, Texas corresponded with an anthropologist from Los Angeles, California about civil rights, both in current events in relationship to the first Rodney King trial (it was occurring at the time of the exchange) and historically, by examining the struggle for African American rights during the late 1950's and early 1960's, with particular emphasis upon the contributions of Dr. Martin Luther King, Jr.
- Third grade students from San Antonio, Texas communicated with a naval officer and meteorologist stationed at Fort Biloxi, Mississippi about atmospheric physics and atmospheric dynamics, even though, as the subject matter expert indicated, they probably didn't realize that their questions concerned such complex topics.
- Sixth grade students in Houston, Texas, who were engaged in multidisciplinary study of the Middle Ages, posed questions to a medieval history professor who worked at the University of Illinois, addressing her as "Learned Sage.' She, in turn, answered their questions, calling them "Seekers of Knowledge."
- Eleventh and twelfth grade students in La Crosse, Wisconsin working on labs about the scintillation of light, extinction of light, and variable stars, consulted a nearby university-based physicist, who, we soon learned, knew their teacher before the *Emissary* project "matched" the team.
- 16-to-18-year-old students from Salmon Arm, British Columbia, who were curious about virtual reality technologies, corresponded with a computer scientist working for Boeing and NASA, later commenting upon his skill in using humor and professional anecdotes to help them to understand technical information.
- Fourteen gifted high school students from Nacodoches, Texas interacted online with 14 different subject matter experts on topics of individual and mutual interest and research, including: marine biology, blues music, harmony in music, computer graphics, the Elizabethan era, biotechnics, black holes, documentary direction and production, the physics of fire-fighting, the effect of the media on public opinion, genetic engineering, the New Age movement, reincarnation, and the effect of daycare on child development.

Additional topics that were collaboratively explored via e-mail during the past three academic years include geometry, geology, human genetics, world events, colonial America, desktop publishing, evolution, rainforests, deserts, acid rain, marine toxicology, chaos theory, bacteria, sharks, skates, and rays, subatomic particles, folktales, mathematical models for ecological systems, and AIDS, to name a few. The number of teams (approximately 30, 50, and 80 during the first through third years of the project, respectively) was limited only by the support available for the project; over 200 subject matter volunteers offered their services, and more teachers requested matches than the project's facilitators could support.

Participants in the Electronic Emissary send and receive e-mail through addresses on the TCET educational research server, so that copies of all project-related messages can be retained (with participants' permission) for study by the project's coordinators. Each expert–classroom team has a unique project address on the TCET server.

Volunteers for all of the teams were solicited via announcements posted to selected LISTSERV groups (subject-specific e-mail distribution lists) and statewide or international newsgroups. At the completion of each semester's exchanges, each team is asked to write a short summary of the project's goals, procedures, outcomes, and applicable suggestions for other electronic collaborators. These summaries have been posted in the Emissary file archive, making them freely available to interested Internet users.

An interactively accessible online database has been created and tested so that "matching services" can be offered to larger numbers of classrooms as they gain access to the Internet. This database automatically accepts, sorts, and stores requests for collaboration and offers for information-sharing according to topic descriptors.

This presentation will describe the ongoing Emissary project, provide an update on matching services available, and summarize preliminary results of research on asynchronous communication among adults and children.

project

The Electronic School Overseas

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Key words: middle school, network, Macintosh, staff development

Background

The Department of Defense Dependents Schools (DoDDS) is a worldwide school system operated by the DoD in 15 foreign countries. Its mission is to provide a quality education from kindergarten through grade 12 for the eligible minor dependents of Department of Defense military and civilian personnel on official overseas assignments. Approximately 95,000 students in 103 schools and one community college are served by approximately 7,500 educators. Lester Middle School is one of two middle schools serving the dependent children of Americans stationed on the Japanese island of Okinawa. A standard stateside curriculum exists to educate the approximately 840 students currently enrolled. The physical plant is new, having been completed for the start of the 1992-1993 academic year.

In 1993, the National Defense Authorization Act provided DoDDS with development dollars to pilot programs of excellence in math, science, and computer-assisted education. Twelve projects were initiated based on submissions from regions and schools. Largest in scope, the Lester project was funded at $550,000 to provide access to information from sources inside (via video and local area network) and outside (via telecommunications) of the school. This connectivity will enable teachers to develop new initiatives, projects, and programs based on an emerging technology that enhances and increases computer literacy among students and teachers.

Pilot Goals

Based on parameters established for the pilot project, the following six goals were adopted:

1. Provide students and faculty with resources to access information sources using computer technology.
2. Provide every student and faculty member with access to information sources outside the school.
3. Establish an environment where students and teachers will be able to work collaboratively with each other.
4. Promote a "paperless" school model with students, teachers, administration, staff and community using the network features.
5. Provide opportunities for the faculty and staff to develop teaching structures/models that will effectively utilize computers to enhance their curriculum areas.
6. Encourage students to use computer technology as a tool to research, develop and/or produce a finished product for classroom projects.

Project Activities, Results, and Conclusion

With the moneys allocated through the grant, network components and Macintosh LC 5?0s were purchased. EtherNet 10BaseT was selected as the network topology and an older 10Base2 cabling plant was removed. To be in line with existing installations at the regional and local level, Novell Netware 3.12 was selected as the network OS. A Mac NLM on a Zenith Z-server has been established for all Macintosh applications. Approximately 240 Macs and 60 PC are on the LAN that features four servers.

Although the project is only a year and a half into a three year implementation plan, information on program planning, site survey, and cable plant installation is available. Other aspects of the implementation continue to develop. Network management and software selection have become a critical issue as student and staff use increase.

The staff development model that was created is being evaluated in terms of feasibility and level of curricular integration. Future training needs are being identified and addressed at the local level to meet rising costs.

The unique aspects of implementation in Japan have not proven to be insurmountable, although the time expended to accomplish some tasks has been considerable and, as a result, more costly.

project

Emerging Challenges of Technology Infusion into Education

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Key words: secondary, network, teacher productivity, teacher training, curriculum design

Abstract

Building Technological Design

Rockford High School, completed in January of 1993, services a rapidly growing suburb north of Grand Rapids, Michigan, as a 'community building' with a variety of academic and athletic, facilities, and numerous technological capabilities. The community supported the effort to bring the district's students into the 21st century by approving a $40 million bond issue for a new high school and other renovations. Designed for 1850 students, the 340,000 square-foot building is equipped with a fiber optic "backbone" or network system to each of the 80 classroom areas, all large-group rooms, and the administrative and departmental offices. This system enables a person in any location to communicate through the 'voice-video-data' lines on either a computer network, telephone line, or video display system. The design accommodates both IBM and Macintosh computers simultaneously through six high-powered servers located in the centralized telecommunications room. Students can save their work directly to the Student Server, thus eliminating the problems prevalent with floppy disks. The centralized telecommunications center includes the latest video technologies in laser discs, CD-ROMs, video floppies, and VCRs. The Media Center is designed to be the 'technological hub' of the building, equipped with computerized card catalogs, circulation systems, a variety of CD-ROMs, and online searching capabilities.

Computer Access for Teachers and Students

Each classroom contains a minimum of one Macintosh LC II computer on the distributed building wide network. This one computer is designed to communicate to the MacSchool administrative network; assisting the teacher in the completion of utility tasks, such as attendance, grades, test creation, curriculum outcomes and electronic mail. Additionally, this same computer has the capability to interact with the other servers on the network to allow any student access to his/her individual work. The teacher is able to display instructional programs through the Dynacom monitor for classroom demonstrations or small group interaction, as well as interactively control the laser discs located in the source rack. One of the servers in the building works as a communications server, with a variety of phone lines/modems, CD-ROMs, etc. All teachers and students have the ability to research the media center materials or other facilities from any location in the building. The goal of the classroom Macintosh is to provide each student and teacher with the capability to access anything from anywhere.

Related technologies are also available in clusters or laboratories strategically placed throughout the building. Listed below are some examples of available technology:

- 5 IBM and Mac LC II computer labs servicing various areas.
- 60+ computers and extensive technology in the Technology Education area.
- 20+ open media center computers for research and individual student work.
- Clusters of computers and other technology in fine arts department and multimedia lab.
- Television Studio.
- Distance Learning Classroom connected to a fiber network.

Staff Training

The high school staff has been involved in an extensive technology training program over the past three years. During the summer of 1991, the district created a 'Technology Leadership Institute' for 11 teachers who volunteered thirty hours of their summer to learn about both the IBM and Macintosh computers. In exchange, the district provided a classroom computer for each teacher to use during the 1991-92 school year. The program was so successful, it was repeated for another 11 teachers one Saturday per month. These 22 teachers became the building 'technology leaders' to wave the technology flag in all academic areas across the curriculum. The 1992-93 awarded Michigan Department of Education Section 98 grant, entitled 'Thinking Skills and Technology: The Teacher Connection', provided $25,000 of the funds needed to train all high school teachers enabling the district to work towards the realization of the district goal of infusion of technology into every curricular area. This allowed all high school teachers to participate in a total of five one-half day technology workshops during the regular school day, at no cost to the district. Teachers were able to explore desktop publishing, multimedia applications, creation of *Quicktime* movies, the basics of television editing in the studio, and much more.

Curriculum Reform

Restructuring has been a large component in the planning process for the new building. Teachers in all academic areas have received technology related training and have begun the process of integrating into the curriculum. Particularly, the business, art, and industrial technology have redesigned curricula to better train students for future work environments. All involved instructors create multiple problem-solving learning centers allowing students to independently achieve to his/her full potential. The open computer labs are used to incorporate technology into other courses, such as journalism, yearbook, art, and writing. Pilot programs have been teaming teachers into instructional blocks of time in order to maximize the learning environment. District reform committees are close to recommending flexible school day and year schedules for the entire high school. Technology has been one major catalyst for educational reform in the Rockford School District.

project
Connections: Curriculum, Community, Business, & Government

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Key words: information technologies, Internet, video conferencing, community connectivity, telecommunications curriculum

Mendocino Unified Schools is the most technologically advanced rural public school district in California. A new partnership with Pacific Bell as an *Education First* site expands the existing partnerships MUSD has already established with NASA, Autodesk, and the state Telemation Project.

Video conferencing has been added to the connections already available to students and teachers. The district's Internet node, provided by NASA as part of NREN, is the hub of our rural regional network. We have taken the "next step" and established a Community Network business. We are now providing Internet connections to local businesses, libraries, and other school districts. As the community, industry, business and academia work together, MUSD is becoming a vital economic as well as an educational resource to our community.

Through the *Education First*, program high speed ISDN lines and teleconferencing equipment enables students to transcend the boundaries that isolate geographically remote rural districts and communities.

The educational power of telecommunications is evidenced in teacher-created and field tested telecommunications crriculum units. Using HTML, high school and adult students, and local business people are adding educational and local business resources to our WWW server. This will link curriculum, teachers, students, and projects.

Our presentation will show ways that people with access to the Internet can use resources educationally. We will provide samples of some units we have available on the Internet.

project
Schoolwide Networking: Front Line Glimpses

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Abstract

This project presentation will highlight the process of implementing a schoolwide instructional network at a middle school with a student population of 1,575. This pilot site was funded through monies raised by a local county bond referendum. The process of developing instructional strategies for use of the network as well as choosing hardware, software, system management and se urity measures will be discussed. Ways in which the network enhanced instruction including student and teacher data and resource sharing, schoolwide e-mail, and networked modem access will also be covered.

Included in this network pilot was a PowerMac 6100/60 with CD-ROM running *SoftWindows* in each classroom. Several DOS based machines running *Windows* were also networked in curriculum workrooms. Network cabling included a fiber optic backbone and 10BASE-T cabling. Novell software, seven servers, and printers were also a part of this site.

A special challenge was the linking of the media center to the classrooms. Connections were made to the Mandarin online card catalog system and a CD-ROM tower. Ways in which student resource capabilities were enhanced through access to electronic encyclopedias, atlases, magazine indexes and special topic files will be discussed.

Finally, the frustrations as well as the successes of a project of this magnitude will be relayed. We hope that educators who are either currently involved in networking or are contemplating some form of this endeavor can benefit from some of the resolved glitches and conquests of this undertaking.

classroom demonstration

Technology and the Special Education Classroom

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Key words: special education, technology for teachers and students

Abstract

When we talk about technology we usually think only of computers. Technology is not limited to computers. It includes cam-corders, cameras (digital and photographic), scanners, printers, televisions, VCRs, cassette recorders, etc. All technology can be divided into high-end or low-end use. When used correctly, technology can simplify the everyday tasks in our lives.

Technology has many uses in the special education classroom. Teachers can use technology to ease administration chores, such as paperwork, behavior observations, and grades. Students can use technology to supplement the education process. Technology, in various forms, can enhance daily classroom assignments as well as portfolio entries.

project

Enhancing Learning with Technology: Using HyperCard with Special Needs Students

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Key words: multimedia, hypermedia, special populations, new technology user

Abstract

Today, more than ever, the challenge of designing curriculum that meets the unique needs and interests of students rests in the hands of the "Classroom Professional." The Kentucky Education Reform Act mandates that schools develop their own curriculum to support all students, even those having special needs.

This project will demonstrate how one "new technology user" met the KERA challenge using non-traditional techniques to work with her special needs students. The catalyst for this project was the use of *HyperCard* with her students.

The presentation will include an overview of why *HyperCard* was chosen and examples of how it was integrated into a variety of learning activities. Copies of simple stacks will be provided.

project

The Odyssey : A Series of Tutorials on the English Translation of Robert Fitzgerald

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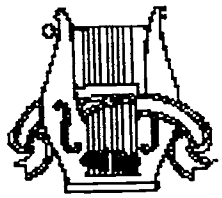
Key words : humanities, tutorials, HyperStudio®



Overview

In recent years, some educators have castigated, even shunned ancient literature and art. As Bernard Knox points out, "Advocates of multiculturalism ... have denounced the traditional canon of literature ... not only as sexist and racist but even as the instrument...used by a ruling class to impose conformity ... [I]t is strange to find the classical Greeks today assailed as emblems of reactionary conservatism... [f]or their role in the history of the West has always been innovative, sometimes indeed subversive, even revolutionary" (*The Oldest Dead White European Males*, pp. 12, 15). Though Knox's title may be laughable, his message is not.

Emerging technologies offer extraordinary opportunities for helping to make challenging literary works accessible to everyone. But simply abandoning the old "tracking" paradigm isn't enough; we must also rethink notions of who ought to read "the classics." I am more convinced than ever that every student should.

My goal in creating these tutorials was to use positive prompts, lively music, and colorful images to help any student progress through a difficult, classic work at a comfortable pace. My dream was and is to help make ancient works of art, Homer's timeless images, and poetry's pure magic as "user friendly" as possible, while honoring the unique power each has to touch the human heart.

My CD-ROM program requires a Macintosh with 8 megabytes of RAM, system 6.0.7 or later, and a CD player. Its features include:

A. A "Master" Index with active buttons shifts the user quickly to the section of his or her choice.
B. Introductory lessons familiarize the first time reader or reacquaint more experienced students with details about epic poetry and Homer's world.
C. "Opening Screens" identify the book or section and offer active buttons for that book's special features. These screens all have full color photographs of Greece or detailed illustrations adapted and hand colored from Thomas Hope's Costumes of the Greeks, used with permission from Dover Press. The illustrations always include music; some use animation.
D. Prose summaries for each of the twenty-four books incorporate selected vocabulary from the Fitzgerald translation. Character illustrations or graphics enliven each section. Text "buttons" invite students to click on words for pop-up definitions. Each book includes interactive quizzes with sound, animated, or pop-up prompts keyed to the reading. When a student clicks a word he doesn't remember, the program returns him to the text and then back to the quiz. Humorous, positive prompts enable students to work at an individual pace.
E. Twenty-four character sections employ pop-up identifications of the characters' roles in each book. Each character section is keyed not only to a particular book but to a master list to help simplify the student's search for information. Each character section also includes a "click-on" pronunciation guide. The student clicks on any name to hear it pronounced.
F. A master list of forty literary terms provides definitions, specific examples from the poem's text, and a "click on" pronunciation guide for the terms. This master list is also keyed to 24 individual sections on literary terms with

definitions and examples of the terms' use in each book.

G. Seven long quotes from key passages in the poem, read aloud as a written text scrolls, enhance students' appreciation of Fitzgerald's musical sounds. Robert Fitzgerald's children have given permission to use his titles, direct quotes, and page references for this edition of 100 copies.

H. Colorful, animated maps illustrate and explain each of *The Odyssey's* important journeys. The program has a total of nine such maps.

I. Informative, lively sections help students interpret the poem's symbolism, offering background on related myths as well as customs in Homer's world.

J. Photographs and background on thirty-one works of Greek art enable the user to connect *The Odyssey* to other works. These lessons also introduce basic concepts and techniques characteristic of Greek Art, thus initiating what we hope will become a life-long interest in ancient art. The Art Museum at Princeton University and The Metropolitan Museum of Art have given permission to use digitized photographs of these works for this edition of 100 copies.

K. The full program offers teachers or any user more than a dozen "template" files enabling computer novices to create their own interactive, multimedia lessons for any subject.

The Odyssey project's wipes, irises, dissolves, sounds, animation, and ease of use captivate students, who realize lessons aren't games, while also recognizing and appreciating the power interactive lessons offer. The program never loses patience, always offers a gentle push, and never judges, thus enabling any student to move through lessons at a pace and in the style he or she finds most comfortable. My experience in using the program shows that students work intuitively in ways they know will achieve the best results. I hope the program helps make this challenging work more enjoyable for your students too.

project

A Writing Classroom without Walls or Clocks: Daedalus and Distance Learning

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Key words: distance education, Daedalus, nontraditional students, freshman composition

Abstract

Indiana University Northwest in Gary, Indiana, is a regional campus in the Indiana University system. Students at this nonresidential campus are very diverse in age, ethnicity, economic background, and educational preparation. One commonality is that most students have jobs, many of them full-time. Many have problems scheduling classes to fit in with their often-changing work shifts.

Description of the Course

The Daedalus Integrated Writing Environment, an integrated software program, consists of a simple word processor, e-mail, real-time conferencing, and programs for inventing writing and responding to the writing of others. This program has been a part of the composition program in traditional classrooms at IUN for several years. Pairing Daedalus with our students has resulted in a freshman composition class that doesn't meet at a regular time; instead students come to the Learning Center at times convenient to them, prepare papers, turn them in to the system, retrieve the papers of others in their peer response groups, and respond to that writing. Several resources play an important role in the success of this class: the instructor is available to students a number of hours during the week, Learning Center personnel are trained to help with technical problems, and the Writing Center is adjacent to the Learning Center and tutors are aware of the particular needs of students in the class.

Students are admitted to this nonscheduled class only with instructor's permission. A questionnaire screens applicants as to academic ability and independent learning commitment. Since the success of the class depends on members' meeting deadlines for peers, students must be able to visit the Learning Center once or twice a week to submit work and respond to papers. Grading is portfolio based, so revisions are made after peer review, again after instructor review, and again after scheduled individual conferences. No grades are assigned to these revisions; the portfolio is graded at semester end.

Materials

Two textbooks are used in this composition course. One, a reader-rhetoric, has thematically arranged readings in several genres with themes ranging from "The Family" to "Language in America". Students choose writing topics from journal writing suggestions following the readings. The second textbook is a small handbook, easy to access, which discusses the writing process, supplies answers to editing problems, and provides documentation formats.

Course Format

One necessity for a course requiring such student independence is a detailed syllabus. This syllabus contains a list of resources, journal-writing tips, a discussion of portfolio requirements and grading, directions for peer editing, and a detailed calendar of assignments and deadlines. Individual conference reminders are also included. Students usually come to the Learning Center and turn in papers by a designated date. Peers are given three or four days to read the papers and e-mail responses. After revisions are made, papers are e-mailed to the instructor who then writes comments and e-mails them to the writer. The instructor does nothin , but comment and make suggestions for further revision; editing comes later at face-to-face conferences.

Future Methods of Delivery

The IUN campus has the technology to enable this course to be taught without students coming to the campus; that will be the next move as the course evolves. Our students often do not have access to computers and modems at home; however, many do have access at their workplaces. Industries, such as the local steel mills, are eager to support distance education as they retrain a work force for the next century. The Daedalus software continues to be improved and new features will undoubtedly lend themselves to this type of distance education.

project

Teaching Shakespeare Interactively

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Key words: interactive, multimedia, Shakespeare, deaf, videodiscs

Abstract

This project involves a collaboration among high school teachers to create interactive instructional modules related to teaching Shakespeare's *Romeo and Juliet*, *MacBeth*, *Much Ado About Nothing*, and *Hamlet*. These modules are designed primarily for deaf high school students, although they are being used with classes of hearing students as well. The teachers participating in the project, who teach in four different schools in three different states, collaborate with each other through summer workshops, electronic communication, and visits during the school year.

The modules use a variety of multimedia resource materials, organized and presented using three PC-based multimedia programs: Asymetrix's *Compel*, Asymetrix's *Toolbook*, and the Institute for Academic Technology's (IAT's) *Express Author*. Using *Express Author*, the teachers have created a series of multimedia glossaries that students can use to help them in understanding Shakespeare's plays. There are also exercises whereby students (and teachers) can explore, in an interactive rather than linear fashion, the movie versions of the plays on laserdisc. Figure 1 is a screen shot of an application on *Romeo and Juliet*. Students use this screen to play and analyze various lines of this famous sonnet.

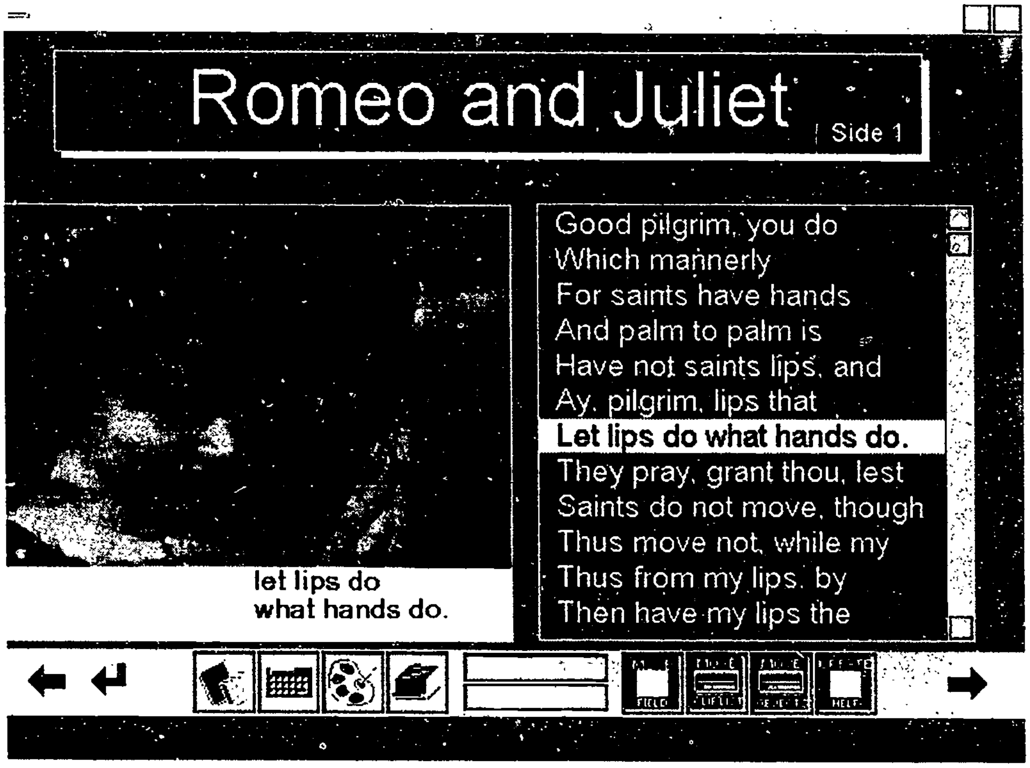

Figure 1. Express Author application for Zeffirelli's *Romeo and Juliet.*

This presentation will include a demonstration of some of this and other modules, along with a discussion of their use and evaluation with deaf and hearing high school students. The process of developing and testing the modules will also be described.

society session

Desirable Computing Skills for New College Students

A Consortium for Computing in Small Colleges (CCSC) Session

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Keywords: computer literacy, computer science education

Description of session

Panel participants will discuss desirable computing skills for incoming freshmen at small colleges. The discussion will address skills for both the general college population and for students expressing interest in computer-related majors. Audience interaction will be encouraged.

Abstract

To make the most of the undergraduate college years, a student should enter college computer literate to some degree. He or she should be comfortable with the computer in general because a student intimidated by the computer will postpone using it when it would be most helpful. An essential skill is word- processing. The ability to use a spreadsheet is also desirable, especially for those students who are uncomfortable with mathematics. Before graduating from college, a student must become computer literate as an end-user.

For preparation for a computer-related major, the ability to program is not needed but, if done, must be done well. Analytic skills are most important here. An appreciation of word problems is also useful for beginning programmers.

classroom demonstration

Elementary School Yearbooks with a Twist: Multimedia is Hot!

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Key words: multimedia, yearbook, HyperCard, school-wide

Revolutionary Multimedia Classroom

Our presentation focuses on constructing a multimedia yearbook. We used HyperCard, but the strategies and techniques used are easily replicable in other multimedia authoring programs: HyperStudio, Digital Chisel, etc.

The multimedia yearbook, with text, graphics, recorded sounds and synthetic speech, offers a dynamic alternative to print-only models. Teachers and students can be directly engaged in every aspect of the yearbook's construction and "publication." A school-wide project can be used to further teacher training, and cooperative learning, and help to equip today's students with skills for the digital age.

classroom demonstration

Creating an Exciting, Print-rich Reading and Writing Environment in Kindergarten/Primary Classrooms

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Key words: language, reading, writing, publishing, kindergarten, primary

Bookmaking, immersion in language, the creation of a visually stimulating print-rich environment, puppetry, creative writing–all these time honored activities can be integrated in classrooms more easily and effectively, thanks to revolutions in both computer technology and teaching techniques. Young children are the inspiration, and computers are the "tools" that enhance classroom language experiences. Teachers and students publish exciting original books and easily create inexpensive whole language materials including Big Books, student books, mini-books and chart literature. Children also have the exciting opportunity to explore fascinating and powerful new interactive, multimedia software and to become immersed in the complete language process–reading, writing, listening and speaking. Moving freely between the various components, children acquire a confidence and capability that is truly astonishing!

In this project, kindergartners are "published authors," and their charming creations stand proudly in the classroom "Book Nook" for all to enjoy, and are also taken home to be shared with others (often in a very unique way!). The computer is used to "publish" student books, and to make whole language materials, printed in sizes ranging from mini to huge! Poetry, songs, stories, and nursery rhymes can be enjoyed in large format with a group, and then become the mini-sized personal treasure of each child. By using the computer, materials can be created quickly, easily, and very inexpensively. This is very useful, for even though there is substantial recognition of the value of whole language experiences for young children, the cost of commercially-made materials can be prohibitive. Moreover, available selection may not coincide with classroom needs, and of course, customized and original work is impossible. By using the computer to replace laborious hand-lettering, materials can be made (and remade) quickly, modifications and alternative sizes are a snap, and readability is improved because of the uniformity of electronic lettering.

Participants will also see how the computer can be used to easily make puppets and story-sets to enhance lessons. They will learn how to make a uniquely designed "Story Telling Apron" that is economical and versatile. Together these resources enrich the variety of classroom language and literature experiences.

Because it is so enjoyable, effective, convenient, and inexpensive, opportunities to explore the pleasure of language are frequent and on-going. Perhaps most importantly, students really enjoy their exposure to poetry, chant, song, prose, process writing, and "layout and design." They are tremendously proud of their ability to "read" both familiar favorites and new creations to each other and to their families. This sense of "audience" has proven to be a very effective strategy for enhancing not only reading and writing skills, but enthusiasm, confidence, and self-esteem as well.

We will also feature the latest in CD-ROM reading and writing software. With these exciting and captivating interactive, multimedia tools, children can be read to (with wonderful sound effects that add to the pleasure of the experience), or read with the computer. The magic and excitement of a specially designed word processor (easy enough for even very young students but surprisingly powerful) enables them to create enchanting original writings and magnificent computer assisted artwork. There is special software that will read back children's own original writing (even "invented spelling"). Students can even record their own voices and become the narrator–a great way to promote both confidence and reading with expression. Also, an electronic "magnet board" cleverly provides phonics and writing experiences with an unusual twist!

Teachers must have the comfort, confidence and skill to use computers effectively to meet their own needs as well as those of their students. We will share both our classroom-proven strategies for using a single computer in a regular classroom and our unique management techniques that help insure teacher and student comfort and confidence. We will demonstrate how even very young students can be self-sufficient with technology, sharing original ideas that really work! Our repertoire of creative ideas and activities will allow even a novice to effectively utilize technology to enhance classroom language. Computers can be remarkable tools for language enhancement in all primary classrooms!

classroom demonstration

Student-produced Books Using Multimedia Technology

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Key words: multimedia, writing process, interdisciplinary, cooperative learning, books, differentiation

This demonstration involves the production of alphabet and trade books by students using technology to create an attractive educational resource for others to use. This project can be used with students at all ability levels. The differentiation is in the requirements and resources made available to the students. The demonstration will show the process, with samples to illustrate each stage. A display of final products from students of varying ability/interest levels will be on display.

Computer technology used to complete this activity include:
- Word processor and desktop publishing programs.
- Graphics programs.
- Scanner using *Ofoto*.
- CD references.
- Video digitizing (Video Spigot) using camcorder.
- *HyperCard*.
- Internet (WWW for resources).
- E-Mail to connect to others for collaborative work.

Skills learned and used to complete project:
- Navigating through various programs.
- Manipulation of graphics.
- Creating educational resource for others to use.
- Presenting work to real audiences.
- Evaluation of published works in this format.
- Advertising techniques/market testing.
- Study of art media/techniques used by authors.
- Use of graphics to support words.
- Use of time management techniques for major/long-term project.
- Production of many parts of a book.
- Identifying individual strengths and weaknesses.
- Practice with expository writing.

Curriculum connections:
- Interrelation of disciplines.
- Use of cooperative work environment with peers/teachers.
- Donation of work to educational institution/media center.
- Becoming a facilitator of learning.
- Creation of risk taking atmosphere in a supportive environment.

classroom demonstration

A Simple and Effective Computerized Technique for Classroom Lectures

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Key words: lecture, demonstration, interactive

Abstract

Introduction

Many courses are taught by an "explain and do" approach. These courses typically consist of a lecture portion and a laboratory portion. An instructor uses the lecture portion to explain the subject matter and students use the laboratory portion for hands-on practice.

In this presentation, a simple and effective teaching technique for the lecture portion will be demonstrated. The lecture portion is expanded from the traditional method to include both "explain" and "demonstrate" activities. This teaching technique can be used successfully and effectively by instructors in a word processing course, in a reading program, in a writing curriculum, and in other appropriate courses.

The essence of this teaching technique

The "explain" activity and the "demonstrate" activity are simultaneously displayed on a large projection screen. The screen is divided into two windows. The upper window is used as an "explain" window and the lower window is used as a "demonstrate" window. The lecture outline and discussion material of a lesson is displayed in the "explain" window for explanation and discussion. Explanation and discussion of a topic is followed by an on-line demonstration of that topic using the "demonstrate" window. A demonstration in an active and interactive environment helps students gain a greater understanding of the material discussed. The "explain" window remains on the screen during the "demonstrate" phase to assist and enhance the demonstration activity.

The "explain" window is activated during the explanation activity, and the "demonstrate" window is enabled during the demonstration phase. Both windows can be scrolled to bring new topics and new material into view. Switching between the two windows is easy and can be done at any time.

The teaching tool and technique described here offers the following benefits:

a. Uses a computer to present lecture outlines.
b. Uses a computer to perform interactive demonstrations in an active environment.
c. Instructors' teaching effectiveness and enthusiasm are greatly enhanced.
d. Students' learning effectiveness and enthusiasm are greatly enhanced.

classroom demonstration
A Toolkit for Visualizing Array Algorithms

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Key words: algorithm visualization, pedagogy, toolkit

A toolkit for animating algorithms for manipulating one-dimensional arrays will be presented. The toolkit has been incorporated into a menu-driven program that animates the following algorithms:

Filling an array with:
- Random numbers.
- Ordered random numbers.
- From the keyboard.

Searching an array using:
- Linear search.
- Iterative binary search.
- Recursive binary search.
- Direct access.
- Hash codes.

Sorting an array using:
- Two forms of bubble sort.
- Two forms of selection sort.
- Quick sort.

This toolkit has been used in introductory programming courses (both Pascal and C++) to help students visualize array algorithms. By annotating and then displaying an array at critical points during an algorithm, an animation effect is created that allows the viewer to watch as an algorithm fills, searches, or sorts the array. In the case of sorts, the viewer can enable or disable a detailed representation of the actual exchange process. Other parameters such as animation speed can also be controlled by the viewer. A method is included to display each activation of an animated algorithm so that students can follow recursive activations.

Instructors and students can also incorporate the visualization software into their own programs to animate their own array algorithms. Instructors can add new algorithms to the demonstration program or incorporate the tools into their own programs to create effective visual demonstrations for use in lectures, labs, or as self-paced tutorials. Students can use the menu-driven program to investigate several standard algorithms, or they can be given lab exercises that require them to add "visualization instrumentation" to code they have written or their instructor has provided. This forces the student to consider what is happening in the algorithm (so they can determine at what points in the algorithm the array should be displayed, and with what annotations) and gives them visual feedback as to whether the algorithm works the way they think it does.

classroom demonstration

The Construct of Parameter Passing: A Study of Novice Programmers

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Key words: computer programming, Pascal, parameter passing, modular programming

After reaching a peak in the early 1980s, student interest in computer science and information systems has declined dramatically. In 1983, more than 10% of high school students chose computing fields as their intended college major. This interest dropped to 7% by 1985 and continues to plummet. When coupled with increased industry demand for information systems professionals and higher than average salaries, the decline is especially troublesome. The Computer Information Systems (CIS) program at a midwestern state university mirrors the problems reported by other sources. Enrollment in the CIS major and/or minor, reported at 381 in 1986–1987, fell to 294 by 1990–1991 and continues to drop. Attrition in the programming courses is high, and students, especially those from other disciplines taking the initial programming class as a service course, are often less than successful.

The literature tells us that many students find college-level computer programming courses demanding, and attrition rates in those courses are high. Various authors offer reasons why students find programming courses difficult. In light of the preceding observations, it is not surprising that reports of studies attempting to identify factors of computer programming success dot the literature. Although some studies have found positive correlations with computer programming ability, the studies generally are not very helpful to programming teachers. Background factors may assist advisors counseling students regarding the selection of programming classes. Teachers cannot alter their students' ages, genders, verbal abilities, high school ranks, cognitive styles, or any other background data. Programming instructors need research that informs the instructional and curricular decisions over which they have control.

Traditionally, the first course in a computing major has been a programming course. Pascal, a programming language developed specifically to teach novices structured programming, has been the language of choice for years. Understanding the language constructs is the first link in the cognitive chain of learning to program. Thus, it is not surprising that researchers have investigated various language constructs, attempting to describe either expert or novice conceptions of those constructs. What is surprising is the absence of attention to the construct of parameter or argument passing, the mechanism by which data are shared among the various program modules in a complex program. In lay terms, it is the way pieces of large programs fit together. The topic is pivotal. Its mastery is crucial for a student's continued success in the discipline, since virtually every program the student encounters henceforth will incorporate the construct. This study's purpose was to describe novice programmers' understanding of the construct of parameter passing, with the ultimate goal of improving the way we teach the concept.

Linn and Songer (1991) describe a three-stage model for conceptual change: action knowledge, intuitive conceptions, and scientific principles. The model focuses on the understandings students bring to a learning situation, their initial conceptions, and the mechanisms that decide the rate of the constructive process. During the first stage of the model, learners acquire action knowledge from action, observation, and unreflective responses to events they encounter. Next, learners combine action knowledge into intuitive conceptions by making conjectures that explain events they observe using a process of reflective abstraction. Finally, learners acquire scientific principles.

The study attempted to answer the following questions: What action knowledge does a novice programmer bring to the study of the parameter passing construct? What intuitive conceptions does a novice programmer possess regarding the parameter construct? How does a novice programmer express principled understanding of the parameter construct? What is the relationship between a novice programmer's conceptual and procedural knowledge of the parameter construct?

The study used several methodologies traditionally employed in qualitative educational research–including observation of the classroom instruction, semi-structured interviews of the students and the instructor, protocol analysis, and document examination. The study occurred at a midwestern state university. The bulk of the data for the study was collected from eight students enrolled in one section of the introductory programming course during a fall semester. The original design called for data to be analyzed according to the Linn and Songer (1991) model–action knowledge, intuitive conceptions, and scientific principles.

Preliminary findings suggest that the novice programmers studied did not develop an accurate mental model of the way the parameters are passed in memory. Most students could solve routine tasks similar to those they had done in class. However, none of the eight students, who all completed the course successfully, was able to do a novel task that required them to understand how variable parameters are passed. The classroom demonstration will present more extensive data analysis and implications for instruction.

project
Exciting Educational Telecommunication Projects

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Key words: telecommunications, education, interdisciplinary, active learning, community of learners

Abstract
Introduction

Telecommunications is much more than just finding information. Educational telecommunications includes developing a community of learners who share and participate in a specific theme. The community may be a short- or long-lived. The Electronic School House of American Online offers classes the opportunity to join such learning communities to explore the depth of topics.

Electronic SchoolHouse Projects

The activities of the Electronic SchoolHouse are coordinated by ESH Tooter and ESH Leni, but the projects of the Electronic SchoolHouse are the work of many teachers. They include:

Westward HO!

Warp back to the 1850's and hitch up your wagons for the trek of your life. Each year a party leaves from the Electronic SchoolHouse to face the hazards of the Oregon Trail. Teachers meet to share ideas for hitching this online adventure to their classroom curricula.

Word Web for Foreign Language Classes

Add to the HyperStudio word web and expand everyone's vocabulary by selecting a picture that lets you illustrate a family of words. What words do you find in a supermarket? What words do you find in a meadow? Use it as the basis of a HyperStudio mini-stack to be added to the Web Center in the SCHOOLHOUSE MAGAZINE library

The SchoolHouse News Bureau

This is for any school or class that publishes a newspaper. In the News Bureau Library schools share articles, pictures, cartoons, research, and ideas. On the Student to Student board they may collaborate on topics of interest to schools everywhere.

Postcard Geography & Geography Detectives

These are two projects for newcomers to telecommunications. In Postcard Geography, classes use "snail mail" to collect picture postcards from other online classes. In Geography Detectives, classes fill boxes with clues to their location. Paired classes exchange boxes via "snail mail" and then these super-sleuths go online to ask questions and solve the mystery.

Classroom On Ice! & Project Central America

These projects are online field trips. This past year we linked with Frank Ball and learned what winter was like in the South Pole. We also followed three bicyclists on their journey through Central America. We heard from teenagers in Moscow during the storming of the Russian White House and crossed AFC RRJoe's Bering Bridge to his many contacts in the East.

Winter Math Online Games

Classes take turns measuring, counting, analyzing, and writing math word problems about their towns and schools. Then they host an online competition to solve the problems. This is a good interdisciplinary activity that provides experience in social studies research, math problem solving, writing, telecommunications, and group interaction.

Name That State

Participants write *Jeopardy*-style questions in designated categories. Questions are posted online for research and study. Students earn points for writing good questions and answering them as they meet online to test their knowledge in friendly competition.

Freedom Wall

Who are the outstanding champions in the quest for freedom? From November through March students from around the country gave their answers. They wrote short essays justifying their choices. Artist, Adam Brooks, took the 100 most frequently chosen champions and is painting them into a sixty-foot tall mural on the side of a building in Chicago.

Sister Shore Bird Project & Steelhead Trout Hatching Project

Classes network with schools tracking the migration of shorebirds or share information with schools hatching trout.

ScrapBook Writing Project

Begun in 1989, 260 classes in 35 states have linked, exchanged essays, and added chapters to the ScrapBook Library. ScrapBook was recognized by the IMPACT II affiliated Connecticut Celebration of Excellence and is described in detail in a ten-page brochure available from COE and in a 70-page Curriculum ToolKit available from AFC Tooter. Spin-off projects have led to a DareBook, Season Stories, and two ScrapBook CookBooks.

The Underground Railroad Project

Individual classes research underground railroad station in their area, share a completed form about it, fax pictures about their local underground railroad station, share stories about the station, and analyze the information from the other schools.

National Student Research Center

Students of any age level can explore the National Student Research Center electronic databases and contribute their findings to the National Student Research Center.

panel
UMassK12: Internet Access for Massachusetts K-12 Teachers and Students

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Key words: Internet, telecommunications, BBS

Abstract

UMassK12 is an Internet bulletin board system provided without charge to Massachusetts K–12 teachers and students. It provides a successful, cost-effective model for K–12 Internet access. The panel will discuss the general features and policies of UMassK12. It will also consider user support and training, telecommunications projects, and networking logistics.

UMassK12 started operating in June 1993, and began issuing accounts to the general Massachusetts K–12 community in September. In the 12 months ended August 31, 1994, it achieved the following milestones in becoming the largest K–12 telecommunications service in Massachusetts and one of the largest in the country:

- Free accounts were issued to approximately 3400 teachers and 1700 students from all parts of the state.
- Over 700 Massachusetts schools had one or more accounts.
- Average use of the system increased from 96 calls per day to 1241 per day.
- During the 12 months, UMassK12 received a total of 240,000 calls.
- About 800 teachers attended training workshops given by the UMassK12 staff

UMassK12 provides these services on a shoe-string budget. It runs on a rather modest host, a DEC 5000/133 Ultrix workstation with 80 MB of ram and 3 GB of disk storage. The host computer, software, and technical support are provided by the University of Massachusetts at Amherst. The software is a customized version of the *FreePort* software used on Cleveland FreeNet. Most Massachusetts residents can access UMassK12 via local calls to 15 University of Massachusetts and State College campuses. These connections are donated to the project. There is also a leased line connected to the local area network and a modem pool at the Franklin County Technical School; this arrangement provides toll-free access for an entire county. Costs for this line and for some user support are provided by an NSF grant.

Teachers on UMassK12 have access via menus to the whole range of Internet services, including electronic mail, newsgroups, telnet, gopher, ftp, and world wide web. Students can only access selected usenet newsgroups. Two kinds of student accounts are offered: basic accounts, which attempt to avoid student access to inappropriate materials, and extended accounts, which have access to all Internet services except the full usenet feed. Student and parent signatures are required for all student accounts.

User reactions to UMassK12 have been extremely favorable. The feedback is positive, and teachers are moving from the stage of learning about the technology to integrating Internet resources into their teaching. User support is a major element in UMassK12's success. Users receive prompt responses to "Messages to Sysop" and to telephone inquiries. Clear menus, help screens, and manuals make it easy to learn and to use the system. A two- or three-hour hands-on workshop enables novice users to understand the main features of the system and to explore further on their own.

The very success of UMassK12 in its first year of operation predictably became a major problem as usage doubled again within four months. New accounts were first limited to students and teachers in western Massachusetts, and then only to teachers in that area.

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invited

The Trials, Tribulations, and Enjoyment of Seeing Research Made Practical

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Abstract

This panel will focus on the difficulties of taking "good" ideas and converting them into profitable ventures. Academia has long enjoyed the luxury of playing with ideas for brief periods of time and discarding them as new toys were discovered. But today, universities, private and public, are increasingly being held accountable for the value-added nature of their research. They are being expected to behave more like for-profit ventures instead of "think tanks."

The government is becoming less interested in true research contracts, and more interested in cooperative research agreements. Grant money is becoming even scarcer. A change in this stance is not foreseeable, and it makes it harder for the academic ponderer to gain funding. This leaves the United States in a position of weakened long-term basic research. Why? Because long-term research cannot demonstrate short-term benefits, which funding agencies always insist on now. To those of entrepreneurial spirit, this provides seemingly limitless opportunities.

This panel will look at the issues that must be considered before one decides to abandon an education career and begin a private venture. We will also look at how universities are trying to cash-in on technologies that are created in their laboratories, and how industry can team with universities and government agencies to commercialize proven ideas that have not been seen through to fruition.

A History of Mutation Testing: From Half-baked Idea to Commercial Product

Several studies have concluded that for most new ideas there is an 18-year lag from the initial concept to the first practical commercial product. This lag holds across many fields, many kinds of ideas, and through many different paths that an idea can take from concept to product. It has also held constant for most of this century (if not longer) and has a fairly low deviation. The initial ideas often come from academic or industrial research, and the first products are often built by former academics, or students of the original researchers.

The lag is result of a number of factors, including researchers not being interested in commercial products, researchers lacking the skills and support to develop practical products, the difficulty of getting acceptance for new ideas, and the myriad of engineering and technological problems that must be solved to bring an idea to market. This progression is the essence of the entrepreneurial process, whether the entrepreneur is from academia, research labs, or industry. From this perspective, the entrepreneur who brings the first product to market is only the final link in a sometimes very long chain of people and prototypes. In fact, the initial products often do not sell well, particularly if the person or company that builds it have not satisfactorily solved all the engineering problems or does not have the resources to effectively market the product. In this case, the entrepreneur becomes a link in a chain that extends beyond the initial product to an eventual product that is successful.

This process of idea to product will be explored through a case study of mutation analysis testing. Mutation is a particularly good example to study this process, as it has had a long history, exhibits many of the problems associated with entrepreneurship, practically all of its development has been in the public domain, the principals who have developed mutation are still active, and it has finally proved to be a successful idea that may can have great impact on the quality of software.

Enhancing Student Learning and Institutional Autonomy Through Faculty Entrepreneurial Efforts

American colleges and universities are among the finest in the world, and perform a vital function in our society. Not only do they train the workers and leaders of tomorrow, but they also perform the basic research and technical advancement that are necessary to our success in a global economy. However, recent years have found universities facing dwindling support from external sources. There is also criticism that graduates are sometimes inadequately prepared for the workforce. Academia is responding to these problems in a variety of ways, from belt-tightening measures to radical experiments in the delivery of instruction.

We suggest that entrepreneurial efforts by faculty and stronger ties between industry and academia can both be effective in addressing these problems. Due to the pervasive use of computers in industry, computer science is a particularly versatile discipline for these activities. There are many possible relationships that could be established between universities and local companies, ranging from research collaboration to consulting and software development services.

Universities need to be more proactive in their support of faculty entrepreneurs. Current university policies typically spell out ownership of intellectual property and division of patent royalties, but do little to support the formation of companies by faculty to commercially exploit new discoveries. This lack of support slows the transfer of new technology to our economy and ignores a potentially large source of revenue for both faculty and the university. Besides being profit centers, such companies could also provide opportunities in these disciplines for real-world learning for students and professional growth for faculty.

These new approaches are not without risk and potential pitfalls. Financial risk and liability need to be seriously considered by universities. Above all, the integrity of the academic mission must be preserved and not subverted by profit motives. In spite of the risks, the potential benefits for all concerned are great enough to merit serious consideration.

panel

Designing On-line Mentoring Environments to Support Young Women in Science and Technology

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Key words: gender, telecommunications, mentoring, high school science

Abstract

This year, the Education Development Center has begun collaborating with the Department of Energy's Office of Scientific Computing and Bolt, Beranek, and Newman's (BBN's) NSF-funded National Testbed Project, on a three year national project to develop "telementoring" environments that encourage young women to pursue careers in engineering and computing. Funded by the National Science Foundation's Directorate of Education and Human Resources, the Telementoring Young Women project draws on the strengths of telecommunications environments to link high school girls with female professionals across the country who can be supportive and constructive in addressing many of the conflicts and concerns young women have in engineering and computing fields. The project is also developing online resources to help parents and teachers effectively support the academic and career pursuits of young women. Drawing on pilot research with students, parents, and teachers in the first year of the project, this panel will explore design issues that have emerged in the development of this prototype mentoring model.

Three central issues will be discussed:

Recruiting, Enticing, and Training Mentors

Mentors participating in the Telementoring project come from a diverse pool of professionals at organizations and institutions concerned with increasing the participation of women in science and computing. Finding appropriate mentors who are sympathetic to the needs of young women is central to the recruitment process. In addition, busy professionals require enticements to participate regularly and training in how to effectively meet the needs of adolescent women. We will discuss recruitment strategies piloted by the project and provide examples of training and support.

Designs for Effective Conversation

The prototype telementoring environment includes a variety of experimental online activities designed to facilitate discussion and forge relationships between mentors and mentees over the network. The telementoring environment includes both one-on-one communication between mentors and students, and small group discussion formats among peers. We will discuss the effectiveness of certain strategies developed to start and sustain conversation between professionals and students, discussion topics and activities that are most successful in increasing students' self-esteem and confidence, technical options for structuring discussions, and challenges the project has faced in establishing trust between people who never meet face to face.

Design of On-line Resources for Parents

Relatively few projects have designed online resources to meet the needs and concerns of parents. Students participating in the project will have access to laptop computers, making parental participation possible. Online resources and discussion forums provide an environment where relevant information can be disseminated and where parents can post their concerns and get information and advice from competent professionals as well as from other parents. We will discuss both content and design issues that have come up in creating these online resources for parents.

project
MusiCard: Integrating Music Instruction and *HyperCard*

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Key words: music, *HyperCard*, integration

Abstract

In general, most CAI software used to teach music is either designed for a musically literate audience or for children. However, students majoring in elementary education at the collegiate level constitute a substantial group of individuals who need basic music literacy skills in order to be able to function musically in the classroom; these individuals may have never received any training in the elements of music. As a result, software to teach music fundamentals to prospective elementary teachers was developed in this project. *HyperCard/HyperTalk* was chosen as the development platform.

Twelve stacks were implemented that took advantage of several different features available in *HyperCard*, including use of aural and visual musical examples, scrolling fields, interactive buttons, and hypertext. These stacks provide textual explanations of music concepts as well as examples of each concept. After a topic has been discussed, a set of practice problems is provided. When a module has been completed, students proceed to another stack to take a mastery test on the topic. The test stacks keep information about how long the students worked on the module and how long they spent completing each portion of the mastery test.

The package, entitled *MusiCard*, was tested to determine its effectiveness in a course designed for prospective teachers. The purpose of this course is to (1) teach basic music theory concepts and (2) develop music performance skills. Previously, instructors of this course devoted a substantial amount of classroom time to music theory, which resulted in a limited amount of time that could be spent developing performance skills. *MusiCard* was designed to reduce the amount of class time needed for theory, allowing more time to be spent on singing and playing instruments. Results showed that *MusiCard* was effective in reducing in-class theory lecture with no reduction in students' acquisition of music theory knowledge. Another feature of *MusiCard* is the use of common folk songs as examples of the topics being studied; students found this aspect of the software package to be quite helpful.

project
A Multimedia Approach to Professional Development

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Key words: multimedia, CD-ROM, math, teaching standards, professional development

Abstract
Introduction

Understanding Teaching, a multimedia professional development seminar on CD-ROM, provides teachers with opportunities to observe classroom interactions that can be used as a common reference for discussion. This technology tool with full-motion video vignettes emulating the *National Council of Teachers of Mathematics Professional Standards for Teaching Mathematics*, situated learning user interface, and reflective practice, allows preservice and inservice teachers to observe the teaching behaviors and student interactions in elementary and middle school mathematics classrooms.

Copeland (1989) proposes using interactive multimedia to provide opportunities for teachers to develop and refine pedagogical reasoning. Bitter and Hatfield (1992) studies find interactive multimedia has the potential for developing preservice teachers' classroom observation skills. Chiou (1992) suggests situated learning, within a multimedia platform, an appropriate context for computer-based knowledge. Pugach and Johnson (1990) suggest that reflective practice has the potential to help teachers consider and incorporate alternative approaches to instruction.

Approach

Understanding Teaching comprises four learning modules–Professional Development (exploring), Teachable Moments (practicing), Application (applying), and Assessment (assessing). Each module, designed within the situated classroom metaphor, reflects upon the six NCTM *Professional Standards for Teaching Mathematics* and underlying substandards. In Professional Development, learners access overviews of each teaching standard that are linked to descriptive text, video, sound, and animation databases of teachers teaching the concepts of geometry and numeration. Apprenticeship is the key element in Teachable Moments. Learners apprentice themselves to an expert teacher when viewing the video vignettes, thereby gaining an in-depth understanding of the classroom interaction. In Applications, learners practice their observational skills by watching classroom video vignettes, select the teaching standards and teaching strategies they would use if they were the teacher, then compare their selections with the choices of expert teachers. Learner-knowledge-gain is the key element in Assessment. After viewing the video vignettes, learners choose the teaching standards believed applicable, then view the teaching standards selections of other learners.

Activities

Inherent in each *Understanding Teaching* module is reflective observational practice in education. While viewing the classroom video vignettes, learners (individuals, small- or large-groups of preservice and inservice teachers) can ponder questions related to the teaching standards and the classroom interactions, then key-in their reflections in the hypertext notebooks. The notebooks can be printed, thus providing learners with a portfolio of their reflections.

Administration

The administrative component of *Understanding Teaching* includes the login system that tracks the paths of learners' module choices, the time learners interact with the program, their teaching standards selections, and reflective comments.

Summary

Understanding Teaching is versatile, portable, and efficient. This innovative professional development seminar provides for reflective observational practice in preservice and inservice teacher education, and can be coordinated with mathematics methods textbooks; education department curriculum requirements; state, district, and local education requisites for updating inservice teacher certification; career ladder advancements; or continuing education units for salary scale advancements. Utilizing appropriate multimedia computer technology, learners can operate the program in a classroom, computer lab, or at home.

project

An Evaluation of the Nebraska Statewide Internet K-12 Implementation

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Key words: Internet, research, telecomputing

Abstract

Introduction

The Internet is an exciting addition to K-12 schools. Both world-wide communication and information gathering is possible using this one source. Nebraska and its educational community are in the process of connecting to this resource, with the passing of LB 452, in 1993. This legislation promotes Internet access to schools, as well as teacher training to use the network in the educational process. Fifteen Educational Service Unit servers, located across the state, provide access to the Internet for almost all public K–12 schools. Teacher interest is very high, with approximately 6000 educator accounts already issued and several thousand more expected to be issued within the next few months. Schools are being connected by modem dial-in, as well as by direct connections. Educators across the state are being trained to effectively use the Internet to improve the education of their students. Currently, an evaluation team from the University of Nebraska at Omaha, in cooperation with the ESUs, is formally investigating the impact of the state-wide effort to connect schools and teachers to the Internet. This 5-year evaluation focuses on examining the impact on teachers, students, and schools, as well documenting the state-wide process. The research is funded by the Nebraska ESUs, U.S. Department of Education, and the University of Nebraska at Omaha.

The research process includes: (1) Pre-training surveys for educators who are beginning the Internet training program. (2) Post surveys administered bi-annually to Internet-using educators. (3) Documentation of innovative uses of Internet in Nebraska classrooms.

The pre-training surveys are completed near the beginning of the standard Nebraska educator Internet training session. This 30 question "bubble" survey includes sections dealing with demographics, teaching style indicators, computer-technology proficiency, and attitudes.

The post survey was piloted during November 1994. Sending and response was by e-mail, with about 180 respondents completing the survey. A revised version will be e-mailed each April and November, and non respondents will receive a ground mail version.

The documentation of innovative users is accomplished in several ways. The staff of the Internet Studies Office, including three professors and 5 graduate students has visited several classrooms in the state. Also, many educators have been contacted by phone and interviewed about their use of Internet, as well as several contacts made by e-mail.

Year 1 Selected Preliminary Results

Pre-Training Survey Results

The data from the pre-survey indicates that educators who are involved in beginning training initially know very little about the Internet, or how they will use it. Baseline information indicates that a large number of teachers have been trained (2643 surveys returned) and that training has been inclusive to a wide range of teacher backgrounds and academic disciplines.

Six Month Follow-up Survey Results

A post survey was piloted by electronic mail in November of 1994. The survey drew responses from over 180 active Internet users, and indicated that these educators primarily use e-mail, with much less use of Internet "information" applications. Most of the pilot group indicated that they primarily accessed the Internet from their home rather than at school, perhaps since many of the respondents' schools currently have 2 or less Internet-connected computers. Student use of the Internet was reported as relatively infrequent. Sixty-three percent of the respondents indicated that their principal encouraged Internet use, and most indicated that they perceived electronic mail to be the most promising curricular application for both teachers and students.

Innovative Uses and Projects

The evaluation process has identified numerous innovative uses of the Internet by teachers and within projects across the state, involving a wide range of subject areas and grade levels. Beginning in February 1995, the evaluation process included follow-up interviews and observations related to these innovative uses.

General Results

In general, the evaluation process is finding significant and commendable progress in the implementation of LB 452. Educators, at all levels, as well as policy makers, seem united on the goal to effectively integrate the Internet into K-12 education.

Future Goals

Future evaluation goals center on expanding and refining the evaluation process, expanding the documentation activities related to innovative uses and projects, and examining the related plans and activities of other states.

project

Designing a Server for a K-8 School

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Key words: Mosaic, MUSE, collaboration, server, cross-grade, WWW

The "Designing a Server for a K-8 School" project was developed to expand peer collaboration and classroom exchanges between students of varying cultural backgrounds and ages from around the world. In order to facilitate that extension, the Baker Demonstration School (BDS) technology coordinator, an National-Louis University (NLU) computer services administrator, and high school students from the USA, Australia, and England created a World Wide Web (WWW) server and a Multi-User Simulated Environment (MUSE), Internet Relay Chat (IRC) and set up Serial Line Internet Protocol (SLIP) connections in several rural and urban schools.

Students from rural, urban, and suburban schools designed home pages and a MUSE so information could be accessed and exchanged using E-mail, the World Wide Web (WWW), Internet Relay Chat (IRC) and a Multi-User Simulated Environment (MUSE). The WWW home pages present autobiographical student information and include project descriptions. The E-mail, IRC, and MUSE exchanges were used to assess how effectively the students processed the information. Students used the WWW, IRC, and MUSE to introduce other students to their projects. Specific groups of students in other schools learned about each other's projects using Mosaic and had real-time interactions with other students using IRC and MUSE.

The presentation, "Designing a Server for a K-8 School," includes a description of the steps taken to expand and enhance hardware and software resources for Internet use, defines guidelines for students to follow when creating home pages and MUSE environments, and explains how to establish partner Serial Line Internet Protocol (SLIP) connections in several remote schools. An example of a student home page and MUSE simulation will be shown. A discussion of possible integrated curricular projects for use with this type of system will conclude the session.

project

From Keyboarding to Writing and Publishing: A Fifth Grade Report

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Key words: keyboarding, fifth grade, writing

This demonstration will present a summary of my work using technology in the fifth grade classroom. The presentation will focus on the methods and materials used to help 10–11 year olds maximize the technology, specifically classroom technology, that is available in their lives. The project summary will include:

- a brief overview of the district project.

- a description of the methods, materials, management, and motivation used.
- a plan to assist others who see this project as applicable to their goals.

Handouts will be included.

project
Hypermedia and Reader-based Pedagogy: Tools for Literature Teaching and Learning

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Key words: hypertext, hypermedia, reader based

Abstract
The ongoing "Multimedia and Literature Teaching and Learning Project" of the National Center for Research on Literature Teaching and Learning at SUNY Albany explores the use of multimedia and hypermedia to support reader-based pedagogical practices. Reader-based theories of literature regard readers as active meaning makers who interact with texts to create defensible interpretations of them. Reader-based pedagogies, then, encourage students to develop multiple and divergent interpretations of works of literature. This session will report on the second phase of the project in which hypermedia tools are being developed to support student interpretations of literary works, and discourse around those interpretations. These tools are being developed and tested at both the elementary and secondary levels, and include visual

and auditory components as well as hypertextual ones. We are also developing and testing a graphical literature MUD, loosely based on *Alice In Wonderland*. The presentation will include a demonstration of the tools as they are currently implemented at both levels, and report on school-based research with students using the applications.

project
Spend a Day at "Top Gun" School

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Key words: hypermedia, multimedia, interactive, collaborative, middle-level education

Abstract

At "Top Gun" School, teachers and students work on collaborative teams to produce most of the multimedia used at Greenwood Middle School. Several years ago, like most schools, Greenwood Middle School was faced with the problem of how to integrate high quality multimedia into the curriculum. Much of the multimedia available was either of poor quality, gamelike, or did not fit into the curriculum. Greenwood Middle School is committed to the philosophy that all technology used in the school must enhance the curriculum. After much consideration, it was decided that perhaps students could create high quality multimedia for other students.

As the curriculum for "Top Gun" was being developed the following issues were kept in mind:

- The class must be part of the curriculum.
- Students would be selected for the class based on their problem-solving ability.
- Teachers would supply the content for the projects, and students would create the projects.
- All projects must enhance the curriculum in some way.
- The class must be able to be replicated.
- Readily available software would be used to create the projects.

Students for "Top Gun" are selected by their fourth grade teachers based upon their problem-solving ability. These students attend a five week summer session between grades four and five. Students who were missed during the initial selection process can attend the class during the summer after the fifth grade. In addition, students who move into the district or demonstrate strong problem-solving abilities in later years can also be added to the class. At the middle school, the class is made up of students from all three grades (six, seven, and eight). The class meets one period a day, and students can elect to take the class for one semester or for the entire year.

Projects for "Top Gun" are submitted by teachers or organizations outside the school. The students select the project they want to work on, then organize themselves into teams of three to five members, depending on the size of the project. The students then meet with the teacher or outside advisor to discuss the project's procedure. During the project, the team meets to talk about the project when necessary. All team members have an equal say in the way the project progresses.

The students use Macintosh LCIII computers with a 160 MB drive and 6 MB of RAM. The computer all have *HyperCard 2.2*, *ClarisWorks* and *Color-IT* on them. In addition the machines have *FoolProof* and *UnderCover* on them to protect the projects.

Some of the projects completed so far are; the dissection of a worm, a modern day trip along the Oregon trail, a tour of the University of Indianapolis, a tour of Conner Prairie (an 1826 pioneer settlement located north of Indianapolis), a simulation of the AMX Synergy media retrieval system (this project was developed as a training tool for the teachers at Greenwood Middle School), an interactive promotional for the Johnson County Literacy Collation, and an interactive time-line for use by freshman at the University of Indianapolis.

project
Hypermedia Projects in the Classroom

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Key words: hypermedia, multimedia, computers, social studies, science

Abstract

Introduction

Today, tomorrow, and for tomorrows after that, we and our students will be bombarded with a continuous and relentless stream of massive amounts of information. To turn these quantities of material in usable knowledge, we have to be able to organize it in a way that permits us to retrieve information efficiently. *HyperStudio, HyperCard, Link Ways, The Digital Chisel* and *HyperScreen* programs are information organizing tools, that enable our students to present information effectively. Using hypermedia, students are able to relate text, scan images, draw, add QuickTime movies, and include sounds for original and ... resting presentations in variety of subjects.

Background

Eighth grade students in Freehold Township School District have successfully used these hypermedia projects over the past five years. To focus and motivate students interest, the assignment is to design a stack based on one of the topics covered in the fourth grade science and social studies curricula. The students plan, revise, and test their individual stacks until they are error-free. Then they demonstrate their stack to a group of fourth grade students in our district. A copy of their stack is left with the fourth grade teacher so it can be used for review during class time. The eighth grade students print-out each screen and put it in booklet form to take home. Stacks are also videotaped so students can show their programs at home.

Educational Advantages

In the process of planning and creating a stack, students develop and refine skills for problem-solving, goal-setting, analyzing data, synthesizing ideas, thinking in a non-linear way, organizing information, making decisions, developing a point of view, designing, testing, and revising a system as well as locating, gathering, and evaluating information.

Conclusion

This project has been successful. It has enabled students to understand the importance of the computer as a tool. This was demonstrated by the students' application of the skills they learned to other areas of study.

project
Empowering Learning in a Multimedia Environment

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Key words: Logo, multimedia, problem solving

Abstract

MicroWorlds Project Builder is a multimedia environment in which children seamlessly integrate text, graphics, animation, and sound. Its features include drawing tools to create graphics, shapes that can be stamped or animated, text processing, and Logo programming. Objects and parallel processing are intuitively part of the environment (cumbersome programming is not required). In this environment, children act as designers as they explore new ideas in the process of building projects.

This rich problem-solving environment is ideal in a school that emphasizes the idea of constructionist learning. Children in grades 1–6 were able to work on cross-curricular projects in which they could build on their own strengths. For example, the grades 1–3 classes worked on writing and illustrating a story with subtle differences. The first grade classes wrote and illustrated stories of multiple pages. The second grade classes also wrote stories including buttons to change pages. The third grade classes animated their stories. The children were able to utilize only the parts of the environment that they needed and

that they could handle.

In contrast, the sixth grade class worked on sophisticated projects that integrated social studies, natural science, language arts, and fine arts. The theme of these projects was "Create a multimedia online tourist brochure on a region of Quebec". The students planned their projects to include a menu page that had buttons to provide links to the culture, history and outdoors activities in that region. The presentation for each area included multiple animations, timed with text, sound, and background graphics. The presentations were completely under program control.

As the students worked on these projects, they confronted different problems. For instance, one student had a horse jumping around a circular track. She had to solve the problem of changing the horse's direction while it was moving. Another student animated a man walking to a tree and then chopping it down. He had to use recursion (a programming concept) and changing perspective (an artistic concept). In this environment, children learned new concepts as the need arose. Their learning was enhanced by sharing ideas with their classmates. For example, a student created a lovely artistic effect using shadings. Other students liked it so much that they incorporated this effect in their background graphics.

Working in this environment is challenging for a teacher since the "curriculum" is jointly a function of the project theme and how the individual students choose to construct their projects. It is empowering for the learners as they set their own challenges, search for solutions, and collaborate with peers both to solve problems and share their knowledge. The "aha's" are very audible!

society session

How to Build Your Own Local Area Network

An ECMI Session

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Key words: LAN, Ethernet, TCP/IP, Internet, Novell

Abstract

This updated presentation provides the basic knowledge to the design and implementation of a low cost local area network (LAN) of PCs and MACs (from Apple Computers) with access to Internet and other existing networks.

The presentation will begin with popular Ethernet/IEEE 802.3 and the new 100Mbps standards. We will then discuss procedures for selecting, installing, and integrating all necessary hardware and software components. The hardware components include network interface cards, cables, hubs and routers. The software packages to be discussed are NCSA Telnet for PCs (DOS), WINSOCK (Windows) and for NCSA Telnet for MACs. After a step-by-step installation discussion, we will also show how this TCP/IP network with Internet link can be integrated into existing networks such as Novell. In addition, we will demonstrate how a home computer can become a network node through PPP links.

society session

Addressing Gender Equity in Computer Science

An ISTE SIGCS Session

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Key words: computer science, gender equity

Abstract

Although women make up 45% of the workforce in the United States, they make up only 30% of employed computer scientists. While on the surface this may not seem surprising considering the gender equity problems across the sciences, it is an issue to which the professional computer science community is paying an increasingly amount of attention, in hopes that it may not be too late to reverse a disturbing trend.

In 1992 the Association for Computing Machinery produced an extensivereport on gender-related issues in computer science. In an article entitled "Becoming a Computer Scientist" the Committee on the Status of Women in Computer Science states that it is widely known that women are underrepresented in the computing sciences, both in industry and academia. This underrepresentation, the Committee says, is alarming for two reasons, first, it indicates that there is something about the field itself that hinders women from pursuing it as a career option. And secondly it is likely to exacerbate the growing shortage of potential workers in a field which is already beginning to feel the effects of labour shortage.

The panel will explore the continuing issue of gender equity in computer science with a special emphasis on strategies for encouraging young women to see computer science as a viable and valuable career option. It will include discussion of such factors as gender biased software, access issues, mentoring and role models, curriculum and teaching, discrimination and the nerd culture. This panel is intended as a means of initiating a dialogue with a broad range of educators at both the secondary and post-secondary level. It is hoped that it will engender discussion, solutions and change.

classroom demonstration
Digital Portfolios: Product and Process

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Key words: hyperstudio, digital portfolio

Abstract

The Project

In the spring of 1994, each 8th grader in the Pierre Van Cortlandt Middle School in Croton-on-Hudson, New York, was required to create and present a digital portfolio representing his/her best works. After a general introduction to the hyperstudio program, the students began gathering work from the year that they felt had potential for this collection. Then, in collaboration with peers and/or teachers, they selected the pieces they planned to include in their portfolios and started to create their hyperstudio stacks. Most of the text was already word processed, so it just had to be translated to the proper format to be digitized. The new challenge of these collections was to present work other than text, including pictures, drawings, paintings, sculptures, musical performances, and other student presentations. Students digitized most of the drawings and painting using a scanner. They processed pictures of 3-D objects, large 2-D objects, and performances using a video camera and a video digitizer board. After the work was saved into their accounts, the students began developing and linking cards and stacks to create an interactive presentation. The project required all students to experience word processing, scanning, video and audio digitizing, and hypermedia development. When the collections were completed, the students were required to present and defend their work.

Observations

1. The project was unique because it was a requirement for ALL students in the 8th grade.

2. The portfolios required collaboration, encouraged students to serve as mentors for others, and enabled teachers to serve as coaches for student-centered learning.

3. The development of the digital portfolios blurred the distinctions between students usually considered "able" and those considered "weak." Some "smart" students would have avoided the project if they could have because it asked them to risk presenting their knowledge in new, challenging ways. On the other hand, some "handicapped" students created technically strong collections, focused more on the quality of their work than they had in the past, and helped other students complete the assignment.

4. The creation of a digital portfolio as a final demonstration helped students develop critical eyes and ears. Self-assessment skills were required and enhanced at every stage of the work.

5. The project expanded the audience for the students' work. They were proud to show their digital portfolios to their families, friends, and anyone else!

Demonstration

We plan to share some of the portfolios created by our 8th graders. You will be able to hear them introduce their collections and, sometimes, play musical selections. You can also see their faces, art, graphs, science projects, writing, and other work. It is essential, however, that we also discuss the process which resulted in the products you will see, for it is in the process that much of the learning occurs and the importance of the use of technology is most clear. In addition, we will discuss the process and progress of the district-wide digital assessment portfolio initiative that will begin this September.

classroom demonstration

Developing Rubrics for Multimedia

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Key words: multimedia, assessment, rubrics, active learning, quality

Abstract

Introduction

We want students to develop wonderful multimedia demonstrations that demonstrate their learning. Yet, we may not be giving them the proper tools for this.

Standards and Outcomes

Many states are encouraging better learning through the use of outcomes and standards. We can us · the same idea as we co-creat: ..ith our students standards and outcomes for presentations that emphasize the learning aspect.

Before we meet with our students, we have to determine for ourselves what outcomes and standards we believe are necessary for this project. We can base these on our district's outcomes, the state's outcomes, or national standards. Then we can specify the level at which we think the students should perform. However, our initial thinking needs to be blended with the students' thoughts about good learning.

Modeling and Rubrics

Students may have little idea of what a multimedia report is. They need to have a model for multimedia. They can look at multimedia demonstrations developed by previous classes or prepared by us. They can list what they think makes these demonstrations good examples of learning. A class recorder can write down these comments. Likewise, they can identify those things that could make these better demonstrations of learning. Again, the class recorder can transcribe these comments.

The teacher can help the students organize their thoughts to create a mutually agreed upon rubric (list of criteria) for the multimedia project. This rubric will help the students work toward a quality product. The students will then know what is expected, and they can self-evaluate their projects at any point.

The teacher, as facilitator, will help the students realize that multimedia is not just a tool for producing colorful and beautiful presentations, but is a tool for demonstrating learning. Likewise, the teacher will want to help the students to see how multimedia presentations differ from traditional reports. Only when students have seen the differences can they be expected to use those differences.

By developing rubrics based on good learning principles, the teacher can help students to produce quality multimedia presentations that demonstrate their depth of learning.

classroom demonstration

Authentic Assessment: Capturing Student and Teacher Performance in Electronic Portfolios

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Key words: electronic, portfolio, teacher, student, assessment, multimedia, Native-American

This demonstration will focus on how we successfully implemented authentic assessment in one public elementary school and one Native-American school with the collaboration of a multimedia consultant, university professor, teacher-education students, classroom teachers, and elementary students. You will get a glimpse of how we used multimedia technology such as scanners, video cameras, and audio devices to digitize samples of student and teacher work for their electronic portfolios. You will have the opportunity to see how using "IBM's Linkway Live!" and "Multimedia Assessment Tools: Student Portfolio" and "Teacher Portfolio" made it easy to record and retrieve the necessary data to indicate progress. You will also see the impact of on-going assessment and how we archived the student data on CD-ROM. Finally, you will see examples of how this can be applied to secondary student portfolios as well as to students on the college level. You will leave with a sample diskette, a configuration for getting started, and many ideas for implementing electronic portfolios in your own school.

project

Links to Learning: How One Company Created a Partnership with Teachers to Establish Telecommunications in Education

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Key words: telecommunications, partnership, Connecticut, telephone company, information superhighway, grant

Abstract

This session will include a review of telecommunications activities created by classroom teachers as participants in the SNET Links to Learning Program–a partnership program including one company (SNET–Southern New England Telecommunications) the Connecticut State Department of Education, and over 200 Connecticut classroom teachers. The overview will be presented by classroom teachers and a representative from SNET.

The effort was launched in 1988 with the overall goal of demonstrating and evaluating how telecommunications could be used in classrooms as a method of enriching the learning environment. At that time, electronic mail was a foreign term to educators; telecommunications was something engineers did, and telecommunications services (data telecommunications, voice messaging, and interactive video) were "unknown" and "untested" in education. How could these tools be adapted for a classroom? A partnership that involved three stakeholders–SNET, the Connecticut Department of Education, and teachers–was created to determine how best to accomplish that goal. As many studies point out, for a real partnership to exist it is imperative that each of the parties bring real value to the table. With Links, SNET provided financial support, program administration, hands-on training for teachers, and technological expertise. The State Department of Education opened school doors, that is, they acted as an interface between the business community and individual schools. Teachers brought the most important ingredient to the mix–their educational expertise, classroom experiences, and willingness to actively participate in the program.

Since 1988, the program has involved over 200 classroom teachers in efforts using telecommunications. From the beginning, SNET placed an emphasis on including as many teachers as possible in the effort. Rather than creating a "model school" program, SNET chose to offer small annual competitive grants that would allow all teachers an equal opportunity to pursue telecommunications activities with their own students. Participants range from complete novices to experienced Internet surfers. It would be easy to cite more examples (of teacher created applications) than space permits, so I will provide a few that demonstrate how teachers adapt the technology to their individual needs:

For those teachers who have limited or no experience with telecommunications, many implement basic telecommunications access such as America OnLine, Compuserve, or Prodigy as a means of "exploring" the technology. Others choose "structured" online services where lessons with defined activities have already been developed.

Other examples include: establishing links with senior citizen centers and elementary schools to share experiences; linking rural and urban elementary schools as e-mail partners; establishing BBS's that can be used as both a school and community resource; communicating with foreign students as part of foreign language classes; using portable facsimile machines as a means of reaching out to special needs students; and, of course, accessing the Internet as a tool for student and teacher activities.

Voice messaging provides teachers with the means to more easily communicate with parents and collaborate with other teachers–some schools chose to establish personal links with special needs parents while others establish school-wide systems. Finally, an interactive five-site fiber-based video network was established in 1988. This network continues to be used for all seven periods of the classroom day, allowing students to take courses that would otherwise be unavailable to them.

In February 1994, SNET announced their plans to create Connecticut's information superhighway: I-SNET. This announcement introduces a whole new era of telecommunications. In the future, it will be possible to: access remote multimedia services over "telephone" lines; Internet access will be available in an easy-to-use graphics interface; and interactive video will become a realistic classroom tool. Other as-of-yet undeveloped capabilities will be presented to both the educational and residential market. However, as in 1988, there are very few educational users who can offer input into how this information highway can best be used to enhance education. In an effort to evaluate these new technologies, SNET created a technology panel consisting of six Connecticut classroom educators selected through a competitive grant process who have accepted the challenge of developing a vision of how the information superhighway can influence education. The participants are now trialing technologies including high-speed Internet access, interactive desktop video; cellular telecommunications; and fiber connectivity to high ed resources. These six educators have accepted the challenge of using the "unknown" and "untried" technologies of today. They, as their predecessors of 1988 did, will lead the way for other Connecticut teachers by sharing their experiences and offering their individual support for those that follow.

In the years ahead, telecommunications technology will offer many new opportunities to educators. It is imperative that

educators have a role in how this technology can best be used in the classroom. Through Links to Learning, SNET continues to support the critical role of teachers as active partners in the ongoing development and evaluation of telecommunications as a classroom tool.

mixed session

Object-oriented CS1 Using Object-oriented Turing

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Key words: OOP, CS1, object-oriented Turing, pedagogy, languages

Introduction

Like many computer science departments in small liberal arts colleges, the department at Moravian College has committed itself to selecting programming languages and programming environments that assist beginning students in the mastery of fundamental programming concepts. The emphasis has always been placed on concepts believed to transcend superficial details such as syntax, and that will provide a longer-term benefit than just fluency in a particular language. Thus, the course at Moravian has never in its 15-year history carried any specific language–either in its title or course description. In fact, early in our program, we used Ratfor before Pascal compilers became readily available because we were sold on "structured programming" in procedural languages for introduction to beginning students.

We now find that object-oriented methodology is the best pedagogical approach for beginning students and believe that an environment that supports and elucidates mastery of concepts is the right choice for our first course. We have chosen Object-oriented Turing (OOT) for reasons that we hope will be clear by seeing examples.

Why Object-oriented Programming in CS1

In recent years, the CS1 course at Moravian has emphasized programming and problem solving using procedural languages. Though Turing was used in place of Pascal for a year or two (because it was felt to be less confounding for naive students), one would have viewed little difference in our course from many using Pascal as the vehicle language. The CS2 course, however, was less traditional and stressed "real-world" programming, such as the disciplined use of type bypassing, separate compilation, and division of source programs into specification and implementation modules. Generally, the CS2 course included a section in which OOP concepts were introduced. For several years, Eiffel was used and more recently, OOT.

The advent of reasonable environments for object-oriented languages such as that for OOT, the fact that the methodology has established increasing interest and use among practitioners, and, mainly, since there seemed to be no compelling rationale for continuing with a procedural language, convinced us to move to an object-oriented approach in CS1. Our brief experience suggests than an initial object oriented approach has some distinct advantages:

- First and foremost, students seem to find configuring solutions to problems in terms of objects that communicate via messages more natural than developing solutions in terms of more complicated algorithms.
- Programs are naturally highly modular and can be studied as individual components. We don't need to stress decomposition since solutions are naturally decomposed into a world of objects (classes).
- Programs are easy to modify in order to add or change capability or functionality. Beginning students can appreciate the need for ease of maintenance by practicing it.
- Constructs, such as functions and procedures, are natural aspects of implementing class methods. Students seem comfortable with this from the start rather than having to introduce these as mechanisms to structure the problem solving process.
- Examples and laboratory exercises are non-trivial–usually a minimum of 4 or 5 pages of code. Nevertheless, each class is relatively simple to understand, consisting of a few instance variables and several methods. We believe that this is much easier for students to comprehend than similar-sized examples based on procedural programs, even when those are well constructed.

Why Object-oriented Turing

Nothing seems more controversial than the choice of language for the beginning programming course. Though reasonably popular in Canada, Tu:ing and its object-oriented implementation, OOT, have not received wide exposure in the U.S. We feel this unfortunate for at least the following reasons:

- OOT is a completely integrated environment. We save considerable time by not having to present lengthy mechanical details of editing, file-management, etc.
- OOT has all the pedagogical features of Pascal with improved syntax, improved error checking, improved I/O and improved repetition constructs, among others.
- Object oriented programming is natural in OOT. It is not seen as an extension to an existing procedural language. Our experience supports this.

The easiest way to support this contention is to consider comparative examples.

Conclusion

Our courses have been quick to change when we see a better way to teach problem solving and to assist in the understanding of fundamental ideas. For now, we see object-oriented concepts supported by OOT as the best choice for the first course.

panel

I*EARN and Discovery Communications: A Collaboration Model

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Key words: telecommunications, television, African-American, migration, history, I*EARN, Promised Land

Abstract

A Model for Collaboration

This presentation describes a model for collaboration between the Discovery Channel and I*EARN. I*EARN is a leading telecommunications network that provides an international forum for young people to explore social and environmental issues online. I*EARN is part of the new "Discovery Learning Community," a special place on the Internet where teachers, learners and community mentors can explore the educational programming on The Discovery Channel and The Learning Channel. The Discovery Learning Community currently focuses on The Discovery Channel's series *The Promised Land*, a five-hour documentary film that chronicles the massive 20th century northern migration of African Americans.

The Discovery Learning Community and *The Promised Land*

Music, art, first-person commentary, and a treasure-trove of film footage and photo stills enable the Discovery Channel's *The Promised Land* to tell the little-known story of America's greatest migration. As the series reveals, from 1940-1970 more than five million African Americans left the poverty and oppression of the rural South for the prosperity and freedom they believed awaited them in the industrial North. Collectively, their journey forever changed American history, politics and culture, and put race relations on the national front-burner. Inspired by Nicholas Lemann's book of the same name and narrated by actor

Morgan Freeman, it is the first major television production to chronicle this American saga.

The Promised Land series aired during primetime on the Discovery Channel in February 1995. It was also scheduled, commercial-free and copyright cleared for teachers, during the spring of 1995. In the Discovery Learning Community, *The Promised Land* serves as the foundation for myriad academic and cultural inquiries and is understood to be a centerpiece of the African American experience.

You may visit the Discovery Learning Community by Web or Gopher:

URL: http://Discovery.syr.edu/Discovery

Or go to the gopher address: Discovery.syr.edu (port 95)

If you do not have access to the Internet, you can still participate, either through American OnLine (go Discovery) or via our active e-mail based Listserv Discussions. For more information, send e-mail to: educ@discovery.com

I*EARN (The International Education and Resource Network)

The purpose of I*EARN is to facilitate educational projects designed to empower young people (K–12) to make a meaningful contribution to the health and welfare of people and the planet. Students work collaboratively in different parts of the world through global networking. In this project students go beyond both simply being "pen-pals" and working on strictly academic work to use telecommunications in joint student projects designed to make a difference in the world. The network is expanding to additional international sites daily and now includes about 500 schools in over 20 countries.

Participants can join existing structured online projects or work with others internationally to create their own projects within the following subject areas of environment and science; arts and literature; social studies, economics, and politics; and interdisciplinary projects. Project facilitators provide online support for each project. Further, I*EARN uses extensive online conferencing as a means of creating "rooms" for project work. The contents of these rooms are shared automatically with the other APC networks used by I*EARN–minimizing costs and maximizing involvement by students and teachers around the world.

I*EARN is a non-profit organization. Not wanting to "re-invent the wheel," we look very seriously at international partnerships that exist already to see if adding telecommunications would enhance and deepen the relationship. Examples of such collaboration with youth and service groups include, Save the Children, World Scouts Environment Network, Partners of the Americas, street children organizations in Brazil and elsewhere, the United Nations Environmental Programme (UNEP), UNICEF, international exchange student programs, etc.

A few examples of recent student projects include:

- "The Contemporary"–News magazine
- "A Vision"–Award-winning literary journal
- "Planetary Notions"–Environmental Newsletter
- "Liberty Bound"–Human rights newsletter
- "ICARUS"–Ozone measurement and newsletter
- "The People We Admire–Las Personas que Admiramos!"–A Bilingual study of cultural heroes
- Holocaust/Genocide Project & Newsletter
- Water pollution measurement
- Rainforest Project
- Support for children in Bosnia and Somalia
- Building wells for clean water in Nicaragua
- The Family Project–A cross-cultural comparison
- The Tolerance Project–Promoting respect and human rights

If you have access to gopher, additional information on I*EAFN, how to participate and a brief description of I*EARN projects (in English and Spanish) is available: gopher.igc.apc.org

URL address: gopher://gopher.igc.apc.org:70/11/orgs/iearn

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panel

Asserting the Role of Programming in the Intellectual and Creative Development of Students

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Abstract

In a mysterious act of insanity, the K–12 school community unilaterally declared programming obsolete. Since the mid-1980s, public education has created a hostile climate towards the act and importance of programming in favor of application software and computer-assisted instruction. This belief is often rooted in the misguided notion that the future will be programming-free. Imagine a world in which every problem can be solved by pointing and clicking. This session will explore the reasons for the death of programming in schools and assert the importance of programming as a legitimate, creative, and intellectual form of expression in the lives of every student.

The programming ban is probably the result of several phenomena, including:

1. The growing educational computing industry creating lots of software packages that schools "just must have."
2. The dire shortage of computers available for long-term student projects were freed-up for obvious short-term uses like word processing.
3. The arrogance and elitism of the AP Computer Science exam.
4. A shortage of teachers who can program.
5. A lack of understanding of what programming is, how it has changed, and the educational benefits of programming.

There is much evidence in the world of learning research and the software industry to argue against the programming ban. The future includes programmable applications, object-based applications, and open architecture system software. At the most pedestrian level, the question could be asked, "Who will create the great software of the future?"

We will explore the intellectual, creative, political, and economic imperatives for providing children with thoughtful programming experiences. This lively session will attempt to define what programming is and the role it should play in the education of children. Examples of student projects will be shared.

panel

California Model Technology Schools, Eight Years and Eighteen Million Dollars Later, Was It Worth the Money?

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Abstract

Eight years ago, California was the first state in the nation to fund Model Technology Schools Projects. These projects were expected to explore the full potential of educational technology from Kindergarten through grade 12 and across all subjects. Funded at approximately $2.8 million dollars each, plus a large infusion of local and business funds, each of the six projects set out to explore different possibilities for the use of technology in education. Now, for the first time nationally, the directors and staff of the six projects share the results. Did the projects fulfill their purpose? Did the projects fulfill their promise? What lessons were learned? What promising practices can be adopted or adapted? Join us for an interactive session featuring video clips, stories, questions from the audience and a few surprises.

panel
Teaching Teleapprenticeships: Using Electronic Networks for Improving Teacher Education

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Key words: electronic networks, teacher education, teacher preparation, teleapprenticeships, network tools

Abstract

Teaching Teleapprenticeships: An Overview

Teaching Teleapprenticeships are innovative frameworks for improving the education of teachers by using telecommunication networks. We have been able to engage education students in interaction with K-12 teachers and students in ways that

are integrated into their education courses and contextualize their learning in authentic K–12 education settings. In this panel, we will describe a range of Teaching Teleapprenticeships models we have implemented, and report on our evaluation of how these approaches may contribute to improving teacher education.

Teaching Teleapprenticeships in an Undergraduate Introduction to Biology Class

Over the past three years, education majors enrolled in an introductory college biology course for non-majors have participated in Teaching Teleapprenticeships. These involved using advanced communication software tools and the Internet to explore network-based sources of biology-related information and to interact with students in K–12 classrooms.

The project has three major goals:

1. To give the university students experience with computer networking and e-mail.
2. To provide an opportunity for education majors to communicate with K-12 students and to find out what kinds of questions they are asking regarding life science topics.
3. To complement their knowledge in the biology course by giving them a need to find new sources of information beyond the course lecture and lab.

This presentation will describe and compare the lessons learned from three different models for structuring the undergraduate students' involvement in the networking activities during the semester.

Teaching Teleapprenticeships in a Year-long Elementary Student Teaching Program

The year-long elementary student teaching program at the University of Illinois at Urbana-Champaign is a collaboration between selected elementary school teachers, university faculty, and the students in the program. By using laptop computers and networks, the Instructional Teams of university faculty and precollege teachers could extend their ability to communicate with the undergraduate students. This has led to course assignments that require the students to use e-mail, the formation of reflector lists that make it easy to contact all students and/or instructional team members, the requirement that students subscribe to one or more listservs and monitor them, and the development of a gopher file containing the course syllabus, course assignments, and curriculum guides of two local school districts. Selected units of study created by the students have been published on the College's Learning Resource Server.

Assignments are being developed in regularly scheduled collaborative meetings, and encouragement to use the computers comes from all the various instructional teams. A syllabus for the technology portion of the students' education will also be discussed.

Teaching Teleapprenticeships and the Impact on Teacher Educators in a Secondary Student Teaching Program

For three years we have been tracking the impact of telecommunications on learning to teach. On interesting by-product of this research is the impact of Teaching Teleapprenticeships on learning to teach teachers. In this presentation, we will talk about the impact of telecommunications on elementary and secondary teacher education faculty at the University of Illinois.

Teaching Teleapprenticeships and the Learning Resource Server: Improving Teacher Education using Gopher and WWW

The Learning Research Server (LRS) is a suite of information servers that form multiple realizations of a distributed learning network. The LRS supports overlapping communities of teachers, researchers, and learners who construct and use the resources available on the LRS. Those resources are in the form of documents, software, images, sounds, databases and, most recently, digital video that was produced within the immediate TTA community.

Conceptual Frameworks and Software Tools for Teaching Teleapprentices

While computer networks offer new learning and support opportunities for students in teacher education programs, these technologies also pose conceptual and technical challenges to these students. We will discuss conceptual frameworks and new network software tools we have been developing to help minimize the challenges and to better support teaching teleapprentices in their uses of rich, globally interconnected network learning environments.

panel
Teaching with Technology: A Faculty Development Perspective

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Key words: faculty development, higher education, K-12, teacher training, curriculum, integration, training

Abstract

Introduction

This panel discusses the role of faculty development in four very different institutions–a state university, a private university, a metropolitan school district, and a professional development school–and explores how the mission and philosophy of each site influences its uses of technology.

The University of Central Oklahoma

The College of Education (COE) at the University of Central Oklahoma, Edmond, Oklahoma, is the largest teacher preparation institution in the State of Oklahoma. Of the 16,000+ students at UCO, 6000 are enrolled in the COE. In addition to the students, the college is home to 105 full-time, and 110 part-time faculty members who provide instruction in six department areas.

The philosophy of the college is based on the goal of "infusing technology across the College of Education." This idea is based on the belief that the use and understanding of technology is a new basic skill that should be integrated across all classroom instruction. In addition, the college believes that users should have a clear understanding of the roles and appropriate uses of technology in learning environments and in society.

Developing faculty understanding of this approach is a high priority. The first facet of this approach was to identify several courses that could use technology with a large number of students. Included in this is education for faculty in the potential for multimedia presentations and coursework. Faculty members consulted the college technology support personnel to develop ideas based on the content of the course. The college then committed itself financially, purchasing hardware and software needed to make these ideas successful.

The college has seen major increases in requests for computers and software, conflicts in scheduling of equipment, and involvement in networking. Further, the college community's understanding of the role of technology in curriculum and communication has changed. Finally, several courses have incorporated technology into the fabric of the course.

Baylor University

Baylor University, a private liberal arts university, offers undergraduate, graduate, and professional degrees to approximately 12,000 students. The School of Education (SOE) enrolls 1,500 students and is served by 55 full-time faculty and 17 staff. Within the SOE, 118 Macintosh computers are connected to the campus network. The SOE houses the Center for Educational Technology (CET).

The CET's work is based on 4 beliefs:

1. Technology is the systematic application of what we know to what we do.
2. Technology liberates when individuals control technology.
3. Basic concepts and primary skills are critical.
4. Rapid technological development permeates the environment.

Five goals activate the philosophy:

- Develop and offer curricula.
- Create and maintain facilities.
- Identify and obtain equipment.
- Provide exemplary services.
- Acquire, develop, and enhance technological expertise>

The most effective program is BITE (Baylor Institute for Technology in Education), which consists of 2 weeks of voluntary faculty development offered after the spring semester and before the 1st summer term. More than one-third of the faculty have voluntarily participated. Curricular activities within 20 courses can be directly attributed to BITE.

Killeen Independent School District

Killeen ISD has a highly mobile population of more than 27,000 students served by 1,633 teachers on 34 campuses. Four new schools will open in the fall of 1994.

After a broad-based strategic planning initiative in 1990, technology was identified as a key district strategy. KISD uses an "Application Tools" approach to promote seamless integration of technology. Teachers must be supported and successful if

expected to change teaching behavior and achieve true integration.

Teachers voluntarily attend "Computers for Teachers," a 45-hour inservice training component. Upon completion, they receive a Macintosh computer, software, printer and supplies to use as long as they are teaching in KISD. Training is designed and conducted at the district level with daily campus-based support and continuing training by the "Campus Technologist." Once trained, teachers become eligible to submit a proposal for a "Computers for Teachers Phase II Classroom grant."

Hillcrest Professional Development School

Hillcrest Professional Development School is a collaborative effort between Baylor University and the Waco, Texas Independent School District. The self-directed school of 271 students is led by Baylor faculty with teams of master teachers, beginning teachers and preservice teachers.

For many teachers, the first step toward integrating technology into their classroom is to gain personal confidence and comfort. Only then will a majority or teachers connect the technology to the curriculum.

The school year starts with faculty conferences and surveys focusing on: comfort using various aspects of technology, comfort teaching various aspects of technology, and training needs. Several months into the school year, teachers meet to review software packages representing a curricular spectrum. Teaches not only had demonstration and hands-on experience, but they also developed ownership. Ongoing staff development activities reflect the survey results.

paper

Caltech CRPC Outreach Programs for Minorities and Women

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Key words: outreach programs, parallel computing, software, minorities, women

Introduction

In late 1992, the National Research Council issued a full report addressing the future of computing [Cou92]. Among the recommendations espoused by the Council is the following (page 154): "The academic CS&E community must reach out to women and to minorities that are underrepresented in the field (particularly as incoming undergraduates) to broaden and enrich the talent pool." In 1994, the National Science Foundation's Center for Research on Parallel Computation (CRPC, a consortium of six universities) at the California Institute of Technology (Caltech) sponsored many programs [TR93]. These activities collectively aimed to reach out to women and minorities at different levels of the educational pipeline (high school students and teachers, and undergraduate students and teachers). These outreach programs were developed to encourage female and minority students to pursue advanced studies and research in high performance computing. This document describes four outreach efforts designed and administered by Caltech CRPC scientists and students:

1. Minority youth awareness program.
2. Minority teachers education workshop.
3. A talk at the ADMI conference.
4. Undergraduate summer research program. Each of these endeavors was well-received by its participants, and some can be emulated at other institutions. Caltech's CRPC site plans to continue these programs annually.

Minority Youth Awareness Program

More than one hundred Los Angeles County high school students visited Caltech on March 21 and 22, 1994, for a computer awareness program. The two-day event, dubbed "Computers: The Machines, Science, People, and Careers!" [Mul94], was designed to encourage minority teenagers to consider computing careers, by exposing them both to the science and technology of computational science and engineering. This year marked the second time the program was conducted at Caltech. Sessions focused on the history and evolution of computers, current computer applications, and the futures in computer science. Participating students traveled to different sites on the Caltech campus for seminars, workshops, and video presentations. In addition, they were able to see and to report to each other about more than two dozen on-site applications of computer technology and computational sciences. By exposing young scholars to real-world uses of computers, professors sought to support the following program objectives:

1. Inspire curiosity about computers by showing them to be fun and exciting.
2. Demystify computer science through face-to-face interaction with professionals.
3. Preview the challenges and rewards of a computer-related career.
4. Develop participant confidence that they could succeed in such a career.

The event was organized by James Muldavin, with the aid of Caltech CRPC Administrative Assistant JoAnn Boyd [Boy94]. Support was provided by the CRPC, with cooperation from Mathematics, Engineering, and Science Achievement (MESA).

Summary of Activities

The minority youth awareness program spanned two days, as summarized in tables 1 and 2.

Overview, Day One

Time	Activity
7:30 am	Arrival: Breakfast
8:30 am	Video/ Discussion: PBS's *The Machine That Changed the World*
9:45 am	Opening: Overview and welcome
10:00 am	Icebreaker: Familiarize participants with topics
10:40 am	Keynote: Dr. William Lester, U.C. Berkeley Chemistry
11:30 am	Interaction: Hands-on Using computers
12:15 pm	Lunch: Sandwiches and discussions
1:15 pm	Community: On-site visits to Caltech labs (astronomy, seismology, geology, physics, civil engineering, planetary science, math)
3:35 pm	Interaction: Student reports on on-site visits
4:00 pm	Leave: Send-off messages

Table 1. Minority youth awareness workshop, day one.

Overview, Day Two

Time	Activity
7:30am	Arrival: Breakfast
8:30 am	Video/ Discussion: PBS's *The Machine That Changed the World*
9:30 am	Q&A Session: Students invited to field questions
10:00 am	Interaction: Parallel processing workshop
11:00 am	Community: On-site visits to Caltech labs (satellite, photography, aeronautics, climate modeling, graphics, biotech, economics)
12:35 pm	Lunch: Pizzas and discussions
1:15 pm	Interaction: Student reports on on-site visits
1:45 pm	Keynote: Career opportunities, by Al Paiz of JPL
2:15 pm	Round-Robin: Educational and career opportunity presentations
3:30 pm	Evaluation: Students share thoughts and ideas
4:00 pm	Leave: Send-off messages

Table 2. Minority youth awareness workshop, day two.

In the next section, as an example of the caliber of the on-site visits, we discuss one of the activities in which the students participated: a parallel processing workshop.

Parallel Processing Workshop

The centerpiece of this workshop was Dr. K. Mani Chandy's hands-on introduction to parallel and sequential computing. He guided the students through an archetypal case study of sorting students, introducing them to software engineering, good algorithm design, and the tradeoffs between alternative solutions. This particular program struck a balance between teaching a few key concepts: keeping students' interest, and simplicity of execution, as elaborated upon in [Rif94]. Our intention was to encourage the students to learn more about parallel computing in the future, and to convince them that computer science is fun. We also wanted them to think critically about issues involved in program design. We therefore set a goal to convey the following points:

1. Computer science concepts are not difficult.
2. Computers operate by following a specific set of rules.
3. More than one set of rules (algorithms) can be designed to solve a problem.
4. Good algorithm design is important for obtaining correct and efficient solutions.
5. Parallel operations are sometimes a natural way of thinking, and can have more efficient performance than sequential operations.

We used the task of sorting a list of numbers to convey our points; allowing each student to "be a number" in the list would provide interactivity. After Dr. Chandy's tutorials, several graduate students helped small groups of students tackle the problem of sorting numbers by themselves. Leaders walked the groups through three different solutions by assigning each a value and "role-playing" the algorithms:

1. Bubblesort to illustrate a sequential solution.
2. Even-Odd Transposition to illustrate a natural parallel version of Bubblesort

3. Parallel radix sort as an alternative parallel solution for comparison.

The 50-minute workshop took the following format:

1. Students were given a short handout the previous day to familiarize themselves with the flavor of the workshop.
2. The workshop began with a 20-minute talk, briefly discussing computer science, good algorithm design, and parallel programming. The talk also described the problem of sorting a list of numbers, and the three algorithms we were going to explore. Audience participation was encouraged, and the underlying emphasis of the talk was that computer science is challenging, and often fun.
3. We then brought the students outside and divided them into nine groups of approximately the same size. Each group was led by a student volunteer from Caltech.
4. Three 10-minute exercises were performed by the group, one for each of the three algorithms discussed, led by instructions given by workshop leader Mani Chandy. Coordination was handled by the group leaders.
5. These exercises culminated in a sorting race, in which all the groups attempted to sort themselves faster than their peers.
6. The workshop closed with some discussion, and students completed a short evaluation form.

The results [Rif94] indicated that students had learned about many of the issues involved in parallel computation.

Minority Teachers Education Workshop Whereas the Minority Youth Awareness Program focused on enthusing minority teenagers with the prospects of studying and working in computing areas and applications, the Minority Teachers Education Workshop focused on helping their teachers to encourage the students with such prospects. High school teachers from various Los Angeles and Pasadena minority districts were invited to participate in the week-long sixth annual Minorities Teachers Computational Sciences and Graphics Awareness Program at Caltech, held June 20-24, 1994. JoAnn Boyd once again did a fantastic job of organizing the lineup of activities [Boy94].

Overview, Day One	
Richard Tapia	Contemporary Issues in Education (3 hours)
Michael Holst	Protein Modeling Equations (1 hour)
Paulett Liewer	Solar Wind Modeling (1 hour)
John Salmon	Particle Physics Simulations (1 hour)
Overview, Day Two	
Adam Rifkin	Electronic Textbooks for Teaching (3 hours)
Michael Garcia	Jet Propulsion Laboratory Tour (3 hours)
Overview, Day Three	
Kimberly Douglas	Hands-on with the Internet (1 hour)
Michael Harrington	Molecular Biotechnology (1 hour)
Jerry Solomon	Protein Folding Computational Methods (1 hour)
Roy Williams	Tour of Parallel Supercomputers (1 hour)
Al Barr	Computer Graphics Research (2 hours)
Overview, Day Four	
Jerry Landry	GALCIT 10-ft Wind Tunnel Tour (1 hour)
Bahram Valiferdowsi	GALCIT T5 Free-Piston Shock Tunnel (1 hour)
Tony Leonard	Computational Fluid Dynamics (1 hour)
Carl Kesselman	Parallel Computing and Object Oriented Programming (2 hours)
Adam Rifkin	Should All Education Herein Be Video Games? (1 hour)
Overview, Day Five	
Michael Holst	Numerical Simulation of Black Holes (1 hour)
Charles Plott	Economics and Poly Sci Experimental Methods (2 hours)
Dave Wald	Southern California Earthquakes (1.5 hours)
Eric Van de Velde	Panel Discussion (1 hour)

Table 3. Summary of the minority high school teachers workshop.

Discussion topics highlighted interdisciplinary applications of computer graphics, biotechnology, and concurrent computing systems. Exposing teachers to the cutting edge of computational science helps them influence their students in turn, by providing concrete experience with the academic and employment opportunities in the field.

The program was not designed to teach advanced biology or computational science to the participants, nor did it enable them to teach those disciplines. Rather, it taught them about the progress and opportunities in these evolving fields. This improved their ability to motivate and counsel their students, since advice and stimulation from a special teacher is a major factor in opening up to many minority students the fascinating careers available in science and technology. In addition to the discussion sessions, the teachers toured the Caltech Concurrent Supercomputing Facilities, the Jet Propulsion Laboratory, and other advanced Caltech laboratories.

Participating teachers were offered a $500 honorarium by the CRPC for the five day, thirty hour program. This activity was part of the Minorities Programs of two NSF Science and Technology Centers at Caltech: the CRPC, and the Center for Graphics and Scientific Visualization. Scientists from both of these centers, as well as other faculty, staff, and students of Caltech, participated in the Awareness program. Table 3 describes activities during the five days of the workshop.

ADMI Presentation and Discussion

The CRPC sends speakers out to regional conferences on minority undergraduate education to complement its local efforts at the various sites. The Association of Departments of Computer Information Science and Engineering at Minority Institutions (ADMI) had its annual workshop July 22-24, 1994, at Spelman College in Atlanta, Georgia. The CRPC sent Adam Rifkin to talk about its concurrent programming tools. Other ADMI 94 talks covered the following subject matter (as listed in table 4): the Linux operating system, languages, network starters, PC-DOS tools, numerical packages, NCSA software, Internet, World Wide Web, scalable computing for HPC, and applications.

Presenter	Session Overview
Jesse C. Lewis	Keynote Address
Byron Jeff	Linux Operating System (3 hours)
Andrea Lawrence	Languages (1 hour)
Jerome Bennett	Network Starters (1 hour)
Ben Martin	GNU, PC-DOS, Numerical Packages (1 hour)
Robert Panoff	Hands-on with the World-Wide Web (3 hours)
Pamela Deveaux	Diversity Programs and Educational Initiatives (2 hours)
Forbes Lewis	Programs at the NSF (1 hour)
Adam Rifkin	Parallel Processing Tools (2 hours)
Anna Frederick	Scalable Computing for HPC (2 hours)
E.C. Ogbuobiri	HPC Applications (1 hour)
Robert Poole	Training and Infrastructure Requirements for HPC (1 hour)
Sandra DeLoatch	Training and Infrastructure Requirements for HPC (1 hour)

Table 4. Summary of the ADMI workshop.

The theme of the workshop was "A Quality Computer Science Program on a Shoestring Budget"; the speakers presented quality, inexpensive software that will execute on inexpensive machines. CRPC research projects are ideal in that they represent cutting-edge work available for free from the working groups. These projects enable people to experiment in high-performance computing at a relatively low cost; for example, softlib provides a centralized system for distributing software and other materials developed at CRPC collaborating institutions.

The CRPC talk disseminated information the CRPC's ongoing research, and how the attendees could get free software currently being developed by the CRPC's research groups [TR93]. This software included MPI, P4, Fortran D and the D System, Maisie, Fortran M, CC++, PCN, xNetlib, and eText. We also discussed the softlib and netlib repositories, the CRPC World-Wide Web page, and other Internet resources; table 5 lists some of the sites mentioned. In addition, participants were treated to videos including the LA smog simulation developed by Donald Dabdub and John Seinfeld at Caltech, a CC++ thread visualization graphics demonstration by James Patton of Caltech using a tool called PABLO developed by Dan Reed at the University of Illinois, and the CRPC high school minority youth program.

CRPC Resource	World-Wide Web Location
Home Page	http://softlib.cs.rice.edu/CRPC.html
ARPACK	http://www.netlib.org/
Benchmark Suite for HPF and Fortran D	gopher://softlib.rice.edu/
CC++ Language	http://www.compbio.caltech.edu/ccpp/
eText	http://www.etext.caltech.edu/
Fortran D Language	gopher://softlib.rice.edu/
Fortran M Language	http://www.mcs.anl.gov/
Ian Foster's book on parallel programming	http://www.mcs.anl.gov/dbpp/
F77D Compiler	gopher://softlib.rice.edu/
F90D Compiler	gopher://softlib.rice.edu/
HeNCE	http://www.netlib.org/
HPF Specification	gopher://softlib.rice.edu/
LAPACK	http://www.netlib.org/
Maisie	ftp://ftp.cs.ucla.edu/pub/
MPI Specifications	http://www.mcs.anl.gov/
PCN	gopher://softlib.rice.edu/
P4	http://www.mcs.anl.gov/
PVM	http://www.netlib.org/
ParaScope	gopher://softlib.rice.edu/
ParkBench	http://www.netlib.org/
PDS	gopher://softlib.rice.edu/
Softlib	gopher://softlib.rice.edu/

Table 5. Excerpt from the CRPC World-Wide Web sites distributed at ADMI.

We also provided information about some of the outreach programs in which the CRPC is involved. It was interesting to hear mixed reviews of praise for the CRPC for going out of its way to attract minority and female students, and criticism of the fact that, for example, a lot of the students that we attracted to Caltech for our summer program were what they deemed "well to do"; that is, these are already highly motivated students at top colleges, and our outreach programs should try to reach students at "second-tier" schools as well. No consensus was formed about how to be all-inclusive, but most participants agreed that the CRPC's programs represented a good step in the right direction.

In all, the CRPC talk lasted two hours, and an additional ninety minutes were spent after the talk discussing issues that had been raised. The response was overwhelmingly positive. Discussion accompanied ADMI 94, and frustration about the underlying attitudes that prevent minority students from pursuing higher education was vented.

Undergraduate Summer Research Program

Each year the CRPC sponsors a number of female and minority undergraduates to spend a summer doing research with Caltech scientists. In 1994, eight Women in Summer Parallel Research (WSPRs) conducted original research in concurrent algorithm development.

Female third and fourth year undergraduates were invited to apply to this small, intensive, personalized program in applied computation at Caltech. Eight women out of eighty applicants were chosen to participate in the program, which was managed by JoAnn Boyd, Herb Keller, Dan Meiron, Mani Chandy, and Caltech students Peter Hofstee, Svetlana Kryukova, Rajit Manohar, Berna Massingill, Adam Rifkin, Paul Sivilotti, and John Thornley. The program has succeeded in previous years as a minorities summer research program; this year, the WSPR's produced several excellent papers detailing their research [Boy94].

The undergraduates worked closely with Caltech groups (other undergraduates, graduate students, staff, post docs, and faculty) on exciting research dealing with computation and its applications. Students worked with their groups, using parallel supercomputers and networks of workstations to develop parallel algorithms helpful in the sciences and technology. Students learned about application areas of interest to them, learned to develop programs for parallel computers, and then used the computers to solve a problem in their area of interest. Research areas available to pursue included applied mathematics, astronomy, biology, chemistry, computer science, economics, and physics. Students were given genuine opportunities to conduct research on significant problems with experts in their fields, using the advanced equipment of the CRPC.

Students were given a minimal load of instruction about parallel languages, using Unix, the World-Wide Web, LaTeX, and HTML. The women created World-Wide Web home pages, collected centrally at the URL site http://www.ama.caltech.edu/~joann/crpc/sugp94.html. Meanwhile, students participated in their research from the beginning, including a weekly meeting in which everyone discussed their current research and bounced ideas around. Most of the students exhibited a degree of maturity that allowed them to seek out fellow researchers, establish research goals for themselves, and implement their goals. The students came from diverse backgrounds, with varying degrees of expertise in computing. Students received a stipend of $1500 per month, a reasonable travel allowance, and lodging on the Caltech campus.

The eight students in the program worked on a variety of projects, although many of them worked on aspects of the ongoing Archetypes project [Cha94] at Caltech. We provide a summary in table 6. For those readers interested in the technical details of the projects, research summaries follow.

Researcher	Project
Amy Biermann	Parallelizing Othello Algorithms
Tzu-Yi Chen	Parallel Mesh Archetype Applications
Mauria Finley	Parallelizing Checkers Algorithms
Claudette Martz	Distributing Objects in OS/2
Anita Mareno	Parallel Mesh Archetype Applications
Yolanda Palomo	Parallelizing Dynamic Programming Algorithms
Alissa Pritchard	Parallelizing Branch-and-Bound Algorithms
Linda Stewart	Parallel Message Passing

Table 6. Summary of the WSPR projects.

Amy Biermann, Bryn Mawr

This project explored the design, implementation and performance of the minimax algorithm with alpha-beta cutoffs in both the sequential and parallel domains for the game Othello. Optimizations for both the parallel and sequential versions were investigated. It was found that the parallel algorithm can achieve a 50% speedup over the sequential version on 4 processors, with promise for much more, though this research did not investigate performance using general numbers of processors. Experience with parallelization suggests that there will be an optimal number of processors for the game to achieve a good balance between communication overhead and load balance. This may be difficult to analyze because the optimal number of processors may vary with the size of the tree to be searched. All of the improvements to the code focused on the time performance of the game.

Tzu-Yi Chen, MIT

This work implemented the pseudocode for several iterative methods presented in Templates for the Solution of Linear Systems by Jack Dongarra, et. al, using an existing mesh archetype to achieve parallelism. This project focused in part on exploring the potential usefulness of archetypes which hide inter-processor communication from the user. Use of the mesh archetype simplified the parallelization of the sequential pseudocode; in particular, the time spent learning how to use the archetype was small compared to the time that would have been needed to learn message passing in Fortran-M, to implement the communication structure needed, and to debug the parallel code. In addition, good scaling was seen for up to four processors. With more than four, the time needed for communication between processors began to overwhelm the time used for computation. However, to ensure that archetypes will be used, detailed documentation is necessary, to make clear when it is appropriate to use a certain archetype, and to make using the archetype intuitive. This project also implemented iterative methods in an easy-to-use fashion, making them suitable for students in solving assorted discretized partial differential equations. By using an idea termed "intuitive stencils", the implementation chosen simplifies the connections between the physical problems posed by certain elliptic partial differential equations, the storage of the diagonally sparse matrices created by the discretization of these equations through finite difference analyses, and the iterative methods used to solve them. In short, this work explored the usability of archetypes by using the mesh archetype to implement a program presenting iterative solvers in a simple and usable fashion.

Mauria Finley, Stanford

This research looked at two parallel implementations of minimax with alpha-beta cutoffs for the game checkers. A centralized algorithm was designed to provide three-fold speedup for a small number of processors. This implementation was then compared to a decentralized algorithm designed to scale to a larger number of processors. The work investigated the problems of granularity, latency, and load balancing, common to all parallel algorithms. Parallelizing minimax with alpha-beta pruning included a challenging problem: to exploit the parallelism without increasing the size of the search (which would counteract the gains of alpha-beta pruning).

Claudette Martz, MIT

This work used OS/2's multitasking and CORBA-compliant distributed objects (DSOM) to obtain performance speedup. The aim of such work was to facilitate the porting of code to a PC platform. OS/2 provides a broad range of synchronization and communication mechanisms, and further support for additional paradigms might be needed. With support for parallel blocks, atomic functions, and synchronization variables, for example, a large collection of CC++ code could have been trivially ported to OS/2. With support for explicit message passing, ported channels, and process creation, Fortran M style programs would be easily translated to run on OS/2. With the increasing popularity of PC's as parallel platforms, such an exploration of the costs/benefits involved in running these applications, typically targeted for networks of workstations or mpp architectures, might have been interesting. We examined OS/2 as is, with no modifications or additions to the fundamental programming paradigm, to determine the ease with which parallel applications can be developed from correct sequential ones. Debugging was found to be a huge problem in the parallel domain.

Anita Mareno, Wellesley

A template is a skeleton of a parallel program that can be re-used with various parallel applications programs that share common features of communication and computation. This work provided the documentation and the code for a 1-dimensional template that characterizes mesh computations, which can then be incorporated into the archetypes methodology for scientific computation.

Yolanda Palomo, UCLA

This work investigated sequential and parallel implementations of algorithms developed using the dynamic programming archetype. Using C and the NX library, solutions to the all-points shortest-path and zero-one knapsack problems were written.

Alissa Pritcard, UC Berkeley

This research project involved creating a template for branch-and-bound tree search algorithms that would enable the user to be concerned with the branching and bounding functions and not with the upkeep of data structures. The template allows the user to run a developed program in either the sequential or parallel domain, without changing the branching and bounding functions that the user provides. The parallel implementation was written using the NX library package, which provides a message-passing interface that can be used to write parallel programs for multicomputer systems, such as the Intel Touchstone Delta Supercomputer, and for networks of workstations. An application of the template, the 0-1 Knapsack Problem, was written to demonstrate the use of the template, and performance timings showed the superior performance of the parallel implementation.

Linda Stewart, Mississippi State

This work explored message-passing paradigms on multicomputers. Several programs were developed, and issues involved in the writing and debugging of parallel programs were explored. The primary focus of this project was the nearest neighbor problem, which involved finding the closest pair of points, given a set of N points in a plane. A sequential and parallel solution to the problem was developed and tested. The sequential version was written in C, whereas the parallel version was implemented using NXLib. The student plans to continue future research on this project at her home institution.

Summary

The 1994 outreach efforts initiated by the CRPC at Caltech have sought to encourage women and minority students at many echelons of education, and their teachers and mentors, to pursue computer science studies and careers. These efforts have been well-received and the CRPC intends to build upon them in future years. We plan on follow-up studies in a year or two to determine the effects of the programs on their participants.

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paper

Gender and Computer Science Majors: Perceptions and Reality

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Abstract

Although women do as well as or better than men in our introductory computer science course, relatively few women even attempt the first course. We recently analyzed the transcripts of all computer science majors over the past five years in an attempt to determine why. We confirmed that women are doing as well as men throughout our curriculum. Moreover we found that women out-perform men at every level of mathematics we studied. A survey of our current students revealed that both men and women believe that men surpass women in calculus. We present some strategies to correct that misconception, in the hope that it will encourage women to enter and remain in computer science.

Introduction

It is well known that the percentage of women in the computer science field is small, and dropping, particularly in academia [GM91]. Although the discrepancies are widest at the Ph.D. level, the gender gap has been shown to appear even before college. This phenomenon is particularly distressing because it is unrelated to competence in the field.

Low self-confidence among women concerning their ability to do science is common in women who switch out of science engineering and mathematics (SEM). Moreover, studies have shown that it is independent of the women's actual level of performance [SE93]. Other studies [WD86],[SH94] found that the strongest difference between male and female science students is in their level of self-confidence.

A study of graduate students cited by L.E. Moses found "... 30% of the women vs. 15% of the men questioned their ability to handle the work; 33% of the women versus 9% of the men feared that speaking up would reveal their inadequacies [ME93]." Other studies [TC91], [WS85] found that men had more confidence in their academic ability. While men blamed failure on poor teaching or difficult material, women tended to blame their own perceived lack of ability.

Our Study

At our own college, a study [SM94] of performance in our introductory computer science course showed that the percentage of women passing the course is higher than that of the men. Yet we found an alarming drop in the already low number of women majors over a period of several semesters. At the beginning of the study, in the fall of 1990, 25% of our majors were women. The percentage steadily dropped until it was 18% by the spring of 1992.

As part of our study we examined the transcripts of 626 computer science majors (449 men and 177 women) over a period of five years. The following factors were considered:

- The number and gender of students who switched from a major in computer science.
- Grade point averages.
- A breakdown of grades in basic computer science courses.
- A breakdown of grades in pre-calculus and calculus.

The average grade point average for women was 2.8 (out of 4.0) whereas for men it was 2.58. In addition, 44% of the women had a B or better average, as compared with 34% of the men. It is noteworthy that, in all but one computer science course, the women performed almost exactly the same as the men. Moreover, their completion rate was higher in all courses. When the switching occurred, it was between semesters, not in the middle of a course. The women were switchers, not dropouts (In Table 1 note the unsuccessful completion rate).

Despite the fact that the women do as well or better in computer science and mathematics than men, their persistence is significantly lower. We found that 44% of the women changed their major from computer science whereas only 29% of the men switched. This follows a national trend where women switch at a much higher rate than men from majors in science, engineering and mathematics [SH94]. In our department the drop usually takes place earlier than mid-major; many of the women never go beyond the introductory course.

Women and Mathematics–Real, and Perceived Achievement

We found that women did significantly better in all pre-calculus and calculus courses. For example in pre-calculus, 27% of the women received an A as compared to 17% of the men. In third level calculus, 25% of the women attained an A while only 16% of the men did. Results for representative courses are shown in Table 1.

Despite this, female students often expressed doubt in their ability to handle the mathematics associated with the computer science degree, and cited this as a reason for avoiding the computer science major. The mathematics requirement for our computer science degree is substantial, and includes 3 terms of calculus, 2 terms of discrete mathematics, linear algebra, and probability.

Table 1: Summary of transcript information for a representative sample of computer science and math courses

Introductory Computer Science

Grades	Number Women	Percent Women	Number Men	Percent Men
A	38	37.62	112	38.62
B	26	25.74	62	21.37
C	16	15.84	41	14.13
D	5	4.95	6	2.06
Unsuccessful Completion	16	15.84	69	23.79
Total	101		290	

Assembler Programming

Grades	Number Women	Percent Women	Number Men	Percent Men
A	42	45.16	124	39.87
B	25	26.88	84	27.00
C	17	18.27	39	12.54
D	3	3.22	20	6.43
Unsuccessful Completion	6	6.45	44	14.14
Total	93		311	

Pre-Calculus

Grades	Number Women	Percent Women	Number Men	Percent Men
A	18	27.27	29	17.26
B	13	19.69	33	19.64
C	14	21.21	37	22.02
D	7	10.60	16	9.52
Unsuccessful Completion	14	21.21	53	31.54
Total	66		168	

Advanced Calculus

Grades	Number Women	Percent Women	Number Men	Percent Men
A	18	25.35	36	16.07
B	18	25.35	46	20.53
C	14	19.71	64	28.12
D	5	7.04	25	11.16
Unsuccessful Completion	16	22.53	54	24.10
Total	71		224	

This semester we surveyed ten computer science classes to assess their perceptions about gender and math ability. Approximately 200 students participated in the survey. A majority of men (75%) felt that men perform better in calculus than women. Only a third of the women thought that women do better. Women also seemed more conflicted over the question of who excels in mathematics. Nearly one quarter answered ambiguously, either leaving the question blank or checking both genders. On the other hand, men almost uniformly gave one choice. Complete results are shown in Table 2.

Table 2: Results of Survey Assessing Perceptions about Math Ability

Gender of Those Surveyed	% and Number Who Answered Men Better in Calculus		% and Number Who Answered Women Better in Calculus		Ambiguous Answer	
Men	75 %	109	12 %	18	13 %	19
Women	43 %	20	33 %	15	24 %	11

It is our expectation that reporting studies relating to women's performance in mathematics will help reverse the trend of switching from SEM. We plan to disseminate this information concerning women's competence in mathematics in various ways. Locally, in our Women in Computer Science Club, we will publicize the mathematics achievement rates for women, in the hope that this will dispel the myth of the women's inferiority in mathematics Nationally, we will use Internet facilities to disseminate the information on the World Wide Web. We will create a home page on the CUNY Web server that will provide access to project data and results.

Our hope is that by making these facts more widely available we can close the gap between perception and reality and thereby influence more women to enter and remain in computer science.

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paper

Confronting Issues of Gender in Information Technology in Australia

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Abstract

In February 19?2 at the University of Tasmania, the Australasian Women In Computing group began with the hosting of the first Women in Computing Symposium. This and subsequent conferences have provided a forum for women to meet, exchange ideas and present research. One of the foci has been on how we can better promote, support and retain our female students in computing. This paper will report on a number of the strategies employed by various Australian Universities to provide this support and encouragement for female students in the computing discipline.

Paper

Background–the Need for the Women in Computing Group

Peer to peer networking has been adopted enthusiastically through the 1980's as a way of enhancing business and career options. It has been noted that women have employed this strategy most successfully and case studies of successful women administrators often point to networking as the critical success factor supporting their management style. Sue Curry Jansen (Jansen 1989) has noted that women in western cultures have historically developed their own alternative information networks such as sewing circles and midwifery as well as reconfiguring mainstream information technologies to serve alternative purposes–such as the telephone. Laura Rakow (Rakow 1988) has documented the transition of the telephone from a tool to support business to a household necessity–largely due to the adoption of it by women as a means of networking to support their then predominantly house based activities.

The establishment of a Women in Computing group was, to some extent, to provide this peer to peer network. A radical restructuring and rationalization of tertiary institutions during the 1990's in Australia had produced large, multi-campus, multi-purpose universities. Old networks were destroyed as the participating groups went out of existence. Most of the traditional information systems/computing groups, whether they were academic or professional, had male dominated executives and a male organizational style. The Australasian Women in Computing network has helped bridge the gap. The group has adopted a supportive style based on inclusion and cooperation and has actively guarded against any moves to change it to a more traditional male oriented hierarchical structure and decision making style.

The Australian Setting

The participation of women in the world of computing is unequal in Australia as in many parts of the world. Approximately 20% of the business computing workforce are female, and of these only 0.25% of women are information technology professionals who earn $80,000 or more per annum. The number of female students enrolled in undergraduate and post-graduate computing courses in Australian universities is also very low. At the same time the drop out rate of female students doing computing courses is high.

The Commonwealth Government Department of Employment, Education and Training–DEET (1990) listed objectives, targets and strategies to achieve equity in higher education for all groups in society. Women were one of the major target groups. Women's participation in higher education had increased steadily to 52.7% of the student cohort by 1991. However, the concentration of women, remained mainly in the arts/humanities, health and education fields (Office of the Status of Women 1993).

National objectives were set to improve the balance of women in higher education courses. Emphasis was placed on two areas:

1. Research and higher degrees.
2. Non-traditional courses–defined as courses where females have generally been significantly under represented. These included the areas of engineering, business studies, economics and science (DEET 1990)

Targets were established where, by 1995, the proportion of women in engineering would be 15% and in other non-traditional courses would be at least 40%. The numbers of women in postgraduate study was also targeted to rise relative to the percentage of women as undergraduates in each area.

In 1993, the Australian Government issued *The New National Agenda for Women* which outlined objectives for the development and implementation of its strategy for women to the year 2000. The Agenda promoted the importance of education as a means by which women could improve the overall quality of their lives. The Commonwealth Government actively encouraged all higher education institutions to provide appropriate support for women in non-traditional courses (Office of the Status of Women 1993).

Computing is one such 'non-traditional' area. Across Australia there is some variation in enrollments in computing courses, between the states and by institution. In 1990 for example, in computer science/information systems courses, New South Wales had 32% enrollments of females. At the other end of the spectrum was Queensland with a female enrollment of 18% (DEET 1993). In 1991 the nation-wide average was 28% female enrollments in higher education computing courses (Gibson 1993, p22). Statistics from other western countries told a similar story: In the United States 33% of Computer Science degrees were awarded to female students, at the undergraduate level, and 11% at the doctoral level (Frenkel 1990). In Britain the number of female students enrolling in computer science degree courses fell from 25% in 1978 to 10% in 1987 and improved slightly to 13% in 1989 (Lovegrove and Hall 1991).

Redressing the Imbalance

Clayton (1993) argued that to increase female participation in the computing profession, three main stages must be recognized and addressed:

1. pre tertiary: to encourage females to develop the necessary prerequisite skills and to enroll in computing courses.
2. tertiary: to decrease female attrition.
3. post tertiary: to equip females with the necessary skills and contacts to get positions in the profession. (Clayton 1993, p16)

Before actively encouraging more females to enroll in computing degrees it is important to ensure that female students will have the same chance of success as their male counterparts. The research projects that will be discussed have focused on the first or second stage as identified by Clayton.

The following is a synopsis of major projects and initiatives undertaken to redress the gender imbalance by some of Australia's 38+ Universities. Most of this material was presented at the Women in Computing Conferences from 1991 to 1994. Due to the targets set by DEET, many of the projects outlined have been able to secure funding by way of equity grants.

Central Queensland University

At the University of Central Queensland (CQU) a Women in Computing (WIC) committee was formed in 1992 to look at increasing women's successful participation in computing courses at CQU. Information contributed at the first Women in Computing Conference was used as the starting point for the formation of strategies to improve the gender balance in these courses. The WIC group decided to work with both pre tertiary and tertiary level students.

Pre Tertiary:

- A 'Careers in Computing Information Pack' for both high school students and mature women was developed. Contents included course information, pamphlets on computing careers, an interactive computer based information system on Computing Careers, a visually challenging poster as well as profiles of female computing professionals. During 1994 the pack was distributed to secondary schools and Open Learning sites in Central Queensland. It was intended that evaluation of this pack would commence late in 1994 (Clayton et al 1994).
- A bridging computing course by external study was produced to primarily increase the basic computing skills and confidence of females. This course was available to students of either gender and incorporated gender inclusive material.
- A market research project was undertaken on students perceptions of the computing industry, barriers to studying computing, sources of information, and key influences in students choice of discipline.

> *Perceptions of the career that is available on the completion of the course influences the final decision that is made when choosing a tertiary course. If an individual does not have a prior knowledge of the course, then they can not form these perceptions, and therefore, have nothing to be attracted to...*
>
> *Some students pictured a computing career as just sitting in front of the computer doing data entry all day.*
>
> (Dooley 1992, in Clayton, 1993)

Tertiary

A series of workshops was held targeted at teaching staff to raise awareness amongst the staff of gender imbalance and to brainstorm for ideas to redress the situation.

University of Tasmania

Studies in 1992 revealed that, for every 100 male students entering computing at the University of Tasmania, 56 would graduate. In comparison, for every 100 female students entering, 26 would graduate (Gibson 1993)[1]. At the 1993 Women in Computing Conference Paay, Gibson and Hartnett suggested:

> *The principal problem appeared to be the lack of natural opportunities for female students to develop support networks and provide themselves with an accepting environment in which to ask questions and explore ideas.* (Paay et al p61)

To overcome this isolation a mentor scheme was established in 1993 where first year female students were matched with second or third year students in small groups. Mentors helped orient the new students sharing with them ways of surviving and learning at University.

One visible sign of the mentor scheme is a strong feeling of group identity among female students studying Applied Computing courses. Their network extends across all years and across all courses. The students themselves have asked for the mentor meetings to continue next semester. Our feeling is they will evolve into network meetings with the mentor-mentee roles barely visible. (Paay et al p. 63)

The Tasmanian group also tried a number of approaches to help the female students including hosting of a morning tea during orientation, and a series of posters showing "A Day In The Life Of A Computing Student / Professional". The poster series had been an initiative following the 1992 conference at which Teague and Clarke had argued that many students had inaccurate perceptions of computing careers. They suggested that one way of attracting more girls into computing would be to provide materials that represented a more accurate view of the nature of the work in the computing profession.

Curtin University

James (1992) gave a description of a support network established at Curtin University in 1990. This group called Women in Information Systems (WIIS) provides a networking body not only for female students but for females working in the computer industry as well. The group provided an opportunity for the

transfer of ideas and experiences, and professional development and updates in current computing activities in both private and public sectors as well as within academia. (James 1992 p. 2).

WIIS meet on a monthly basis with each meeting consisting of a formal presentation by a guest speaker as well as time for informal networking. The group has provided women in the computing industry with a networking body and has provided many opportunities for its members that might otherwise not have presented themselves. The meetings have also opened up lines of communication between the University and the computing industry.

University of Ballarat

The Bachelor of Computing degree at the University of Ballarat had a low enrollment by female students and it was found that these students were performing more poorly then their male counterparts in computing subjects (Cartwright and Colville 1994). Although it was recognized that a number of factors contributed to this, one major problem appeared to be the lack of peer support and networking. A mentor scheme was established in 1994 for ALL first year students though participation was not enforced. Mentoring occurred in small groups: five mentees and two mentors. It was decided to involve all students, as previous research had found that the female students did not want a support scheme set up exclusively for the girls and "*it was felt that all students could benefit*" from such a scheme (Cartwright and Colville 1994, p3). One of the activities organized for the groups was a "treasure hunt" during Orientation week. Students had to discover the location of lecture rooms, computer labs and staff offices. Students also met personally all of the academic staff.

Positive outcomes from the scheme to date have included social and work interaction between students from all years in the course. As a consequence of the initial treasure hunt staff were perceived to be more approachable and helpful. On the negative side "*none of the female students believe that they have gained any real benefits from the mentor scheme*" (Cartwright and Colville 1994, p6). Changes are planned for 1995 with the possibility of the creation of a mentor group just for females.

Smith and Kelly (1994) are also investigating the feasibility of introducing programming to students via visual programming in 1995. They argue that the

visual approach offers a common reference point for teaching students the correct techniques in programming on an equitable basis. Additionally the new strategy provides an avenue for females to overcome learning difficulties encountered in programming classes. (Smith and Kelly, p106)

La Trobe University, Bendigo

To encourage more girls to enroll in computing courses the Department of Computing and Information Systems has created a promotional kit (video, brochure and poster) that has been distributed to approximately 120 secondary schools in the area (Martin and Staehr, 1994). Contact has been established with local secondary schools and university staff have participated in school run career sessions.

During 1994, the success and retention issues of current female students was approached through a pilot program. Commencing students were allocated to tutorial groups so that 50% of each group was female. Senior women students were employed to act as demonstrators for these groups and to increase the staff-student ratio. Fortnightly meetings were held between the students, senior students and program leaders to discuss progress and problems. As yet the evaluation of both initiatives has not been published. A number of administrative problems with the pilot program were documented: such as the difficulty of maintaining contact with students and problems with the academic calendar and the scheduling of group meetings.

Deakin University

The findings of Jones and Clarke (1993) on the effects of a single-sex educational setting on the attitudes and computing experience of girls suggested that girls from single-sex settings have more experience with computers and their attitudes towards them are more positive than for girls from co-educational schools. However when the factor of prior experience was removed from the analysis the type of educational setting was no longer found to be significant.

Diversity of computing experience was the strongest predictor of secondary girls' attitudes towards computers. The findings indicate the importance of designing computing curricula for girls which emphasize a broad range of computing activities in preference to focusing on skill development in a single area. (Jones & Clarke, p1)

Clarke and Teague (1993) produced a video entitled *Girls, have you considered computing?* which attempted to bridge the gap between the reality of working in this field and the perceptions of students. The video was aimed at secondary girls and has been purchased by over 300 Australian secondary schools and there has been an enthusiastic response from the girls who have viewed it. This video was also included in the Computing Careers Information Pack distributed by CQU. Victoria University of Technology undertook a similar project with the assistance of local school girls to produce a promotional video "Real Girls Use Computers."

Victoria University of Technology

In 1993, 22% of continuing female students withdrew from the course before the end of the year compared with 12% of male students. Retention rates amongst female students was therefore seen as a major issue confronting the Department of Business Computing especially as the intake of female students was initially only 32%. In 1994, with the assistance of a grant from the Equity and Social Justice Department[2], members of the department established a mentor scheme (MicroNet). The aim was to provide commencing female students with support from older female students; by giving the students the opportunity to speak with, and get help from, other students who have been through a similar experience. It was considered that these commencing students would feel less intimidated and therefore more confident in continuing their studies in information technology with this support. Meetings were facilitated through the provision of time and space. Two computers were set aside exclusively for MicroNet girls and equipped with an e-mail facility. This greatly assisted communication between the girls and gave them alternative computing facilities.

The response to the scheme was very positive. Interviews with a number of the girls suggested they want to continue with the scheme; they enjoyed the contact and would like more social activities in the future. One point came out strongly in the interviews, the girls feeling of isolation and the need they had for contact with more women studying computing. At least two of the students said they were planning to drop out but, as a result of MicroNet, they had reconsidered. Interestingly, these two girls were second year students and mentors in the program.

An other activity undertaken by Victoria University of Technology to promote the range of options girls have, in the computing field, is to host an annual "Girls in Computing Day". Girls, aged between 14 and 16 years, from neighboring secondary schools are invited to spend a day at the University exploring computers. The girls are given hands on experience through a series of different activities, using a range of software. The aim is to present to the girls the many faces of computing and to move their thinking away from seeing computers as word processors or machines just for programming.

University of Southern Queensland

University of Southern Queensland has taken this idea further and has recently conducted a 'Girls into Information Technology' residential camp. This was an extension of a previous initiative 'Girls in Math and Science Summer School' (Ryan 1994)–a residential camp that is conducted annually by USQ. The four day information technology camp was held at a rural Queensland site to enable outback twelve to fourteen year old girls to gain practical experience, knowledge and confidence in their use of computers. Girls needed to go through a selection process to participate in the camp and they were fully funded to attend. A residential school was chosen to enable participants to come from a wide area. This also enabled more opportunities for the girls to network with other girls with similar interests. Other advantages identified were the fewer distractions and the greater opportunities for group work.

Conclusion

There is little doubt that in the past three years there has been a growing awareness within educational institutions of the need to provide equal access to success in non-traditional areas, including computing. This research and actions undertaken have highlighted the fact that present imbalances exist and need to be redressed. The research has also documented a variety of ideas and strategies that have been implemented.

Much has been achieved since our inaugural Women in Computing meeting in February 1992. The continuing annual conferences have provided the catalyst, with participants sharing ideas on how to tackle the major issues our female students face in computing. What now do we see as our key challenges for the future? Firstly we need wider acceptance from both within and without our own institutions of women's place in information technology.

For our female students to be successful in commencing and completing, there needs to be greater acceptance and recognition from the wider academic community of the needs of women in these courses. It will come as no surprise that many of our male colleagues do not accept that our female students face difficulties that are different from those of their male counterparts. The males simply do not see that there is a problem. This is certainly hindering progress.

We live in the age of the so called SNAG (Sensitive New Age Guy). Many men appear to understand and repeat the feminist rhetoric, however their behavior shows no more than superficial support for female colleagues, their attitudes show no fundamental change. Any initiatives undertaken to increase or support female participation in our courses is often seen as exclusive and generally sexist in that it does not include the male students. Establishment of schemes such as the mentor scheme have to be done carefully and to some extent subversively to avoid the ire of others in the department.

Secondly there is a continuing need to encourage more women to see they have a future in computing. We are in a catch 22 situation; because there are so few women undertaking computing courses the support and networks they need to succeed are not there, as a result few women complete. Girls moving into tertiary education do not see computing as a career because so few women are there; we perpetuate the cycle.

The challenges for the Women in Computing group is to further support our female students and to try and change the perspective girls have of computing. The path has not always been easy and there are many hurdles still to overcome but we believe the effort is worthwhile and progress is slowly being made.

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paper

The Use of Multimedia in Response-based Literature Teaching and Learning: A Critical Review of Commercial Applications

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Abstract

This paper describes a review of multimedia applications for literature teaching and learning from a response-based perspectve. Forty-five applications were evaluated according to three multimedia and four response-based criteria. Findings reveal that although such programs are generally of high technical quality and linked to works commonly taught in school, the pedagogical approaches taken are not response-based.

There is growing recognition among educators of the need for establishing practical pedagogies that facilitate response-based approaches to the teaching and learning of literature (Holland, 1975; Iser, 1978; Langer, 1990). Where traditional approaches to literature teaching and learning champion the close readings of texts and single "correct" interpretations, response-based theorists regad readers as active meaning makers whose personal experiences affect their interpretations of literary works. A response-based pedagogy, then, encourages the exploration of multiple perspectives regarding literary works and student construction of defensible interprettions of the same, with the quality of students' critical and creative thinking being the focus of assessment. The National Center for Research on Literature Teaching and Learning's ongoing "Multimedia and Literature Teaching and Learning" project explores the potential of multimedia to facilitate such response-based pedagogies.

The project's first stage, detailed in this report, involved reviewing existing commercial applications from a response-based perspective. The sections that follow describe the criteria we developed for evaluating multimedia literature applications from that perspective and the program acquisition and evaluation process. The findings of that review are then summarized, and the implications of those findings for response-based literature teaching and learning discussed.

Evaluation Criteria

Criteria for evaluating multimedia literature programs were developed by a group of exemplary teachers of literature and graduate students of both literature education and instructional technology, together with the project directors and the directors of the Literature Center. Seven evaluative categories were established through a series of focus group sessions. Responses within each category, while including ratings on a ten-point scale for comparative purposes, were designed to be essentially narrative in form to encourage the same kind of critical thinking about multimedia applications that we would hope such applications would encourage about literature. These fall into two groupings — multimedia issues and response-based issues.

It is entirely possible that a multimedia literature application might be excellent from an instructional technology perspective, but deal with literature in a manner not at all response-based. Group members wanted to distinguish between the two. The first three evaluative categories — *content clarity, technical quality*, and *use of technology* — adopt the former perspective.

There is some reason to believe that a unique characteristic of the computing medium is its ability to represent cognitive processes in ways that support their internalization as habits of thought (Papert, 1980; Salomon 1981; Swan & Black, 1993). This category grouping, which includes *what counts as knowledge?, the role of the text, the role of the students*, and *the role of the teacher*, specifically considers how the formal aspects of multimedia literature applications might support or detract from a response-based perspective. It is thus concerned with whether or not existing multimedia programs represent literary works in ways that might support the processes involved in the development of literary understanding.

Program Acquisition and Evaluation

Multimedia literature applications for review were identified through a detailed search of listings dedicated to multimedia materials, such as the Multimedia and Videodisc Compendium (Pollack, 1994) and Multimedia '94 (Educational Resources, 1994), and vendor catalogs that included educational multimedia. We identified fifty-four multimedia literature programs or program series, and acquired and reviewed forty-five of them for this paper.

The multimedia literature applications we acquired were evaluated by twenty-five graduate students of literature education and/or instructional technology. Most were practicing teachers. Each evaluator was given two programs to evaluate and asked to spend some time exploring each of the applications. They were then to complete a written evaluation while viewing the program. The written evaluations were collected and reviewed for consistency by a group of four graduate students and the project directors, at which time some changes were made in ratings to affect a general consensus. The evaluations were then collated and summarized by the project directors.

Summary of Findings

The multimedia literature applications we reviewed were generally moderately priced and designed to be used on commonly available computers, indicating that publishers are trying to make multimedia literature applications that can be used in ordinary classrooms. The majority of them accessed multimedia from a CD ROM disk (31), although some used a combination of CD ROM and laserdisc (10) and few (4) used only floppy disks. The majority (24) were offered for dual platforms (MacIntosh and PC computers), with the remainder evenly split between applications designed exclusively for MacIntosh (11) and those designed exclusively for PC (10) computers. In general, their cost ranged between \$25.00 and \$100.00 for straight CD ROM or floppy disk offerings, and between \$200.00 and \$300.00 for laserdisc offerings.

Another good sign was that the programs we reviewed were evenly split between those designed for elementary (22) and those designed for high school (23) populations. Because we found quite a difference in approach between applications designed for elementary students and those designed for high school students, general descriptions of the programs in these two groupings are given separately below. These are followed by discussions of program ratings on each of the criteria we developed.

Programs designed for elementary students

Fully nineteen of the twenty-two applications we reviewed that were designed for elementary students could be best described as *talking books*. At their most basic, these applications presented stories as illustrated text in a linear fashion, with the text read to the students. All of them highlighted the text as it was read in phrases, but allowed users to click on single words to have them pronounced. Many also defined words on request, and some defined elements of pictures. Many also included a non-English language option in which the text was presented and read in a language other than English, usually Spanish. Most also included sound effects and/or music, and many included animated illustrations. None of the elementary applications we reviewed included video, and only one included any background information about the works presented. None included on-line features that encouraged student comments on, or interpretations of, the works, although a few encouraged off-computer interpretive activities by presenting open-ended questions to be answered on paper, pictures that could be printed and colored, and/or suggested extension activities in a teacher's guide.

Student interaction with elementary talking books was, then, constrained to a kind of enhanced page-turning capability, in which students could click on icons to turn pages, to access definitions, sound, and/or animations, or to access particular stories, chapters, or pages in the program. Nine applications included a print function that allowed students to print text or pictures. Six had interactive quizzes at the ends of chapters or works that tested students' comprehension with multiple choice, single-correct-answer questions. Five included "interactive pages" — illustrations which students could explore by clicking on their different elements to find hidden animations. Two applications allowed students to cut and paste text and pictures, to add text, and to color pictures; one allowed students to add sound.

In short, the elementary talking book applications we reviewed uniformly centered on the reading of highlighted text. The centrality of this feature indicates that publishers view the teaching and learning of literature at this level as little more than the teaching and learning of reading. A common focus on content comprehension and the lack of interest in interpretation, literary devices, authors, and/or background information are further indications of a bias toward skills-based reading as opposed to response-based reading.

The other three elementary applications we looked at were quite various and therefore defy classification. One was an adventure-type game in which players explored an imaginary environment and picked up objects that they were then supposed to return to appropriate nursery rhyme characters. The other two applications might best be described as *story makers*, which, although they included story examples, were primarily devoted to student assembly of a variety of elements to create their own stories.

Programs designed for high school students

While the elementary multimedia literature applications we looked at made more extensive use of the computer's sound and graphics capabilities than did the high school applications we reviewed, the latter made greater use of its nonlinear linking capabilities and interactive video technologies. The high school applications we reviewed also exhibited a difference and a greater diversity in pedagogical approach. Although some of these applications could best be classified as "books on computer" (6), they were different from the elementary talking books. We also found programs whose approaches most resembled those of databases (7), hypertexts (2), hypermedia (6), and problem solving games (2). Each of these is described separately below:

Like their elementary level counterparts, high school *books on computer* presented the full text of collected or single works on the computer screen, had the capacity to access definitions of selected words, and were essentially linear. Many also included interactive questions and/or reproducible off-line exercises similar to those found in the elementary programs. On the other hand, although a few included audio readings of selected passages, none offered a complete reading and none highlighted text as it was read. They were also more likely to at least minimally value student interpretations by providing on-line note-taking capabilities, and less likely to provide high quality illustrations and/or animations.

The *database programs* provided book notes or the complete texts of collected works, together with background information and a variety of database functions for searching, collecting, and printing the information they contained. Most of these applications also included note-taking capabilities, and a few included interactive questions and answers and/or off-line exercises. A few also included rudimentary illustrations, but applications included in this category, like the applications designated "books on computer," were all essentially text-based.

The two high school applications we categorized as *hypertexts* were also essentially text-based. Programs in this category differed from those designated databases in that they did not include typical database functions, but rather extensive links between entries. Both applications in this category were focused on background information about a single author and his works, and, although they included selected passages, did not provide complete texts. Both provided on-line note-taking capabilities, and one application could be extended by students or teachers who wanted to add to the information it contained.

High school programs designated *hypermedia* linked the complete texts of particular works to video segments presented via laserdisc. All also provided extensive background information on authors, historical context, literary devices, and literary analysis; all provided extensive teacher materials; and most included open-ended questions presented on-line but designed to be answered off computer. None included note-taking capabilities.

The final two high school multimedia applications we reviewed were *problem solving games* ostensibly linked to literary works. In both games, students were asked to explore simulated environments and collect clues to solve a mystery. Both games were highly interactive and contained excellent graphics and sound including digitized video segments. Although both allowed students to copy information into a notebook, they did not allow student-generated entries, and the thinking encouraged was convergent and focused on single correct solutions.

In general, then, the high school applications we reviewed were much more concerned with literature — with interpretations, context, authors, literary devices, and analyses — than were their elementary counterparts, and they were more likely to provide for at least note-taking on the part of students. In tone, however, and more importantly perhaps, in form, these applications focused on single "correct" interpretations and analyses. They shared the text-based approach to literature teaching and learning still found in most high schools.

Multimedia Issues

Multimedia issues consider the general quality of multimedia literature applications without regard for their relationships to response-based pedagogy. Evaluators generally rated the programs we looked at quite high (7.26 overall) on the three criteria in this category — content clarity (7.88), technical quality (7.18), and use of technology (6.69) — indicating that commercially available applications are generally of good quality. Specific findings for each criterion are detailed below:

Content clarity

Content clarity is concerned with the general accuracy, completeness, and age-appropriateness of a program. Both elementary and high school applications were most highly rated on this criterion (high school, 8.09; elementary, 7.68), indicating that the applications we reviewed could quite easily be incorporated into literature teaching and learning. Half of the elementary programs reviewed focused on fairy tales (9), fables (2), and Mother Goose rhymes (1). Five elementary applications were somewhat similarly based on existing picture books adapted for the computer, and one, the only one that included references to literary concerns, was linked to a commercial reading series. All but two of the high school multimedia literature applications we reviewed were based on book-length works among those most frequently taught in high school English classes (Applebee, 1989) or on authors common to the seven major literature anthologies used in such classes (Applebee, 1991), thus could be incorporated into high school literature classes without any change in existing curricula.

Technical quality

Technical quality is concerned with the quality of a program's user interface and its ease of use. Evaluators found most programs to be of generally high technical quality (7.18), indicating that they were fairly easy to use and lacking in technical problems. Elementary applications were rated slightly higher (7.45) than high school applications (6.91) on this criterion, most probably because of their basic simplicity. Evaluators had difficulty using the more complicated functions of some high school programs, and some high school programs required more complex and more specific hardware configurations, making them difficult to install and run.

Use of Technology

Use of technology is concerned with whether or not an application makes good use of multimedia and computing technologies. Evaluators generally agreed that the programs they reviewed did (6.69). High school applications were rated a good deal higher (7.52) on this criterion than elementary applications (5.86), as it was generally felt that in many cases *talking books* could just as well be on tape as on computer. The most highly rated applications in terms of technology usage were the high school level *hypermedia* applications (8.11), most probably because of the high quality of the video they accessed, but also because many had extensive nonlinear linking and their availability of tools for student or teacher construction. Other features viewed positively in this regard included interactive pages, search, cut and paste, and print functions, and note-taking capabilities.

Response-based Issues

Response-based issues specifically consider how the formal aspects of a program might support or detract from a response-based perspective. Both high school and elementary applications were generally rated a good deal lower on response-based criteria (4.69 overall) than on multimedia criteria, and elementary programs were rated significantly lower (4.06) on average than high school programs (5.32). Such results are quite discouraging, indicating as they do that multimedia literature applications, rather than breaking new ground in literature teaching and learning, have generally adopted older and more traditional reading and text-based pedagogical approaches. Specific findings concerning each response-based criterion are discussed below:

What counts as knowledge?

What counts as knowledge? is concerned with the formal representation of knowledge within a program; with whether a program represents knowledge as constructed or as static, as evolving or as canon. In general, evaluators found that the multimedia applications we reviewed tended toward the latter (overall, 4.65). Elementary level applications were rated a good deal lower (3.82) than high school applications (5.48), mostly due to their overwhelming focus on single readings of texts. The more highly rated elementary applications provided multiple voices, open-ended questions, access to background information, and/or interactive pages. Elements in high school programs that evaluators found particularly response-based included multiple representations of the same knowledge, search capabilities, provisions for note-taking and/or editing, open-ended questions, access to background information, nonlinearity, and construction tools.

The role of the text

The role of the text refers to the way a program represents meaning in relationship to a text. In general, evaluators felt that the majority of applications they looked at did not support a response-based approach to text (4.83), but rather adopted a more traditional, text-based approach. Elementary level applications were rated lower (4.18) in this category than high school level applications (5.48). For the most part this is due to their lack of provision for student responses, but also because of their frequent use of pop-up definitions which evaluators thought created a very concrete impression of meaning residing in text. The two elementary applications most highly rated on this criteri, in contrast, offered alternative definitions of words from which students could choose. The extensive use of single-correct-answer, multiple-choice questioning in the elementary programs was also deemed text-based as opposed to response-based in form. Evaluators found high school applications to be a good deal more response-based in their representations of meaning, mostly on the strength of two features commonly found in them — note-taking capabilities and open-ended questioning. Features in high school applications that evaluators felt detracted from a response-based approach included single interpretations of text, the ability to click on text to obtain meanings and new information, pop-up definitions, and, to some extent, search capabilities.

The role of the students

The role of the students is concerned with whether and how a program validates students' responses to a literary work. Evaluators gave this criterion the highest ratings in the response-based category (overall, 5.59; high school, 6.09; elementary 5.09), indicating that they felt that students were somewhat empowered by the programs we reviewed. Features that evaluators found response-based included interactive pages, construction tools, note-taking capabilities, nonlinear access to background information, and open-ended questioning, although it was noted that the common practice of presenting questions on-line to be answered off-line tends to value the questions (i.e., the "expert") over the answers (i.e., the student). It should also be noted that the programs we reviewed, if they provided them at all, provided opportunities for individual student responses rather than spaces in which discourse among students was encouraged, and that none of them encouraged student-generated questions.

The role of the teacher

The role of the teacher is concerned with whether a teacher is empowered or constrained by a program, and with whether it promotes student-teacher interaction. Evaluators gave this criterion the lowest ratings in any category (overall, 3.68; high school, 4.22; elementary 3.14), indicating that they felt that teachers were essentially disregarded by the programs we reviewed. Few of the applications we looked at had well designed teacher materials; those that did usually placed them in printed teacher guides, thus undermining their value, and many teacher guides offered no teaching materials at all. Very few of the applications we looked at included any provision for teacher input other than the ubiquitous "notes," and only one included program management tools.

Discussion

The results of our survey of commercially available multimedia literature applications reveal that while such programs are generally of high technical quality and linked to works commonly taught in schools, the pedagogical approaches taken are not response-based. In general, we found that the approaches to literature teaching and learning taken by the applications we reviewed mirrored the approaches taken in the majority of American schools (Applebee, 1990). Programs designed for elementary students commonly equated literature education with reading instruction; programs designed for high school populations generally adopted a traditional text-centered approach.

Our preliminary findings also indicate that the applications currently commercially available are technology, and not pedagogically, driven. Most of the applications we have looked at exploit the capabilities of multimedia technologies, often very well, but frequently at the expense of reader-response pedagogies. We have commonly seen single explanations, interpretations, definitions, and pictures popping out of text. We have seen enormous arrays of biographical, historical, and cultural information surrounding texts to the point of overwhelming them. We have seen graphics, animations, sound, video, hypertext, and color used for seemingly no purpose other than that they can be. We have seen very little provision for student input, almost no provision for collaboration. In short, we have seen applications that support the development of "correct" interpretations of literature rather than the development of literary understanding.

We have also seen a lot of promise. We have seen features in many applications that we believe would significantly contribute to students' development of literary understanding if they were made accessible to them — the linking capabilities of hypermedia, the affective dimensions of video, graphical, and design tools, and communications capacities for supporting on-going conversations among students. The construction of effective tools for response-based teaching and learning is the focus of the second phase of the "Multimedia and Literature Teaching and Learning" project. It will be informed by the strengths and shortcomings of the applications reviewed in this study.

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paper

Project KITES: Kids Interacting with Technology and Education Students

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Abstract

Project KITES paired beginning education students and fourth graders in learning activities using technology. The education students learned to use technology and gained practical experience acting as facilitators and partners in learning. The project has enhanced the pre-service program in many ways far beyond those of technology inclusion. It has also provided the foundation for a new technology-infused teacher education curriculum.

Introduction

Faculty and administrators at the College of Education at Louisiana State University recognized the need to infuse technology into all of their programs. The College had acquired significant resources to support the integration of technology into teacher preparation curricula. This included two full Macintosh teaching labs with accompanying software and multimedia equipment. In addition, classrooms were modified to support class demonstrations and network access. All faculty were provided with computers, which were linked to communications networks and file servers with instructional software. Two full-time technicians and a secretary were employed to maintain and support the operation.

The next step after the creation of the technology environment was to proceed with the faculty development and curricular integration that was envisioned to accompany the facilities development. The College had a requirement that some students take an introductory course in educational technology. Most students took this course in their senior year, and thus learned to use computers as personal tools but got little practical experience using them in instruction.

Project KITES Developed

In the fall of 1994, a new pilot project, Project KITES, Kids Interacting with Technology and Education Students, was initiated. The project was designed to provide students just beginning their professional education component with real experiences with kids using technology. Preservice teachers were paired with fourth-grade students in a variety of technology-based learning projects. The pre-service students were to work as facilitators of the learning experience and were to develop an awareness of teaching methodologies using technology at the same time.

The philosophy behind the project was simply to instill the concept of technology as part of the normal classroom environment. This was to be done through actual class experiences rather than dedicated courses or demonstrations. The plan was to follow the practice established in this pilot project of including technology-based clinical experiences in future courses so that the education students entered the job market fully prepared to integrate themselves into the computer infested classrooms in the community.

Although the focus of the project was technology, the project was designed to enhance the teacher education curriculum in many ways beyond technology infusion. The education students would get real experiences working with children and learn methodologies for communications with children. Moreover, they were being prepared to function as partners in learning. Often, they would learn new technological skills from the exploration with the children and develop an appreciation for environments where they did not have to maintain superiority.

The elementary students were also to benefit from the project. They too would learn new ways to express themselves with technology. This would add to a base foundation already developed through prior experiences at their school. The children would also reap the benefits of a learning partner who cared about them and listened to them. They would have the benefits of personal attention to their own needs and learning styles and positive reinforcement about their schoolwork. They were to be treated as full partners in this technology-based learning experience.

Background on Integrating Technology into Teacher Education

As computers rapidly swept into classrooms, the mandates were clear that technology was fundamental to the education of all students and therefore all teachers. National initiatives clearly elaborated the role of technology in pre-college education in all subject areas. Most professional education societies were actively involved in producing standards for technology use with various subject areas (Donovan, 1994). Finally in 1994, the prestigious teacher accreditation agency, NCATE, the National Council of Accreditation of Teacher Education, formally recognized the role of technology in all teacher preparation programs. NCATE issued its revolutionary revision of its unit standards guidelines to include indicators that reflect technology infusion in the entire professional education unit and all programs (Thomas, 1994). This includes standards for facilities, support, equipment, software, faculty development, and curriculum integration. Thus, many colleges of education are now moving quickly to modify or adapt their programs to meet these new defacto national standards.

Professional education units have traditionally tried a variety of methods to integrate technology into their operations. One common approach is to dedicate significant energy and funds into acquiring equipment and resources with the expectation that they will then be used to their fullest potential. Another is to require that all students in teacher preparation programs take a required foundations in educational technology course and hope that it will result in them naturally using technology well in their classrooms. A third is to undertake massive faculty development programs and assume that curricular revisions to include technology would naturally follow. Current research now clearly illustrates than a planned approach involving the entire professional unit, including faculty development, facilities, curricular revisions, and technical support is needed to fully achieve technology integration within programs.

A current common approach is to develop technological personal productivity skills in students, often starting with their entry into the program or university. This can include techniques such as issuing Internet accounts to students (Bishop-Clark, 1993) and requiring certain electronic communications with professors or classmates and even maintaining specialized electronic bulletin boards for program participants (Wiebe, 1993). It can also include required word processing of papers and electronic journal writing (Anders, 1994) as well as technology-based research and the like. While this often produces students who are technologically or information literate, it does not in itself produce students skilled in the methodologies of using technology in the classroom.

The approach piloted by Project KITES was a unique departure from the traditional methods used in the past. It involved real experiences with children. This approach is reflected in the findings of Wetzel (1993) that "teacher educator majors need to use computers in K-12 schools and see teachers using them." The basic principles of learning by doing and promoting active rather than passive learning apply equally to education students as they do to children. The education students were not necessarily taught all of the technology skills first, but were to learn these while learning to work with kids. They were getting experience in teamwork and technology. This was first to happen in the very controlled setting of this pilot project and to be expanded in other courses to a point where the students were able to prepare technology-based learning units and incorporate technology into a variety of learning situations.

This project in itself is not envisioned as the entire means of curricular integration. It will be combined with other approaches to produce an environment that mixes technology and learning and teacher education in realistic and meaningful ways.

Profile of Education Course and Student Population

The university student population involved in this project consisted of 28 students enrolled in EDCI 2030, Teaching, Schooling, and Society, at Louisiana State University. These students were all enrolled in a new five-year teacher preparation program. In this program, students fulfill many of their general education requirements in the freshman and sophomore years. In their junior year, they begin their professional education training. All of the LSU students in this study were college juniors.

First Professional Education Course

EDCI 2030 is the first education course in the elementary education program. Typically the course consisted of lecture, discussion, and classroom observations at field sites. There was no formal contact with pre-college students except through passive observation. It was a rare occurrence that students happened upon a classroom actively using technology. This new approach, mixing real children, technology, and active participation into the formula marked a dramatic departure from the traditional "standard" for this course.

Prior Computing Experience

The college student population consisted of 3 males and 25 females. At the beginning of the course, a survey was conducted to determine the amount of prior experience the students had using computers, their attitudes about using computers, and their views about the role of computers and technology in education. This class had a substantial amount of prior experience using computers. Twenty-four of them (86% of the group) had used computers for word processing and games. Many had used graphics packages and other personal tools. Twenty-one students (75%) had used the computers in the campus library to search for holdings. Only four (14%) had used computers in a work setting. Less than half, eleven (39%), owned a computer.

Students were asked to indicate their level of comfort using computers. Two (7%) responded that they were very comfortable. The majority of the students, 18 (64%), selected one of the two somewhat comfortable levels. The remaining 7 (25%) did not feel comfortable using computers. Thus there were some students most enthusiastic about the proposed mixing of technology into the class and a few with the usual cases of computer anxiety that can be found in such groups.

The bulk of their formal computing instruction had come from pre-college experiences. All but two (93%) had taken a computing course in high school, including 24 (86%) who had taken state mandated computer literacy courses. Only 5 (18%) had taken a college computing course. The investigators were quite surprised to find this level of prior experience and relative comfort around technology.

The students had some experience, therefore, using the computer as a personal tool. A few had used instructional software in middle school or high school. Students were asked to identify situations in college where they had seen computers used as part of instruction, other than in computing specialty classes. Only two reported seeing such use, both demonstrations of fractals in mathematics classes. Thus their pre-college computing foundations were not being reinforced at all in their college coursework. Almost all viewed technology as important in their professional education careers.

Collaboration with University Laboratory School

The project involved interactions with technology and a fourth-grade class at the University Laboratory School. The Lab School is a unit of the LSU College of Education, with a complete K-12 school occupying a site on campus. Often, pilot projects such as this one, start with experiences at the Lab School, due to the proximity of the school and the diverse student population of the school.

Fourth-Grade Class Selected

The fourth-grade class selected to participate in the project was ideal for the project. The teacher was new to the school and had acquired few resources for the class. Hers was one of the few classrooms without a computer, although it did have a weekly scheduled time in one of the school's computer labs. The school itself was not overly technology-rich, but had integrated a fair amount of technology into its classes. The students in this class had all had some computing experiences in second and third grade, particularly keyboarding exercises. The teacher had come from an environment where she had computers in her classroom and was an avid user of computers herself. Thus, she was eager to use technology in her classroom and actually sought out colleagues within the College of Education to work with her and her students.

Project Arrangements

The three principle collaborators in the project, the Lab School instructor, the EDCI 2030 professor, and an educational technology faculty member decided that the project would focus on language and reading skills using technology to support shared-literary experiences. An inspection of the Lab School facilities determined that the computer labs at the school were already occupied during the EDCI course time and that they could not run the types of software envisioned. It was decided that the fourth graders would walk to the labs within the College of Education, about three blocks away. Arrangements were made for the education students to assemble at the Lab School and escort the fourth graders to and from their school. Ten joint sessions were planned during the two-hour lab block, including time for moving the elementary students to and from their school and an hour of hands-on laboratory time.

Breaking the Ice with Student Interviews

The first joint activity was to have the two student populations meet each other at the Laboratory School classroom. Two icebreaker activities were planned: Construction of kite nametags and interviews between the student groups. The project directors prepared packets with colorful descriptions of Project KITES and two interview forms. Special attention was given to producing materials that were at appropriate reading levels for the fourth graders and that would make the fourth graders feel that they were important participants in the project.

The LSU students gathered with some trepidation outside the Lab School for this encounter. One student who was late to arrive exclaimed, "We are not really going in, are we?" This experience was a real lesson in the reality of what their next three years of preparation was all about.

Inside the classroom, each LSU student sat by one of the fourth graders. This child would be his/her partner for the first project. The first pairing, therefore was almost random. Since there were only 3 male LSU students and 12 of the 27 Lab School students were male, they were not paired by gender. Partners were changed for each of the next two projects.

Once involved in the activity of decorating their kite nametags, the group came alive. There was a wonderful rapport from the start. Expressions on faces became more animated and excited as partners bonded with each other.

Survey of Lab School Students

To help them get background on their students and to provide some of the data for this study, the LSU students interviewed the fourth graders. They were instructed to conduct the survey as conversation rather than a test and thus get the children to talk about themselves. To help the fourth graders get to know their partners, a shorter fun survey was devised for them to conduct as well.

The fourth grade class consisted of 15 females and 12 males. Only two had spent less than three years at the Lab School. All had used computers in second and third grade, mostly for keyboarding and playing games. The children reported using computers outside of class as well, for playing games and for writing papers. Twenty three (85%) of the students had computers in their homes. An interesting trend is that of three of the four students without a computer at home were female. All but two checked that they like working with computers a lot. The other two fell into the "It's OK" category. No fourth grade student was overly negative about using computers.

The fourth graders were enthusiastic computer users. Unlike the college students, most had ready access to computers at home and virtually all were comfortable with computers. They also all seemed to be reading books at least at the fourth grade level and some were reading much more sophisticated books. They talked freely to their college partners and seemed to relish working with them.

Reactions to First Encounter

A critical component of the education course was the follow-up activities to the interactions with the students. The education students completed weekly writing assignments about their experiences and their concerns as well as suggestions for improvement. Class discussions were held to review the lab experience, elaborate methodology or principles observed or learned, and to address areas of concern.

The college students were exhilarated by their first experience with live students and also a bit concerned. Most wrote about fears and anxiety prior to entering the school for the first time. They were also somewhat intimidated by the fourth grade students. Many commented on how smart the kids were and how much the kids already knew about computers. This group of children did not match their recollections of their own fourth grade classes or particularly fit their mental images of young students. They also expressed the feeling that this was not a realistic setting. They sensed that this was a special group, not typical of the normal class.

Perhaps the biggest concerns were about the books the children were reading. Several commented that the books were inappropriate and contained violence or offensive material. These prospective teachers wondered if they should try to influence their fourth grade partners' choice of books or interfere in other ways. Thus, there was a need to define their roles in the project including limitations as well as expectations.

College Students First Laboratory Activity

Prior to the first lab activity with the elementary students, the college students spent one two-hour session in the lab. During this session, they learned to turn on the computers, practiced using the mouse, and worked with some of the beginning software that the elementary students would use. This included exploring two packages, *Kid Pix 2* and *Kid Works 2*.

Despite their proclamations of comfort around computers, many of the students expressed concerns about using the technology in the laboratory. One sat at her workstation proclaiming "I hate computers. I hate this. I am not going to do this." before they had even turned the computers on. Once they actually took the first step and became involved with the engaging software, most of their prior reservations vanished. Typical comments during class and during the follow-up discussions were about amazement that such exciting software was available for kids and that using the computers was so easy and fun! These students were totally turned onto the potential of using technology with kids by this simple encounter. The most dramatic change in attitude came when the student who had been so vocal in opposition to the project asked the professor where she could buy the software! Thus, armed with a little experience, these students were ready to move onto the joint sessions with the elementary students.

This activity was also a lesson in teaching with technology. There were only 22 lab stations for the 28 college students, thus they had to share and take turns. They quickly learned to help each other and also discovered that the professors did not have all of the answers! They saw that despite the best plans, things can go wrong. They also learned that you can achieve a lot with limited resources and energetic leadership.

Activities Planned

The project directors planned three projects for the student partners to undertake. The first was a slide show book report using *Kid Pix 2*. The second was a newsletter using *The Writing Center* and the QuickTake camera to digitize pictures into their projects. The final project was a multimedia presentation. The first joint lab activity will be discussed in this paper.

They also recognized that the real goals of the project were not to see how many projects they could complete, but rather to have positive experiences using technology. Thus planned activities were refined and adjusted during the project depending on the progress of the group as well as the amount of intrusion of other factors, such as rain or technical problems.

Slide Show Book Reports

The first joint activity was a shared literary experience to produce slide show book reports using *Kid Pix 2*. Part of the first meeting at the Lab School was used to prepare for this activity. The fourth graders told their college partners about the books they were reading. It was decided that the college students would each read the books that their fourth grade partners had selected. This was a real eye-opener to a new generation of children's literature for the college students.

At the same time, the investigators were preparing materials to support the lab activity. Following the model set out for the class, the EDCI professor read a book by one of the favorite authors of the current fourth graders. The project directors then created their own slide show as a model for the group activity. This included illustrating the graphics of the software and well as the animated movies and sounds that could be incorporated.

The slide shows were to use the graphics already available with the software as much as possible and enhance the slides with text, sound, and animation. A few used scanners or digitized pictures at this early stage. Photographs of each team were prepared for slides of the production team for the end of each slide show.

Laboratory Experiences

Ten joint lab sessions were held. For each, the college students escorted the fourth graders to and from their school and worked together as teams on assigned projects. They facilitated the learning as much as possible, but allowed the children to gain technological skills. Thus, the college students undertook some of the more involved tasks such as retrieving the software from the network and saving projects. They also had to learn to relinquish the controls and let the elementary students explore the software, run into problems, and find their way out.

The size of the group was a problem for several reasons. Just finding chairs to accommodate the group and placing them in a lab that normally held 22 stations already tightly packed together was a major effort. The size of the two groups combined far exceeded the number of people that should reasonably be placed in the lab and made movement and concentration in the lab difficult. Thus, lab experiences were hectic, particularly in the early phases of the project.

Fortunately there was a small five-station lab next door to the main facility. Five college students volunteered that they felt quite comfortable working independently with their partners. Thus, these ten members of the group moved to the secondary site. This group tended to be the most creative and really explored and tested the limits of the software.

Project Outcomes

Since the project is still in ongoing, concrete statistical measurements of outcomes have not yet been developed. Investigators already can clearly see that many of their goals have been met and can also identify other outcomes not perceived prior to the project. These include the following:

1. Providing experience with real children to education students early in their studies;
2. Instilling the concept that technology is a standard tool in elementary education;
3. Using active learning to teach methodologies for incorporating technology in classroom activities;
4. Overcoming anxieties about using technology through a non-threatening, supportive atmosphere;
5. Preparing prospective teachers to be facilitators of learning and collaborators in team situations;
6. Exposing prospective teachers to elementary curricula and content areas;
7. Motivating new education students about their chosen field of study;
8. Fostering cooperation with the lab school and the local community;
9. Enhancing the learning of elementary students through the use of technology; and
10. Providing a beginning model for integration of technology into teacher preparation programs.

Don't Forget Dewey

The project caused an immediate stir within the College of Education. Many faculty members noticed the invasion of the children into the building and wandered into the lab to see what was going on. Quickly, others within the College asked how they could do similar things with their classes or at least expose them to the benefits of using technology in instruction. Teachers in the field at the Lab Schools and other sites began requesting to have student volunteers work with them and their students.

This one project could easily have consumed the entire course. It was only a matter of time before the elders of the department began to scrutinize what was going on and became concerned that the project was being done at the expense of the traditional educational foundations that were normally the cornerstone of the course. For example, one professor called to be sure that the students were reading enough of the works of the educational philosopher John Dewey.

Adding this activity to an already busy course was difficult. The professor took great care to retain the traditional core as well as to enhance it. Students still did reflective writing and observations. They visited other classes using technology. Due to their experiences in this project, their observations about the uses of the technology and techniques of the teachers were much more insightful. They also completed assigned readings that were much more meaningful since they were now experiencing Dewey rather than simply reading him.

Conclusions

Project KITES enhanced the education of prospective teachers through the use of technology. It is easy to observe young students learning naturally when placed in well-constructed learning environments. Project KITES showed that the same philosophy can be used on education students. Through immersion in learning environments that include technology they will learn to use technology in their teaching and view technology as a normal part of any classroom. At the same time, they will be exposed to good models of teaching using technology and develop their own styles and practices based on these models.

Project KITES also provided real experiences to the education students early in their professional preparation. During this project, these students underwent significant growth as educators and experienced great emotional turmoil in the process. Many had to come to grips with the reality of their own future plans. Most emerged with a new strength of conviction about their careers.

Project KITES is just one model of infusing technology into teacher preparation programs. It is only one part of a planned progression of activities that are be needed to achieve total integration of technology in teacher education. At least in this case, it may prove to be a real catalyst and pave the way for a great marriage between technology and education at one university.

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paper

Electronic Student Journals: A Means to Enhance Classroom Communications

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Abstract

To increase the exchange rate of journal entries between a teacher and his/her students, it was proposed that electronic mail be utilized as the medium by which the journal entries were transmitted. The results from the study found that the students who used electronic mail as the means of transmitting their journal entries wrote significantly longer entries than the students who wrote in traditional written journals. No differences were found, though, between treatment groups as to computer-related knowledge and attitudes.

Background

At the heart of the educational process is the role of communication between the teacher and student. Shale and Garrison (1990) view the teacher and student as "partners in [a]... communication relationship" (p. 32). Schramm (1983) analyzes this relationship further by describing the communication relationship as a "transaction in which both parties are active" (p. 14) and which involves the two-way exchange of information.

This two-way dialogue process is typically reduced in most classrooms to a simple question and answer pattern of communication between the teacher and the students (Shimanoff, 1988). McGrath (1990) attributes this to the "normative force" that governs most classroom interaction–the expectation that face-to-face interactions are regulated and follow anticipated patterns.

Strackbein and Tillman (1987) and Nahrgang and Petersen (1986) see writing as a means of fostering communication between teachers and students. Other proponents of writing, such as Britton (1972), view writing as a means of enabling people to better understand and learn from events. Leahy (1985) and Odell (1986), focusing more narrowly, advocate the use of writing to help promote greater understanding of a subject.

The medium that is strongly advocated for both written communications and learning purposes is the journal (Fulwiler, 1987). Written journals can provide the teacher with feedback on the success or failure of course material (Crowley, 1984; Gambrell, 1985; Hart, 1972; Leahy, 1985; Mikkelsen, 1985; Perraton, 1988; Stout, Wygal, & Hoff, 1990). More specifically, journals enable the teacher to check on student understanding of the course material and also related misconceptions (Durfee, 1989; Hart, 1972; Nahrgang & Petersen, 1986; Tarnove, 1988).

Elton (1988), Emig (1977), Stout et al. (1990), and Yinger (1985) advocate the use of written journals as a means of actively involving students in the learning process, thereby aiding in the transfer of the course material (Kruger & May, 1986; Yinger, 1985). Finally, the time and space flexibility associated with the writing and evaluation of journals is a major reason given by Elton (1988) and Mikkelsen (1985) for the use of written journals.

The time and space benefit of journal writing, though, is actually quite limited in its flexibility as a medium of communication. The major problem lies with the frequency of the exchange of the written journals between the teacher and the students. Strackbein and Tillman (1987) suggest that the journals be collected and read by the teacher on a daily basis. But in a college or university setting, most classes are not scheduled to meet daily. For classes that meet once a week, the exchange process could span over at least a two week period. Written journals would thus play only a limited role in the between-class communication between teachers and students, since the exchange process is usually confined to the time of the class and to the assigned classroom (space restraint).

What is needed is a medium through which the exchange of communications can take place without regard to time and space considerations. Electronic mail (e-mail) can fulfill this need. It is proposed that students who frequently communicate with their teacher using e-mail as the medium of exchange of written journals will achieve higher grades in the course and more positive attitudes toward the course-related material than students who either communicate with their teacher only during traditional times (class time or teacher office hours) or students who communicate only intermittently with their teacher using e-mail.

The primary benefit of using e-mail as the medium of communication is its flexibility with respect to the time and place of its utilization (Davies, 1988; Elton, 1988; Wilson, 1987). Bull, Harris, Lloyd, and Short (1989) found that students use e-mail for informal conversations and for between-class interaction with professors. Eisley (1992) expands on this use of e-mail by using this medium as a means for students to submit assignments to the teacher and also as a means for the teacher to give students personal feedback on their test results and assignments.

In a study conducted by D'Souza (1991), the benefits of using e-mail (vs. traditional classroom handouts and announcements) as a means by which to communicate and disseminate class information and assignments to students was explored. The results D'Souza obtained indicated that the students who were in the treatment group where e-mail was used as the medium of communication scored significantly higher on exams and assignment grades than the students in the control group where the means of communications relied on traditional handouts and announcements.

Research Design and Methodology

This study was conducted at a small, mid-western regional state university. Every student enrolled in the university is provided an account on the VAX computer network that links the entire campus. With three VAX terminal labs located across campus, plus a terminal located in every dormitory room, the subjects thus had ready access to the network. Every instructor on campus is also provided a VAX terminal in his or her office.

The investigation took place over the 16 week length of the semester in a required freshman level computer literacy course. Three sections of the course, all under the guidance of the same instructor, were selected to participate in the study. Assignment to the course sections was based on student self-enrollment and section availability. Approximately 28 students were enrolled in each section.

The three sections of the computer literacy course involved in this study were randomly divided into one control group and two treatment groups.

Control group

Student/teacher communication was generally limited to the traditional course format–class time and office hours communications. The students were given the option to communicate with the teacher using e-mail.

Treatment group one

To supplement the traditional student/teacher communication process, the students were required to submit to the teacher, via e-mail, written journals. The format used for the journals incorporated the attributes of both a course log, which focused on the course material/assignments (Durfee, 1989; Nahrgang & Petersen, 1986; Stanley, 1991, Stout et al., 1990), and the dialogue journal, which was a running conversation between the student and teacher dealing with course content and other areas of interest and concern (Gambrell, 1985).

Each Friday, the students submitted their journals in the form of an edited computer file sent to the teacher through the electronic mail system on the VAX network. Each entry was appended to the end of the file in order to provide both the student and the teacher with a running account of their written exchanges. The journal entries were based on specific instructor-generated questions that discussed the previous week's course material and assignments plus related student interests and concerns. The teacher responded to the students' journals by Monday's class.

The teacher included in each student's journal a written response to any questions that were presented and comments related to what the student had written.

Treatment group two

The communication format that was used with this treatment group utilized a spiral notebook provided by the instructor. The students were also required to submit their journal entries every Friday. The same teacher response scheme that was used with treatment group one was also utilized with treatment group two.

Instruments

A pretest/posttest design was used to determine the changes in students' computer-related attitudes and knowledge. The initial section of the pretest requested information on the student's gender, age, college classification, and the last four digits of his or her Social Security number. Additional questions related to the student's ACT composite score, prior computer learning/experience, and ownership of a computer were also included in this section.

The next section of the pretest surveyed the student's attitude toward computers. The Computer Attitude Scale, authored by B.H. Loyd and D.E. Loyd (1985), is a five point Likert-type instrument consisting of 30 items. Positively and negatively worded statements of attitudes toward computers and the use of computers are presented. The overall coefficient alpha reliability of the Computer Attitude Scale is .95.

The last section of the pretest was a survey of course-related knowledge constructed with the assistance of university instructors familiar with the field of computer literacy. Forty computer knowledge-related multiple choice questions were presented. The scoring for the knowledge survey was performed on a correct/incorrect basis with the total points converted to a percentage. The reliability coefficient for the knowledge test was .71.

For the posttest, the first section asked for the last four digits of the student's Social Security number. The six demographic-related questions on the pretest were replaced by three questions that surveyed the subjects' experience with and attitude toward journal writing.

The remaining sections of the posttest were comprised of the Computer Attitude Scale and the knowledge survey. Both of these instruments were identical to the versions presented on the pretest.

Data Analysis

The subjects in treatment group one submitted, on average, fewer journal entries than the subjects in treatment group two in both the topic and discussion categories (Table 1). The difference in the average word count for the discussion category, though, was statistically significant (F Value: 4.55, Pr>F: 0.0377). The subjects in treatment group one wrote, again on average, more words per journal entry than did the subjects in treatment group two (Table 2).

Submission Category	Treatment Group One	Treatment Group Two
Topic	9.12	9.93
Discussion	12.50	13.21

Table 1: Average Number of Submissions

Submission Category	Treatment Group One	Treatment Group Two
Topic	73.68	66.83
Discussion	50.82	39.56

Table 2: Average Number of Words Per Submission

The differences in the percent changes in attitude and knowledge scores between the three groups were considerable (Tables 3 and 4). The results, though, were not statistically significant.

Group Type	Pretest[1]	Posttest	Percent Change
Control Group	112.96	113.00	0.04
Treatment Group One	105.84	111.92	5.74
Treatment Group Two	112.50	111.61	-0.79

[1] Maximum of 150 points

Table 3: Average Computer-Related Attitude

Group Type	Pretest[1]	Posttest	Percent Change
Control Group	49.22	59.07	20.01
Treatment Group One	44.72	56.64	26.66
Treatment Group Two	48.04	59.07	22.96

[1] Percent correct

Table 4: Average Computer-Related Knowledge

The findings from the three posttest questions that surveyed the subjects' experience with and attitude toward journal writing indicated that the subjects in both treatment groups were ambivalent as to whether the writing in the journals helped them academically in the class (Table 5). In response to the question, "I feel that the journal increased communications between myself and the instructor," subjects in both treatment groups generally felt that the journals did aid in increasing communications (Table 6).

Treatment Group	Average Response[1]
One (Electronic Journal)	2.44
Two (Written Journal)	2.55

[1] Five point scale (Strongly Agree to Strongly Disagree)

Table 5: Posttest Question #1

Treatment Group	Average Response[1]
One (Electronic Journal)	1.64
Two (Written Journal)	1.75

[1] Five point scale (Strongly Agree to Strongly Disagree)

Table 6: Posttest Question #2

In response to the third posttest question that asked the subjects if they would prefer to write future journal entries either in a notebook, using electronic mail, or not write any journal entries, the differences in responses between the two treatment groups was statistically significant (F Value: 8.31, Pr>F: 0.0058). The breakdown of the data obtained is shown in table 7.

Group Type	Notebook[1]	Electronic Mail	No Journals
Treatment Group One	4.0	80.0	16.0
Treatment Group Two	57.1	25.0	17.9

Table 7: Posttest Question #3

Discussion

The overall results indicate that though the subjects that submitted journal entries via e-mail submitted fewer journal entries (often due to technical errors), their entries were much longer, especially on the discussion questions. Such results may have contributed (though not statistically significant) to the greater percentage changes in attitude and knowledge scores for the subjects in treatment group one versus the subjects in treatment group two and the control group.

The posttest journal-related questions demonstrated that the student journals helped to enhance communications between the students and the teacher. The questions also indicated that once exposed to using e-mail as a means of communications, students prefer to continue to use this medium in the future rather than communicating through written journals.

Results thus obtained from this study should provide teachers, who have access to electronic mail, with more insight into the effectiveness and practicality of utilizing e-mail as the medium of exchange of written journals with their students.

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[1] In 1991 the non continuing students at higher education institutions averaged 14.6%, however this proportion of non continuing students is only a crude measure of drop out rates. (DEET 1992)

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project

The Multimedia Workshop: Methods for Teaching Multimedia Production

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Key words: multimedia, teaching, workshop, interactive, production

Abstract

Overview

This presentation will explain methods for teaching educators to use multimedia technology for instruction and communication. The topics to be discussed include: teaching methodology, workstation logistics, software and hardware selection, and instructional material development.

These methods are a result of workshops the author has conducted for colleges and school districts. There are three unique aspects to these workshops. First, is the emphasis on cooperative learning: all workshop participants work in pairs (sometimes in teacher–public-school student pairs) and are required to teach other students in the workshop. Second, is the inter-disciplinary approach to the instruction. The classes attract students from a variety of majors, including art, music, education, computer science, and communication. Finally, the importance and application of multimedia to school reform is discussed in the workshops.

Course Description

Students learn to create multimedia using some of the most common programs. They can use these to create research projects, publications, video productions, and interactive presentations and tutorials. It is my belief that "hands-on" experiences are the best way to stimulate thinking and discussion about the issues surrounding multimedia use for communication

and education. The class also includes discussions, guest speakers, readings, and demonstrations of multimedia use in education, business and personal productivity.

Course Content and Software

The basic outline of the course is as follows:
Overview–Applications and Implications
Image Processing–*Adobe Photoshop* tutorial
Optical Media–CD-ROMs and Videodiscs
Desktop Video–*Adobe Premiere* tutorial
Desktop Presentations–*PowerPoint* tutorial
Authoring–*Digital Chisel*
Other software and hardware
Issues and future trends

Assignments: Students complete any five of the following projects (each is worth 20 points): a research paper on multimedia, reviews of two CD-ROM or videodisc programs, a curriculum-based project from the *Visual Almanac* program, a *HyperCard* stack, a *Photoshop* graphic including a scan, an edited *Premiere* movie, a *Painter* graphic, a *Digital Chisel* program, two reviews of magazine articles, a *PowerPoint* presentation. Each class session begins with a presentation of one of the programs by a pair of students . Students may also propose their own assignment. I reward them for effort, enthusiasm, and helpfulness to other students. The emphasis is on the process and not the product.

Problems and Solutions

Problem: Lack of equipment
Solution: Work in pairs

In my lab, students work in pairs, rotating between different work stations. We enroll 16 students, grouped into eight pairs. The independent study nature of the tutorials makes it possible for the student pairs to be working on different software simultaneously.

Problem: Cost of hardware and software
Solution: Workstations and rotation

We configure eight different workstations with different hardware and software. Thus, we require only one videodisc player, one scanner, etc. We also set up one station as a presentation station. Power Mac 6100/60 AV's with built in CD-ROM drives work well as multi-purpose stations. Eight megabytes of RAM is a minimum, with 16 MB more workable. All of the software producers offer affordable licensing arrangements.

Problem: Rapidly changing technology
Solution: Present it as an evolving science

The workshop needs to be constantly updated; this makes it exciting. Students should also be aware that some of this technology is not yet refined. Sometimes they are working on "the bleeding edge".

Problem: Lack of teaching materials
Solution: Develop auto-tutorials

The goal is to get the user up and running quickly and painlessly. Initially we used tutorial chapters from the software manuals, but I am now at work on a textbook of more focused tutorials (*Multimedia Magic*–Allyn and Bacon publishing, 1996).

Problem: Diverse experience levels
Solution: Peer teaching:

Students enter the workshop with a diversity of computer experience. I allow the students to form their own pairs, but it might be advantageous to remix some incompatible pairs. Again, I stress more experienced students working on their teaching skills with a less experienced partner. Some students found it better to work alone outside of class hours. Assignments can be turned in individually or in pairs.

Problem: Access Logistics
Solution: Flexible lab hours

If a student was absent or required additional time, the rotation could be upset. It is important to allow extended lab hours for make-up and additional work. Increasingly, students are purchasing multimedia computers for home use.

Successes

The workshops have had several benefits. Most obvious, is the students' acquisition of skills and information. They were able to produce some impressive and effective multimedia materials. A less anticipated outcome was the high level of motivation and excitement the students had for doing multimedia production. It resulted in some insightful thoughts about the applications and issues of this field. The use of student pairs, presentations, and peer teaching had some exciting implications for school restructuring. College faculty have increased interest in multimedia production, electronic publishing, and using multimedia for instructional purposes. Local school districts have expressed interest in getting more teachers "up to speed" with using multimedia in their classrooms. The multimedia workshops were a highly effective addition to the curriculum at Southern Oregon State College.

project

Helping Preservice Teachers Design Classroom Materials Using Desktop Multimedia

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Key words: teacher education, multimedia, visual literacy, instructional technology

Here at La Salle University, we have successfully taught our preservice teachers to create more effective classroom materials by integrating instruction in the principles of visual literacy and design with powerful, yet teacher-friendly, electronic desktop presentation tools such as Microsoft's PowerPoint. Working from the primary assumption that, in order for teachers to design more effective visuals for their own classroom instruction, they need to master some basic prerequisite skills–namely, the ability to both comprehend and apply principles of visual design such as arrangement, unity, legibility, sequence, motion, color, type style, and so on.

In our teacher preparation course entitled, *Instructional Media and Technology*, we begin by giving our students an informal diagnostic test to help us determine the kinds of prior experiences they may have had working with computers in other classroom environments. Typically, our students possess some word processing skills, together with a modest knowledge of spreadsheet and data base programs; however, many arrive with little knowledge of how to create textual and graphical information effectively for display purposes.

Therefore, in order to help them become more cognizant of developing a systematic approach to creating visuals, we compare and contrast some models of projected and non-projected media which incorporate a range of effective and not-so-effective elements of visual design. For example, we share with our students a pre-produced thermal transparency containing a numerical table which is somewhat difficult to read. Through interactive discussion we explore some possible reasons for this difficulty. Students most often determine that the data contained in the table is too small, or too numerous, or poorly labeled. They then suggest concrete ways in which the table could be improved. Using another example, we distribute two word-processed handouts which contain identical language, however, the printed information for each one is laid out and designed differently. We then ask our students, "Which of these two handouts communicates more effectively–and why?" In addressing this question, students quite naturally employ vocabulary which reveals that they already possess the necessary cognitive schema needed to begin resolving the implicit issues contained within it, such as: What does *effective* mean in this context anyway? Discussion of such *declarative* knowledge prepares our students for the latter stages of our course when we expect them to develop additional *procedural* knowledge; that is, they are asked to construct pedagogically appropriate "electronic handouts" which are subsequently displayed on computer monitors or projected with LCD panels.

After having our preservice teachers *manually* generate and design some everyday classroom materials such as worksheets, overhead transparencies, posters, flip charts, chalkboard and bulletin board displays, we then help them make the transition to the computer screen. At this time we demonstrate how computer technology–particularly multimedia technology–can help them generate visually literate instructional materials with speed, accuracy, style, and creativity. Students observe how easily text can be manipulated, clip art can be imported, colors can be changed, and so on.

We next coordinate a series of hands-on computer workshops (a.k.a. lab experiences) in which students create, manipulate, and edit a variety of text and graphics utilizing, as best they can, the principles they have been assimilating from day one of our course. We emphasize that creating visuals, like creating written compositions, is a developmental, reiterative process that occurs over time. Just as an effective final draft of a paper goes through a series of revisions, so does an effective visual. And just as in writing workshops, where teachers assist their students by giving them timely and frequent feedback concerning their work, so, too, do our students receive such positive, interactive criticism. It is during these critical drafting and revising stages that we, as instructors, begin to incorporate inductively some of the modern, technological expressions and processes–such as *computer builds*, *transition effects*, and *electronic storyboarding* –into our instruction. Students not only become more aware of how their visuals can become linked in a variety of ways, but they also learn how sound and video can be added to them, in order to heighten their impact and improve their pedagogical effectiveness.

During the final weeks of our course we have our students–working individually, in pairs or small groups–prepare, create, and demonstrate *technology-infused classroom lessons* in which they are given the option to incorporate electronic desktop presentations using Microsoft's PowerPoint and a multimedia computer replete with a built-in CD-ROM drive. The results of our students' efforts have been gratifying.

project

The Effects of Hypermedia Training on Graduate Students' Cognitive-Level Changes

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Key words: hypermedia, cognitive-levels, cognitive taxonomy

Abstract

Bloom's taxonomy is widely recognized and often used to classify learning objectives. Bloom's taxonomy of the cognitive domain consists of six distinct levels of cognitive skills, ordered hierarchically, with each successively higher level requiring attainment of those skills subordinate to it.

One of the most common uses of the cognitive taxonomy has been to establish learning objectives. Typically, this has involved the teacher determining desirable levels of cognitive activity. Students are then expected to strive for these teacher-determined levels. Thus, we, as teachers, have imposed cognitive limitations or established unrealistic cognitive objectives for many students. Allowing students a means for cognitive freedom within the taxonomy might alleviate this. Providing students equitable access to each of the levels of the cognitive taxonomy via cognitive prompts on open-ended response logs, or journal entries, might be a method of establishing this cognitive freedom.

Design of the Studies

Participants

Twelve graduate students enrolled in the Hypermedia in Education course participated in Study 1. Twenty-one students enrolled in the Hypermedia in Education course participated in Study 2.

Independent Variables

Treatment

Hypermedia in Education was a one-semester, three-credit-hour, graduate-level course segmented into five distinct sequential parts. The course focused on hypermedia theory, research involving hypermedia, applications of hypermedia to the content areas, designing and authoring hypermedia software, and the evaluation of hypermedia programs.

Dependent Measures

Cognitive-Levels

For each weekly response log, students listed five to eight questions, statements, or points of interest from weekly assigned readings on hypermedia. Bloom's taxonomy was used to assess students' levels of cognition by having students select nouns from a list of 30 that were provided.

Procedures

The 30-noun list was alphabetized and given to the students for them to select from in their weekly response logs. They were not told that the nouns originated from the cognitive taxonomy. Students in Study 2 were given definitions for the 30 nouns; students in Study 1 were not. The six levels were assessed for each student using the frequency of his or her citations at the six levels in his or her weekly response logs, and then were then grouped into Lower-, Medium-, and Higher-order cognitive-level groups.

Analysis of the Data

Early- and late-treatment cognitive-level scores were compared using nine paired t-tests. For three paired t-tests, the Lower-, Medium-, and Higher-order early- and late-treatment percentage scores were compared. For six of the paired t-tests, the early- and late-treatment percentage scores of the six cognitive-levels were compared.

Results–Study 1

The difference between early- and late-treatment proportions of Lower-order citations was not significantly different, although the mean percentage did decrease from 40.4% to 31.3%. From the early- to the late-treatment point, the percentages of Medium-order citations significantly decreased from 41.3% to 34.5%. From the early- to the late-treatment point, the percentages of Higher-order citations significantly increased from 23.7% to 34.2%.

There was not a significant change in the proportion of Knowledge, Comprehension, or Application citations from early- to late-treatment data collection points. There was a significant decrease in the proportion of Analysis citations from early- to late-treatment data collection points. There was an increasing trend for the proportion of Synthesis and Evaluation citations from early- to late-treatment data collection points.

Results–Study 2

There was a significant difference between early- and late-treatment proportions of Lower-order citations with the mean percentage decreasing from 31.9% to 26.2%. There was a significant trend for early- to late-treatment proportions of Medium-order citations. The mean percentages of Medium-order citations increased from 32.7% to 37.4%. The difference between early- and late-treatment proportions of Higher-order citations was not significantly different, although the mean percentage did increase from 36.9% to 40.9%.

There was not a significant change in the proportion of Knowledge , Comprehension , Analysis, or Synthesis citations from early- to late-treatment points. There were increasing trends for the proportion of Application and Evaluation citations from early- to late-treatment points.

Summary

The patterns evidenced by these cognitive-level changes indicate that students successfully built upon their prior experiences and progressed to Higher-order cognitive activity. They, likewise, underwent a gradual accretion of new information as a result of the course that continued to add to their knowledge base throughout the semester.

project
Instructional Strategies for Teaching Hypermedia

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Key words: hypermedia, multimedia, interactive, educational computing

Teachers are being encouraged to incorporate multimedia into their instruction to improve learning. One such example is the project funded by the Department of Education, Office of Special Education and Rehabilitation Services: Acquiring Literacy Through Interactive Video Education (Project ALIVE!). In Project ALIVE!, eight teachers of middle- and high-school deaf students were recruited to determine the effects of using teacher-produced multimedia products on the literacy levels of their students. Teachers and project staff participated in a one-month workshop during two consecutive summers in which the teachers learned to create their own multimedia products. In addition, the teachers worked on their multimedia products during the regular school year with the support of project staff through direct visits and telephone contact.

The summer workshops were the times when the most intensive instruction occurred. During these workshops, teachers acquired technical and instructional design skills to produce effective hypermedia instructional products. As a result of a thorough task analysis, the skills the teachers needed were specified, ordered, and grouped into meaningful instructional units. The instructional strategy for teaching these skills was based on Gagne's Nine Events of Instruction. Prior to the teachers' arrival at the first workshop, a group of learners comparable to our workshop teachers were recruited for a formative evaluation tryout. Subsequent revision of the instruction reflected evaluation data.

The first step of the workshop instructional sequence had participants view sample hypermedia products to provide them with a concrete picture of what they would be achieving. Project staff even introduced themselves through hypermedia presentations. Next, with the assistance of project staff who manipulated the software to create what the teachers envisioned, teachers created simple hypermedia, interactive products. This activity exposed participants to the breadth of the software's functions. They were then ready to learn to use the hypermedia software themselves. This began with the teachers viewing a demonstration of an application of the skills they were about to learn. Then, because some teachers preferred to learn independently, using a discovery approach, they were able to decide whether they wanted to follow a guided learning approach with an instructor or would rather be "unleashed." Since each lesson included an assessment activity, participants could decide which instructional strategy he or she preferred after viewing the demonstration and reviewing the assessment activity. Project staff were available to provide clarification and mini-lessons for those who needed them. Reteaching, and adjusting the explanation to suit the learners' understanding of the concepts was the rule. In addition, demonstrations and instruction beyond the scope of the instruction intended for the entire group was provided for those teachers who were interested.

By the second year of the summer workshop, participants had grown both technically and in the design sophistication of their products. However, they were not growing homogeneously. Rather, one or two teachers had learned a group of skills because they needed or discovered them, while other participants had learned something completely different. To accommodate this diversity, a competency-based instructional system for learning technical skills was set up. This strategy emphasized to the participants what the instructors considered to be the core competencies. The teachers could evaluate themselves to determine whether or not they wanted formal instruction in specific areas. Based on the needs of the eight participants, instructional sessions were scheduled, followed by assessments and repeatable testing as needed. Because the participants were trained teachers, instruction related to effective instructional use of hypermedia, computer-based technology was provided on an as-needed basis.

During the first summer workshop, all participants were asked to meet with the project's instructional designer to clarify the goals and organize the content of the product they would be developing. During the second summer workshop, a major design-related weakness needed to be addressed. The teachers tended to fill their hypermedia presentations with too much textual information and not enough visual information. As a result, instruction that focused specifically on how to create fewer text-heavy, more visual screens was provided and reinforced throughout the workshop.

project
Facilitating Cross-cultural Interactions: The "Yes, You CAN" Chinese American Network Project

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Key words: cross-cultural, Chinese and American, network, electronic mail, virtual friends

"Yes, You CAN" Chinese American Network was a cross-cultural project designed for Chinese and American students to communicate with each other through the use of electronic mail. Forty college students and university faculty in United States and Taiwan R.O.C. were involved in networking activities exploring cross-cultural issues in education and culture. The participants engaged in online discussions and "virtual authentic activities" to contextualize the interactions. For example, participants were randomly assigned to different scenarios in which they were to act as hosts to friends from another country (i.e., Taiwan or America). The participants proposed (over the network) a three-day plan for their virtual guests that highlighted salient aspects of their own culture. Overall, CAN provided a cooperative learning environment in which participants were actively involved with the "virtual friends" and ongoing electronic discussions to gain diverse cultural perspectives.

This session will discuss advantages of the CAN project mentioned by the participants, as well as the difficulties they encountered during the network interactions. Findings related to cultural diversities in attitude, communication style, and level of participation will also be presented.

project
Exploring Diversity Issues through Computer Software in Early Childhood Education

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Key words: diversity, multicultural, early childhood, ages 3–8 years

Abstract

The next twenty years will bring dramatic changes in the population of the United States. According to The Kiplinger Washington Letter (December 1993), there will be a increase in racial and ethnic minorities, especially in Asian, Hispanic, and black populations. We will experience surging immigration. These changes mean that our children will live in increasingly diverse communities.

Young children have always noticed obvious differences in people and have not been shy about asking questions about them. Children can be taught to respect and defend differences, such as racial, cultural, or physical differences. They can be helped to develop a sensitivity to discrimination and to see that they live in a community that is both multicultural and diverse. They can gain awareness of the importance of individual uniqueness.

Technology can be ·ed to help support diversity awareness, even with very young children. In this project entitled, "We Are All Special," we identify commercially produced software available for children from ages 3 to 8 years. Through the use of this software, a teacher can address questions young children might ask such as: "Why is that person in a wheelchair?" "Why is his skin so dark?" "Why does she talk funny?" and "How can he get anywhere when he is so slow?" This session will present the goal of the project and identify software that can be used to support the goal, as well as ideas for introducing an awareness of diversity with the help of technology.

paper

Is the Medium the Message? Comparing Student Perceptions of Teacher Responses via Written and E-mail Forms

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Key words: e-mail, teacher education, telecommunications

Abstract

This study addresses students' application of educational technology and to encourage self-assessment and critical thinking by integrating the use of electronic mail to gauge the development of methods students in their capstone course prior to student teaching. The project aimed to increase apprentice teachers' technology use and evaluation skills while determining the value of e-mail communication in facilitating those processes.

Paper

The continuing growth of educational technology use in American public schools has inspired investigation of its impact on both students and teachers. Although technology use is increasingly being integrated into K–12 classrooms, recent studies suggest that preservice teachers have little familiarity or experience with computers or educational software to prepare them for teaching in the public schools (Beaver, 1992). Other studies recommend using telecommunications as a rewarding introduction to technology infusion into teacher preparation courses. Telecommunications in the classroom helps transform familiar types of assignments into new forms, increasing students' motivation while extending opportunities for critical thinking important to successful teaching (Schrum, 1988; McLaughlin, 1991).

This study was designed to address both important issues–to expand students' practical application of educational technology and to encourage self-assessment and critical thinking–by integrating the use of electronic mail as a means to gauge, through reflective journaling, the development of Methods students in their capstone course prior to student teaching. The goals of the project aimed to increase apprentice teachers' technology use and evaluation skills while determining the value of e-mail communication in facilitating those processes.

The participants in the study were secondary English Education majors at Buffalo State College, enrolled in the Methods for Teaching English course required of all majors the semester before student teaching. Although all students enrolled in the course were required to complete regular self- and course-assessments to accompany their reading logs, they were offered the choice of forms: the more traditional notebook-style handwritten journal or e-mail communication. During the fall, 1994, semester, thirteen of the twenty-seven students enrolled in Methods chose to complete their assessments through e-mail (the e-mail component was only part of a larger effort by the College's education faculty to increase the use of technology with our students). Students received on-going feedback, explored teaching concerns through writing, and developed their self-assessment skills by means of a continuing written "dialogue" with the instructor.

Unlike the handwritten documents submitted weekly by non-participants, the relative immediacy of e-mail communication allowed the students and instructor to participate in day-by-day discussions of their experiences and offered a means to communicate as concerns arose. Guidelines intended to chart students' sense of their individual development within the context of the course and to reflect on their experiences via the telecommunication process; the parameters aimed to discourage generalized or insubstantial messages and create ownership for each communicator (Waugh, Levin, & Smith, 1994). At the end of the semester, participants were asked to complete an anonymous questionnaire concerning the value of the experience as a course component.

The data accrued from the study strongly suggest that an e-mail "journal" helps students synthesize their learning and develop increased self-assessment skills beyond that of traditional journaling. As important, the instructor received a vastly more comprehensive understanding of the students' concerns and perceptions of their Methods experience. The correspondence not only allowed increased feedback before and after formal class meetings but, perhaps most important, helped recreate the student-teacher relationship, transforming evaluation into a mentoring process important for fostering beginning teachers (Glanz, 1993). Additionally, e-mail provided a relatively "easy" and rewarding transition into technology use–even for self-described "technophobes."

Both the qualitative and quantitative data support the use of e-mail "journals" to supplement teacher preparation courses for a variety of reasons. Attempting to provide, or even summarize, a semester's correspondence with thirteen student, however, cannot capture the richness of their insights and growth. As other research has indicated, the pseudo-anonymity offered by the e-mail medium created a much freer and expressive venue for students to reflect on their educational experiences (Rivera, *et al*, 1994). At the same time, students perceived the feedback they received as more personal than handwritten comments, creating more extensive and responsive messages from both sender and receiver. As one student indicated after a course review: "I like the e-mail letter format. It makes for a more personal approach, which is what this project needs" (Tom). Unlike assessments submitted in written form, e-mail messages regularly began with a salutation similar to that of a letter ("Hi!" "Hello," "Greetings," "Dear Dr. Deal," etc.), indicating students' sense of a personal correspondence and interaction provided by e-mail.

Besides the heightened sense of personal communication, the progress of the students' correspondence strongly illustrated students' concern for feedback and immediate responses to their messages, not expected from the scheduled weekly submissions of work: "Hi. I didn't get a reply from my e-mail today... I'm worried about whether you got them or not (Tom); "This is not this week's entry yet, it is just an answer to the question you asked me [on the previous response]. . ." (Melissa); "Did you not get me last message, or have you just not responded yet?" (Kathy). Additionally, occasional problems with the College Vax interfered with transmission of some messages, causing students to worry about receiving replies: "I hope that this means you got my message. . ." (Kathy). Even the problems inherent with technology use seem useful for students to experience: to extend instructional facilities requires additional effort. Several messages suggest that the study participants remained undaunted about working with computers, even when the "system" failed to work as expected: "This is a little bit different from the regular program that I am used to using. I am going to try and send this now. This is neat!!!" (Eileen).

In fact, discussion of the electronic medium was often part of the students' and the instructor's dialogue. The exit survey revealed that only 25% of the study participants had ever used e-mail before; although sometimes frustrated with the "glitches" inherent in technology use, all new user were proud of learning and regularly using the new skill: "Finally! I got into the system and I'm actually accomplishing something on a computer" (Tom); "My experience with e-mail has been one of my first introductions to the world of technology... I was happy to learn that sending e-mail was so simple, though it took me several assessments to remember all the steps..." (Tanya); "This is the first time that I have ever used e-mail. I hope that it is done correctly" (Kathy); "I hope that me messages reached you... If I miss hitting the return key, the line will break up and the messages may not reach you. But from your response, I see that you did read it. I was so relieved that you had. . ." (Eileen).

The project also allowed the instructor to assess her own work by receiving more immediate feedback concerning the individual course sessions. The sheer length of the e-mail messages far exceeded the typical 1-2 page evaluations submitted by non-participants. e-mail communication gave increased and deeper insight into students' classroom experiences during Methods as they gave suggestions and provided feedback conversationally: "This week I want to discuss the unit plans. . .I didn't think it was going to be as hard as it" (Tony); "One thing I didn't like about last class was the knit-picking [sic] of the lesson plans. . ." (Tom). Such comments helped the instructor either re-assess the value of particular course components and techniques, or provided opportunities to offer further explanation about the importance of certain assignments and lessons.

The correspondence also created a venue for students to express their anxieties and yet "coach" themselves through fears: "I understand this commitment [to teaching] and have honestly been humbling myself with this truth. As a matter of fact, I have greatly tempered my enthusiasm and seem to have instilled a certain seriousness about the field" (Matt); "I am filled with personal doubt about whether I want to teach" (Tom); "I often question my competence. Am I too shy to be a teacher? What is my philosophy?" (Tanya); ". . . the thought of standing up in front of students. . .scares me" (Kathy). e-mail allowed the instructor to provide encouragement and advice more extensively and individually in response, helping students directly with long- and short-term decisions about teaching: "I thought [high school] would be a better level to teach but... you thought that I would be a great middle school teacher. It's not that middle school scares me but sometimes I feel it would be more difficult to prepare for this level" (Tony); "I did a great thing yesterday: I quit my job. What better way to be a go-getter [like you suggested] than to get rid of the thing that weighs you down" (Tom).

The participants were unanimously positive about their role in the project and the value the journals had for their experience. As one of the most thoughtful and analytic users noted in a self/course evaluation, "e-mail can connect students to a world of people and ideas. . . e-mail can be a wonderful educational tool if students are encouraged to become active learners" (Tanya). The affective responses gathered from the anonymous exit survey about the project also revealed students' positive understanding of e-mail as an important educational technology; "An interesting, excellent learning tool"; "It was a great experience. It not only helped with the class but also in communicating with colleagues"; "e-mail was a great experience for giving and taking feedback. It provides a more informal base for communication and when I used it I really got the sense I was talking to somebody. It really is important to maintain contact [through] a computer."

The exit survey also provided the quantitative data to encapsulate the affective responses documented throughout the semester's correspondence. Using a Likert scale, students were asked to assess their experience with e-mail and to rate the quality of the communication using the medium. Although only one-quarter had used e-mail before the course, 100% rated the overall quality of the experience as "Very Positive" (a 5 on a 1 to 5 scale). When asked to compare the effectiveness of e-mail to handwritten comments, 100% again rated e-mail as "More Effective." Perhaps most significant for the overall infusion of technology into teacher education programs, students assessed their interest in educational technology before and after completing the project. Although no student described him/herself as antipathetic toward technology before the project, half characterized themselves as "neutral" and a quarter as "somewhat interested" in educational technology use; only the remaining 25% described themselves as "enthusiastic." However, after completing the semester's correspondence, 100% were converts to educational technology; all chose to characterize their interest level as "enthusiastic" (5 on a 1 to 5 scale).

As an interesting side note, the enthusiasm of the e-mail users in the class communicated itself to other non-participants. Several times through the semester, students who were not involved in the project logged on to communicate with the instructor and, in many cases, to explore e-mail for the first time. In a typical message, one student experimented with the medium to convey her excitement over a team teaching experience: "This is the first time I've tried e-mail but I wanted you to know our field experience teaching went well" (Beth).

In its initial form, the telecommunication project provided an enriched experience for both the student teachers and the college supervisor. However, such projects need careful planning and limitations and also require new skills development, not to mention a significant amount of additional work, for instructors employing the method. Familiar techniques for responding to student work need modification. For instance, marginal comments to create a dialogue with students on individual points is not possible with e-mail; to respond to key points, jotting down by hand, or maintaining a simultaneous word processed document is necessary. Creating a manageable file system for the messages is also important as well as regular–essentially daily–logs on to check messages.

To encourage maximum technology use, the instructor allowed students to extend sending their assessments by e-mail to include assigned reading reviews as well, which proved a mistake. The length and complexity of these messages created additional logistical problems (especially with only one phone line in the house!) Although worthwhile to both students and instructors, the time commitment involved in responding even to the assessments alone proved incredibly time consuming. Offering e-mail as an option, rather than requiring its use of all students, naturally allows some students to avoid increased use of technology. At the same time, using the medium with all students can easily become an overwhelming addition to an already demanding work.

Nevertheless, through e-mail, study participants documented their growth as preservice teachers, reviewing their development through use of the electronic medium. The final conclusions about the value of the process suggest that such telecommunication would be valuable for other education courses as well: "e-mail has helped me in the transition of becoming a teacher. You know my situation, the problems I've had. . . Just being able to tell someone who can accurately assess the situation has helped me tremendously" (Marj). As Patti summarized her experience, "I am very glad that I was able to participate in this e-mail project. I sort of feel sad having to leave [it]." Perhaps most important for teacher education, e-mail as a medium of communication provide useful messages to assist education faculty members enhance the quality of preservice teacher mentoring for their future success in the classroom.

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project

LEP-NET: Limited English Proficient Network Project (Year 1) Establishing a Database with a Bilingual Focus on Internet

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Key words: English language development, Internet, K–12 curricula

Abstract

Project Description

LEP-NET, now officially CALLNET, is a Department of Education Technology Innovative Grant project that employs telecommunications in a preservice and inservice collaborative model to develop and disseminate teacher resource materials for educators working with second language learners.

The State of California Department of Education estimates that, by the year 2000, fifty percent of the students in California schools will be limited English proficiency students. The project aims to support K–12 and college instructors as they retool to meet the growing language development needs of California K–12 students by offering online collaborative curriculum development opportunities.

The project builds a model and identifies the steps taken to achieve that model and its product application that can be replicated to meet other professional development needs.

First year outcomes included the development and initial testing of an online collaborative curriculum development tool. Project participants directed development of the database structure, developed/selected curricula for the structure, and provided initial feedback on effectiveness of the structure.

The presentation will overview first year goals and outcomes, as well as curriculum criteria development, database design, technology training and support, equipment overview, and ongoing collaborative aspects of the project.

project

Project S.E.E.D.–Seeding Multimedia into K-12 Instruction

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Key words: multimedia, English language development, science, social science, rural

Abstract

All students need equitable access to the core curriculum for academic success. This presentation will describe the first year of incorporating multimedia instructional materials with English speaking and non-English speaking students and parents.

Setting

Project S.E.E.D. (School Electronic Equipment Demonstration) is a consortium of small, rural schools in Northern California integrating multimedia tools into K-6 (science) and 7-12 (social science) classrooms: three elementary/middle schools, three high schools, and the special day class students in Special Education. Project S.E.E.D. was designed to assist English language development, and provide all students access to the science and history/social science curriculum using multimedia mobile resources in an "applied acquisition setting".

Project Description

Students and adults used primary language curriculum materials and collaborated in small groups to synthesize and present information to classmates, students, parents, teachers and the larger community. This links with a specific aspect of the California Science Framework in which students and adults connect science with its applications in technology and with the student's own experiences and interest, using hand-on investigations and documentaries. This also links to a specific aspect of the California History/Social Science Framework in which students develop (1) participation skills, (2) critical thinking skills, and (3) basic study skills.

At the heart of Project S.E.E.D. were "seed teams." Each team consisted of a regular classroom teacher, an English as a Second Language (ESL)/Bilingual Teacher/Aide, two students from each class, and a limited English speaking parent who was participating in the school's adult ESL class. "seed teams" received on-going technical assistance throughout the school year and developed strategies for developing cooperative learning projects using video cameras, CD-ROM, laser discs and interactive multimedia tools. A unique feature of Project S.E.E.D. was the inclusion of non-English speaking parents and students into the project development "seed teams".

Resource Management

Each site received equipment to configure a mobile multimedia station. S.E.E.D. software resource materials (laserdisc, CD-ROM, computer software) were catalogued into the automated circulation system at the County Teacher Resource Center to ensure that these items were circulating and in use. Statistics were available any time to track and monitor material use. Resources were on display in the center where teachers came to preview and learn what products were available.

Year 1 Outcomes

This presentation will discuss the outcomes of the first year of implementing cooperative multimedia projects into K-12 classroom settings. The impact on classroom environment (student/student; student/teacher interactions) and English language development and student achievement will be discussed. Sample classroom multimedia projects will be included, along with "key aspects" of project development.

Funding for this project was made available by the California Department of Education (SB 1510) and was adapted from two Model Technology School Projects in California.

classroom demonstration

Notre Héritage Louisianais: A Collaborative Interdisciplinary CD-ROM Project

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Key Words: French, multimedia, elementary, CD-ROM, interactive

The purpose of this project was to produce educational materials on Louisiana's French heritage on CD-ROM that could be used in the elementary French Immersion classrooms. *Notre Héritage Louisianais*, is a collaborative project based on a pilot folklife-in-the-classroom residency project that resulted in the production of *"Le Tissage Traditionnel,"* the first CD-ROM in the series. Educational materials on Louisiana culture for use by elementary and secondary educators are scarce in any format, so this project fills a tremendous curricular void and an expressed need, at the same time offering materials in a state-of-the-art interactive multimedia technology. Project activities target elementary French immersion students, but have application for the entire school population in Louisiana and may serve as a national model for multimedia presentation of multiculturalism.

The Educational Technology Review Center (ETRC) in the College of Education at the University of Southwestern Louisiana served as hub institution for a collaboration by individuals, organizations, and institutions who are active leaders in Louisiana humanities education. The Lafayette Parish School Board and Louisiana Public Broadcasting are central in this effort. This is the first project of its kind in south Louisiana.

The content of the CD-ROMs can be divided into two parts:

1. A series of interactive lessons on aspects of Louisiana French folklife; i.e., foodways, ritual, performance, trade and domestic crafts, using a combination of video, photographic, audio, textual and illustrative cues.
2. A "shell" program offering contextual background for the lesson content, educational models, teacher training materials in the multimedia-disciplinary use of folklife materials, evaluation tools, general suggestions for use.

The program which was produced in MacroMind Director. In this project demonstration, the presenters will demonstrate the CD-ROM developed and discuss the continuation of series.

project

Behind the Dikes: Information Technology in the Netherlands

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Key words: curriculum, secondary education

Facts

The Netherlands has 15,400,000 people within 41,526 square kilometers. There are 456 people per square kilometer. The capital of the Netherlands is Amsterdam. There are 1.5 million students, aged 6–12, attending 8,300 primary schools. These schools have a total of 29, 000 computers. On the secondary level, there are 1 million pupils, aged 12–18, attending 750 schools. These schools are equipped with 18,000 computers.

Curriculum

In primary education, the school determines how many lessons of informatics are given to each student. The government has provided the schools with 29,000 computers. A lot of schools have bought extra equipment themselves to have approximately one computer for every 30 students. Computers are used for the school paper, the schools' administration, and by students. A *Windows*-based system is used. A lot of remedial teaching is done with small programs for languages, math and geography, also a lot of wordprocessing.

In secondary education, the subject of information technology is one of 15 required subjects in the first year. The schoolweek exists of 32 lesson hours, out of which only one hour is for IT. The class is only required for one year, and it is just enough for students to learn the basic elements. Besides the class requirement, a lot of energy is put into trying to integrate IT within other subjects: wordprocessing with languages, spreadsheets with economics, drawing with design, and composing with music.

The goals of the subject IT in the primary stage of secondary education are recorded within the 'kerndoelen,' the core-curriculum.

The last years of secondary education are being reorganized. This is being done in order that the classes have a better connection with the following studies or the industrial life.

The students can graduate in four different directions:

1. Culture and society
2. Economy and society
3. Nature and health
4. Nature and technology

It is possible to choose IT as one of the subjects of examination. A lot of other subjects will be using the applications of IT.

Trends in secondary education.

Decentralization

Schools in Holland are bound by strict requirements for final examination for every subject. The finances are tightly controlled by the government. This tradition is changing. The educational goals are becoming more stringent; the schools more often make their own choices. This is amplified by the possibility for schools to rule their own finances: "Do we repair the roof or are we buying new computers?"

Enlargement

The government stimulates mergers between schools. Some years ago, the Netherlands had 1800 schools for secondary education, now in 1995, we only have 750 schools left. Schools of 1500-2000 students are normal these days.

Home computing

The number of computers at home is growing every year. More than 50% of the students have a computer available, either at home or at the neighbors'. So, the differences between students are growing. At schools less time has to be committed to the basics.

Software

Usually commercial software of the larger companies is used. For special educational applications like registration, controlling and experimenting in the subject of science, unique soft- and hardware is being developed. IP coach is a fine, well-used package. A special program used in a lot of schools is *Reisplanner* which enables you to plan a journey through Holland by train and to pick a goal for the journey to go to.

IT integration

After providing schools with hard- and software, the government is now aiming at providing networks between schools– not only electronic but also relational. Schools within a region are being organized for the use of IT in one subject. Teachers form groups to help each other. This project, PIT, gets a lot of interest from schools and clearly accelerates the integration of IT. *SimCity* is used to study simulations and to reflect on the actual domicile, the physical planning, and local politics. In the lessons for music, pupils use a workstation to explore timbre, composition etc. New books about designing and robotics will follow. The first series of lessons with the CD-ROM *Musical Instruments* will be published summer 1995.

Didactics

One of the most important changes over the years is the approach to the student. No longer a consumer who is awaiting on what will be offered, much of what a student learns is on his/her own and active. The student must become independent of the teacher. Students will have to build their own studies, more or less like studies at the university. They will not just be learning the facts but investigating questions and making discoveries. Facts can be found with the computer or using other sources.

Learning to learn.

Students are working more in groups and presenting the results of their investigations to the class. This is not completely new but now mandatory for all schools Therefore, IT use has increased. On one end of the usage spectrum, IT is used to keep track of student's results, and on the other end, it is a source of knowledge to the students. School libraries are being supplied with CD-ROM and CD-I, and schools are being hooked up to Internet. Increasingly, the teacher becomes a coach and facilitator of the learning process. Not everybody shares this idea, certainly not all the teachers. However, political committees and study groups are working with this and renewal is being guided by these ideas.

Telematics

There is an overwhelming, nationwide interest in telematics. Everybody with a computer can get an account for Internet for a reasonable price. Weekly TV shows are dedicated to the World Wide Web. The educational bulletin board 'SLO-lijn' is flourishing. It is not clear yet what the consequences will be for education. Many experiments will show the possibilities.

Lesson materials

There are 10 methods for the subject information, published by educational publishers. The number of schools using self written lessons is diminishing. The newest method 'Vensters' is the first to be completely based on *Windows*; DOS is no longer mentioned.

Finally

A lot of lesson material is becoming available for many programs and subjects. More advanced computers are entering the schools. Teachers are gaining more insight into the use of computers.

There are a lot of problems to overcome, however. Especially in the use of IT within other subjects. Are enough computers available? And if so, does the teacher have enough knowledge? Also, very important in the education in the Netherlands, does the subject's curriculum allow the use of computers? Financially, integration of IT in education remains a large problem. Despite all these problems, the importance of IT will grow.

The government in the Netherlands plays a stimulating role:

- In 1995 the International Olympiad on Informatics will be held in the Netherlands. More than 60 countries will send their delegation of pupils from secondary education to this competition in Eindhoven.
- In a project with the national telephone company, all schools for intermediate vocational education will get a connection to Internet.
- The PIT project, organizing schools in networks, will go on for the next several years.

[redacted]

classroom demonstration

Technology Assisted Assessment: Video and PDA's

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Key words: assessment, authentic, observation data, parent communication

Abstract

When you woke-up morning, there was a new product with the potential to change our world. This happens every day now. Technology is changing at a breakneck speed. Schools are changing too. The SCANS report cited a need for real-world learning to prepare students for the world of work. That kind of preparation demands authentic teaching. Authentic teaching should contain disciplined inquiry, the integration of knowledge, and value beyond evaluation. Authentic teaching demands authentic assessment. Elliot Eisner in *The Enlightened Eye* (1991) said that, "I believe no effort to change schools can succeed without designing an approach to evaluation that is consistent with the aims of the desired change." We need to create a new vision of assessment that emphasizes meaningful tasks instead of drills and skills, critical thinking instead of rote memorization, self-reflection instead of traditional grading scales, and more thoughtful learner outcomes instead of standardized tests. Schools have begun to investigate ways to assess student work in a manner that reflects the learning that takes place. The old paper report card is not enough any more. In our search to find a replacement for this antique form, we are looking for something that is easy to use, presents an accurate portrayal of the student's progress, and promotes awareness between home and school. Technology can facilitate this reporting process.

What impact does technology have on authentic assessment? Video runs our world. It is possible to use video to provide a real-time picture of the student, provide for shared self-reflection, and promote home-school understanding. This demonstration will present the methods, shortcuts, and results from a two-year project on video report cards with kindergarten students, a middle school project using video portfolios, a year-long research project with PDAs, and ways to use multimedia to create student performance assessment. Selected cuts from the children's videos will be shown. Feedback to students, self-reflection, and goal-setting will be discussed.

One of the challenges in authentic assessment is to gather enough data on observations and interactions with students to be able to formulate future learning experiences. Providing data-driven instruction is facilitated by the use of hand-held PDAs. The presenter will share ways to use the Newton Message pad with the *Learner Profile* software in grades K–12. Actual results from a year long research pilot program with 70 teachers will be shared. The project includes widely varied classes from kindergarten to high school lab science. It is now easy to go beyond paper and pencil tests to check a student's comprehension of academic processes. You can look at yesterday's data, evaluate how well each student in your room grasped the concept taught, and base your day's lesson on that data.

It is a given that students love to work on computers. It is possible to use that fascination to produce meaningful portfolios that include data and voice. These portfolios can be used to develop a self-perception of progress, as well as provide concrete examples of progress to parents. Samples of these will be shown.

These technologies can help teach the students the process of positive, as well as critical, self-assessment. The highest form of assessment is self-assessment; what does the student thinks about him/herself, where he/she thinks they will encounter challenges and his/her plans to meet those challenges with the guidance of a mentor/teacher. This is the way assessment should be done, and technology is a rich source to enhance the process. Further, technology virtually guarantees a student's ownership of the assessment process.

classroom demonstration

Putting Quality into Subject Area Technology Learning

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Key words: subject area, assessment, rubrics, active learning, quality, TQM, project

Abstract

Introduction

How do we know that the subject area technology projects that we have selected for our students really help them to achieve the desired results? How do we know that the technologies we have selected are the most appropriate ones? How do we help our students to focus on the results and not get sidetracked by the technology? How do we help students to be successful? Total Quality Management (TQM) has many techniques that we can incorporate to build quality into the subject area technology projects that our students do.

Overview

This presentation will include creating futuristic visions, selecting outcomes, selecting the most appropriate activities, selecting the most appropriate technologies, establishing a quality matrix (rubric), and building in improvement strategies to help students be successful. Techniques such as Deming's PDSA, force field analysis, quality matrix, and fool-proofing will be included.

Identifying and Building in Quality

Students can engage in many subject area technology projects that do not help them achieve futuristic skills. They can be busy without being on a path toward specific learning. TQM helps us to focus on a vision for the future and to do only those things that help achieve that vision.

The first step is to dream, and think about what skills the students will need for the future. Once we have such a general list, we can assess which of these skills our students presently have. We have to make sure that we are thinking of these skills with a future mindset and not a past mindset. We need to check to see if the students are using modern day technology tools as they try to obtain these future skills. If they are using the same tools that were available in a school in 1850, then our students are definitely not being prepared for the future.

Once we have the future skills or outcomes firmly in mind, we can start to brainstorm and select appropriate activities. Affinity Grouping can help us to visualize these possible activities. By using a Quality Function matrix, we can verify which activities score the highest toward achieving the outcomes. We may want to modify low scoring activities to make them more powerful learning events.

Likewise, we apply a Quality Function matrix to the selection of technologies. We continue to focus on our vision and to select those technologies that best help meet those outcomes. Unfortunately, we tend to have our favorite technologies, which might not always be the best in achieving particular outcomes.

As we think through our vision to the reality of student presentations, we will realize that there are some mistakes that students will probably make. Some of those mistakes will be learning mistakes. Others will be time-wasting ones. We can do a Force Field analysis to determine what we can help the students to succeed as they proceed through the project. We will do some Poka-Yoke to prevent time-wasting mistakes.

As we talk with our students about the outcomes, we can co-develop a Quality Learning Competency Matrix that they can use to verify that they are on the same vision path as we want them to be. They can evaluate themselves against it at any time during the project. They will aim high as they use the technologies to demonstrate their learning.

With a clarity of vision, our students can create subject area technology projects that demonstrate a depth quality of learning. These simple and yet powerful TQM tools can help us improve subject area technology learning.

classroom demonstration

Thinking: Integration through Multimedia

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Key words: multimedia, interdisciplinary, authoring software

As a high school teacher, I was looking for a way to integrate subjects and ended up creating a class called Multimedia Explorations. The focus of Multimedia Explorations is to help students learn to think and to combine bodies of knowledge. The technology is not an end in itself, but a tool.

The course was designed to:

- Integrate disciplines through use of technology.
- Encourage teamwork and communication.
- Familiarize students with computer technology.
- Proceed at student' s pace and be self-directed.
- Work with students who are experts and novices.
- Integrate complex thinking skills.
- Provide "real needs" skills for college or world of work.

Students are introduced to computers and authoring software such as *HyperCard* or *LinkWay*. After a period of tutorials completed at each student's individual pace, special projects are begun. Students choose their own projects, but these can be from any discipline the student is studying or for any class. Projects are interdisciplinary because students combine art, sound, computer controlled pages, text information, and their unique perspectives of topics. Individuals consider and plan the approach to a topic, using several peripheral devices. Some students get particularly interested in more complicated programming of the software. Finished projects are maintained as a multimedia resource for all students and teachers.

Within the classroom, the teacher is a coach who helps where needed and encourages students to help each other. Thinking skills, particularly those of planning, evaluation, and synthesis of information, quickly become very important. An idea board and notebook are kept to show student contributions and ideas for graphic design or scripting. The students quickly learn to trade information and ideas.

Any student may enroll, provided the class is not already full, and all levels and backgrounds are represented. Students with no computer experience are in the same class as those who are already quite comfortable with computers. This diversity helps students relate to each other but does not restrict students from moving at their own paces, because outcomes for each are different. A student with computer experience can be expected to move more quickly through the tutorials and produce high quality stacks while a novice may need a little longer to finish the tutorials and produce simpler stacks. However, it is the distance traveled by the student which is important and evaluated.

Students master the basics of computer use and learn how to create a branching program, in context. The class is designed to focus on a specific area of study using the technology to reflect and refine the student's understanding of that area. Computer technology for its own sake is not the focus here. Students also learn to break subjects down into subtopics and to recombine them, requiring mapping skills and the ability to consider the end user an interactive participant. Including the "right" pictures and sounds to go with a stack encourages experimentation in integrating aesthetics and information.

The climate in Multimedia Explorations is positive. The students are self-directed; they can work alone or together and get advice from each other. They learn by doing. In addition, they are visibly proud of how far they have come and of their ability to "wow" peers and adults. Students also believe in their work, knowing others will use it. A feeling of contribution and worth is an important outcome in Multimedia Explorations.

classroom demonstration

Integration of Interactive Technologies in Science and Language Arts

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Key words: multimedia, curriculum, interactive, hypermedia, science, language arts

The purpose of this presentation is to demonstrate the use of various interactive technologies and to electronically display multimedia projects completed by teachers and students in the areas of science and language arts. Students with varied learning styles have used hypermedia development, incorporating a wide range of interactive technologies, to create various curriculum-related projects. This presentation of a 1994 Pennsylvania Pioneering Partners for Educational Technology Award winning project, funded by The Buhl Foundation, demonstrates the ease of integration of multimedia into existing curriculum.

The multimedia presentation consists of live and virtual demonstrations of the actual technologies used by the students and electronically displayed samples of student project work.

The multimedia technologies are not taught as a separate class but are fully integrated into the curriculum. Portfolios are kept for each student to record the technologies that they have been exposed to in their various classes. This enables the teachers to keep track of progress of each student and to plan for new interactive projects accordingly.

Students are first exposed to the program, *HyperStudio*, and taught the basics of hypermedia development creating buttons, text items, and graphics. Students then learn the basics of color scanning and still frame digitization to enable the importation of outside materials to their computer projects. More advanced technologies such as exportation of CD-ROM materials and laserdisc access are added into students' repertoire of skills as they progress through the year. Finally, live video production, digitization, and editing, are learned to enable more creative final projects.

SCIENCE PROJECTS

Multimedia Lab Reports—Students completed traditional chemistry laboratory assignments while videotaping and photographing the process. The computer was then used to develop a lab report following the scientific method and incorporating the movies and photos from the actual experiment.

Interactive Periodic Table—Students have created a fully interactive periodic table by researching a specific group of elements and entering the information into a template made by the instructor. Information on individual elements can then be accessed from the main periodic table menu by clicking in the box for each element. This connects the user to the individual element card. This card also links the user to related laserdisc information and multimedia lab reports.

Multimedia Dissection—Students completed dissection of various animals in their biology class. The dissection process was videotaped and photographed for the students to incorporate into a multimedia display and explanation of the process.

Multimedia Science Research—Students were assigned a topic from their textbooks; then, they researched all related, available laserdiscs and CD-ROMs to find information about their topic. Textbook photos were scanned and *QuickTime* movies added to visually support the information the student reported

Telecommunication Projects—Classroom Prodigy, America OnLine, and the Internet were available for students to use in support of curriculum objectives. Weather information was downloaded, interactive, educational games accessed, and bulletin boards were used for students to interact with others around the world.

Science Tutorials—The teacher was able to use any or all of the technologies to create tutorials related to textbook materials. The tutorials contained visual information helping the student comprehend complex scientific concepts.

LANGUAGE ARTS PROJECTS

Multimedia Resumes—High school seniors produced hypermedia stacks that contained traditional resume information, such as personal background, educational history, interests and activities, and career goals, and incorporated scanned photos, live videos, and graphics in an interactive format. Younger students produced stacks containing autobiographical information illustrated with scanned family photos and clip art.

Multimedia Research Presentations—Students completed computer-based research writing tasks and then imported their text into hypermedia stacks. Multimedia visuals were added, using scanned photos from textbooks, computer graphics, *QuickTime* movies and laserdisc access to create a hypermedia presentations on their research topics.

Language Experience Stories—Students took *QuickTake* photos of their experiences on a field trip to the Pittsburgh Zoo. The photos were imported into a hypermedia stack to support student writing. Students then did follow-up research on various animals, displaying their information in a hypermedia stack illustrated with scanned photos and laserdisc images.

Interactive Literature—Students used the laserdisc of the movie, *The Great Gatsby*, along with teacher adapted *HyperCard* stacks from the *Literature In Navigation* series to facilitate analysis of various literary themes within this classic novel. A teacher-produced hypermedia stack was also produced to provide color-coded captions for hearing-impaired students when reading and viewing the movie version of *Romeo and Juliet* and to facilitate understanding of the complex Shakespearean dialogue.

HyperFables—Teacher-produced interactive stories were designed to improve independent reading comprehension by providing immediate access to vocabulary meaning within the text in the form of written definitions, pictures and sign language graphics.

panel

Present and Future of Educational Computing in Latin America

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Key Words: Latin America, educational computing, culture, collaboration

Abstract

Latin America is one of the world's poor regions where two similar languages are spoken (Spanish and Portuguese) by more than 300 million people. There are many cultural similarities among the countries, thus it is a good candidate for collaboration in the use of computers in education. Several attempts have been made to establish networks of people and computers for this purpose with only limited success. The most successful one has been RIBIE (Red IBeroamericana de Informatica Educativa) primarily because of the financial backing of the Government of Spain. Several international meetings have been organized in various countries such as Cuba, Costa Rica, Mexico, Venezuela, Argentina, Brazil, Chile, Guatemala, Republica Dominicana and others. Some of them had the participation of the International Society for Technology in Education (ISTE), most had the backing of the country's Ministry of Education, and in some instances there was support from the National Academy of Sciences of the United States, UNESCO, and other international agencies. As a result of the various meetings, the Latin American Society for Informatics in Education (Asociacion Latinoamericana de Informatica en la Educacion, ALIE) was established in Mexico in 1991. Due to lack of funding it has been quite difficult to keep it alive; nevertheless, it continues to function by meeting in places where conferences on educational computing in Latin America are regularly organized. One of the panelists from Argentina is the President of ALIE, and will expand on the activities of the Association as well as the situation in his own country.

At the national level there are interesting activities in some of the countries. For example, in Cuba, which for many years has suffered a trade embargo led by the United States, the educational system is highly respected by Latin Americans because of the way it has improved literacy and university education among its population in spite of the grave economic situation. Cuba has managed to have an intensive educational computing program largely based on the "Joven Club System" of community centers where young people use personal computers to do educational projects. Surprisingly, the Cubans have developed a good quantity of educational software in Spanish which is being marketed in various Spanish-speaking countries.

Another small country, Costa Rica, has established a country-wide system of computers especially in Primary Schools. By using the Logo Philosophy it has been talked about worldwide as an example of a successful application of computers in the education of all children in a country. One of the speakers in the session, a consultant to the Minister of Education of Costa Rica and Former Director at the Fundacion Omar Dengo, will provide current information.

Mexico is a large country that has attempted a different approach: group interaction with the computer. For this purpose, it started at the secondary education level by introducing a single computer per public school in a special room plus a few "regional laboratories" with ten computers each where students from the region can have personal interaction with the computers. Aided by outside developers, the COEEBA (Computacion Electronica para la Educacion Basica) Program, managed by the Instituto Latinoamericano de Comunicacion Educativa (ILCE) has developed educational software for computers with large TV screens that can be seen by everybody in the classroom; the teacher uses the equipment as a teaching aid as he/she explains a lesson. Several hundred lesson programs have been developed in mathematics, Spanish, natural and social

sciences. The private schools, where the better students attend, usually have computer laboratories with many machines that provide students the opportunity to interact directly with the computer using foreign educational software. As could be expected, many researchers in the field claim that the net effect has been to widen the educational gap between the "haves" and the "haves nots," whereas the computer was supposed to close that gap. Some of the software developed, however, is quite good. Mexico's current financial crisis will probably mean that things won't change for a while.

Due to the fact that researchers are an elite class in the region, the research on the use of computers in education in Latin America is of comparable quality to that done in developed countries and touches many fields. There has been quite a bit of work on the application of artificial intelligence to education in countries like Colombia, Brazil and Cuba. In addition to Costa Rica, Argentina has shown considerable interest in Logo, and Chile and Uruguay have developed new versions of the language. The use of computers in research at Latin American Universities is considerably ahead of that at the lower levels of education. Some of this research will be described by one of the panelists from Mexico.

panel
Telecommunications and Reform in Science and Math Education for Rural Teachers: Five Annenberg/CPB Math-Science Projects

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Key words: telecommunications, rural

Abstract
In 1994, the Annenberg/CPB Math and Science Project funded five rural telecomputing projects and charged them with creating online services to support the development and activities of communities of rural teachers who use telecomputing to improve their own math and/or science teaching.

In a panel discussion, these panel members will tell how they met that charge. Located in Colorado, Minnesota, Montana, Tennessee, and Washington these projects are

1. Creating Connections: Rural Teachers and the Internet sponsored by the Boulder Valley School District.
2. Teacher Online Projects sponsored by TIES (Technology and Information Educational Services) in Minnesota.
3. Reach for the Sky sponsored by Western Montana College in Dillon, Montana.
4. The Tennessee Valley Project sponsored by The Center of Excellence in Computer Applications at the University of Tennessee at Chattanooga.
5. The Rural Community Alliance for Enhancing Science and Math Education sponsored by Eastern Washington University

Each of these projects approached its charge somewhat differently. Each tapped individual resources and assets; each faced problems that are both unique to its approach and common to the overall mission of the Annenberg/CPB Math–Science Project Rural Telecomputing Initiative. Therefore, each project will describe its unique approach to meeting the Annenberg/CPB Math-Science Project mission and join in a discussion of the following common issues:

- Implementation: including teacher training and follow-up activities, solving technical and equipment problems in getting teachers online, and designing and conducting telecurricular projects.
- Partnerships and collaborations with businesses, government agencies, professional mathematicians and scientists, and any other resources unique to individual projects.
- Results in terms of effectiveness (how teachers rate the usefulness of telecommunications in their classroom instructional activities) and use (number of participating teachers, number of times they used their telecomputing connections).
- The panel discussion will thus cover a wide range of issues, problems, and approaches in enabling teachers to use telecommunications to become more effective in their classroom science and math instruction.

panel
Ethical and Professional Issues in Computing

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Key words: ethics, professionalism, curriculum

Abstract

Privacy, autonomy, property rights, and power are moral issues that have been considered for many years. While the issues remain the same, the ability to infringe on the rights of society increases as technology continues to advance. The speed and volume by which data can be obtained, stored, and retrieved forces our society to take a serious look at legal restraints and moral awareness in terms of computerized data and software limits.

All of the panelists were participants in a workshop on Professional and Ethical Issues in Computing funded by the National Science Foundation. The workshop was conducted by Deborah Johnson, the author of the book entitled *Computer Ethics*. This workshop was hosted by Rensselaer Polytechnical Institute and participants included philosophers, engineers, and computer scientists. A vast amount of information and resource materials was disseminated at the workshop; some of this material will be available to those who attend this panel discussion. Each panelist will provide a bibliography of resources they have actually used in their own courses.

The panel will lead discussions in four areas:

- An overview of ethical issues in computing.
- Philosophical ethics.
- Incorporating ethics throughout the CS/CIS curricula.
- Including the issues in project-oriented courses.

Following the panel discussion, the panelists will simulate an actual class activity that can be incorporated into courses/ modules on computer ethics. Additionally, ideas of interesting and stimulating ways to conduct classroom discussions of the ethics topics will be presented. Time permitting, the audience will be asked to share ideas they have used in the classroom to present ethics issues.

panel
Teaching the Breadth of Computing in the First Courses

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Key words: computer science, curriculum, breadth-first approach, CS1-CS2, CS1-CS4

Abstract

Recent activities in computing education focus on educating individuals as computing professionals rather than developing them as programmers. This philosophy is supported by leading international computing societies such as the Association for Computing Machinery (ACM), the British Computer Society (BCS), and the Computer Society of the Institute of Electrical and Electronic Engineers (IEEE-CS).

With the changing computing environment, professional societies encourage early exposure to the broader elements of informatics and computing. These elements include: algorithms and data structures, architecture, artificial intelligence, databases, human-computer interaction, numerical computing, operating systems, programming languages, and software engineering, which are usually relegated to advanced courses. Programming, algorithms, and problem solving are the focus of early courses. This portrayal often misrepresents computing as simply programming and results in students receiving a false impression of computing as a discipline and a profession.

Recently, the ACM and the IEEE-CS jointly published *Computing Curricula 1991*. This report endorses an earlier study published as Computing as a Discipline (better known as the *Denning Report*), that outlines the aforementioned elements necessary for the development of a computing professional. *Curricula '91* implements the elements of computing in sets of knowledge units rather than courses. This gives institutions of learning the ability and flexibility to design their own computing programs without compromising their mission or academic constituency.

Curricula '91 also suggests that the broad elements of computing be introduced in the early stages of a student's educational experience, much like is done in engineering and in other sciences such as biology, chemistry, and physics. This pedagogical manner of presentation, commonly called the "breadth-first" approach to the study of computing, focuses on teaching the broad elements of computing early in the curriculum. Depth of knowledge in individual topics can be addressed in more advanced courses.

The departure from the "programming-first" scenario has created a new excitement in the discipline. The breadth-first approach has contributed to innovative ways of teaching the discipline of computing as a science and engineering experience. Presenters will demonstrate how they have implemented this new approach at their institutions and reflect on the impact it made on their curriculum. They will also engage in an interactive discussion on modes of implementing breadth in the early stages of a student's computing career.

panel

On-line Education: Strategies for Successful Development and Implementation

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Key words: on-line education, distance learning, telecommunications, curricula, pedagogy, computer-mediated learning

Abstract

Our society is currently experiencing a demand for new ways to bring education to all learners regardless of their geographic location, age, or special needs. Rural and urban educators have experienced difficulty finding inservice activities that fit into busy schedules. Many educators have considered taking or creating online courses for continuing education or graduate credit, yet a variety of pedagogical, instructional, and institutional issues exist that challenge all who tackle this task.

This panel will present strategies that have been used with online course preparation and instruction. Each panel member has designed and taught online courses and brings a wealth of experience to this discussion. They will present a variety of course configurations, describe their experiences in introducing online courses, present research on the efficacy of this new educational pedagogy, and offer practical suggestions for solving common problems. Audience members will have a chance to participate in the discussion section of the presentation.

paper

Music and Computers: Symbiotic Learning

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Key words: music, computers, programming, sound

Abstract

This paper presents a series of programming projects involving elementary concepts from the field of music. These projects are designed for individuals who possess a fundamental interest in music and computers, and wish to further develop their abilities. Since the projects are intended to be completely self-contained, students or instructors with limited musical background should be able to absorb the necessary musical concepts as they progress through the projects.

Introduction

Many individuals in middle school, high school, and university settings have an interest in both music and computers. This interest, if properly directed and developed, can lead to a deeper knowledge and appreciation of both disciplines.

This paper seeks to help direct that interest by providing a series of computer programming projects. Each project is built around an elementary musical concept. Each group of projects is preceded by a short discussion of the relevant underlying musical concepts. In this way, a person who has an interest in music but lacks a strong background should be able to complete the projects without having to refer to outside sources.

Similarly, as the projects are completed, a person will be developing a stronger ability in programming since the projects are ordered by increasing programming difficulty also.

The projects of the next section, **Musical Scales**, do not attempt to produce any sounds. These projects could be solved using any language on any type of hardware. The following section, **Musical Sound Production**, does create sound output in most of its projects. These projects will need access to a microcomputer system running Pascal, Basic, or another language which allows the user to create sound output in some relatively straightforward manner. No projects require the use of MIDI boards or any external instrumentation.

Musical Scales

A pitch in music is a continuous tone which has a specific frequency expressed as vibrations per second or hertz. In Western music, an equal temperament scale or tempered scale is composed of 12 distinct pitches such that each successive pair of pitches has an identical frequency ratio, namely the 12th root of 2. That is, if X and Y are 2 adjacent pitches with Y being higher than X, then Frequency(Y)/Frequency(X) is the 12th root of 2. An octave is defined to be any sequence of 12 successive pitches.

(1.) Write a program to input a starting frequency and then compute and print out the frequencies for each of the 12 pitches in that octave.

A piano has 88 keys tuned to the tempered scale. The human ear is able to hear sounds in the range 20-20,000 Hertz.

(2.) Design an algorithm to input a starting frequency for the lowest key on a piano and compute the resulting frequency for the highest key on a piano. (27.5 is a traditional starting frequency.)

(3.) Design an algorithm to calculate what frequencies would be possible for the lowest key on a piano in order to ensure that the highest key would still be audible.

The keys on a piano are given names:

A,(A#,Bb),B,C,(C#,Db),D,(D#,Eb),E,F,(F#,Gb),G,(G#,Ab)

The notes A,B,C, etc.. are the <u>white</u> keys. The notes in parentheses are the <u>black</u> keys. Each black key may be called by either name in parentheses in the projects defined here. Additionally, each key is identified by the octave in which it is located using the numbers 0 to 8. Thus D3 would be the D in the third octave from the bottom. Each octave begins with a C. Thus B4 would be followed by C5. The lowest piano key is A0. The highest piano key is C8.

(4.) Design an algorithm to input a starting frequency and a starting pitch name and print out a table showing the pitch names and the frequencies for the 12 pitches in that octave.

(5.) Design an algorithm to input a starting frequency and a starting pitch name for the lowest key on a piano and then print out a table showing the pitch names and the frequencies for all 88 keys. (Use A0 with a frequency of 27.5 as a starting point. In this case, A4 should end up being close to 440 Hz which is the international tuning frequency.)

(6.) Write a function or procedure which will accept a pitch name as a character string (e.g. C#5) and return the frequency of that pitch assuming A0 is 27.5.

Musical instruments have a <u>range</u> which defines the pitches they are capable of producing. For example, the piano range is A0 to C8. A violin has a range of G3 to approximately E7.

(7.) Design an algorithm to input the range of a given musical instrument by entering the lowest and highest pitch names which can be produces. Print out these ranges and the corresponding frequencies which can be produced.

(8.) Design an algorithm to input the names and ranges for several musical instruments and store them in an appropriate data structure and/or external file. Prepare and print a graph in which the horizontal axis is the range of audible frequencies 20-20,000 and each instrument is presented as a horizontal line corresponding to its frequency range. Label the axis with frequency numbers and/or pitch names.

(9.) Design an algorithm to input the names and ranges for several musical instruments and print out the range which is common to all those instruments.

(10.) Design an algorithm to input the names and ranges for several musical instruments and then input a desired range. Print out the instrument(s) which are capable of producing all pitches in the desired range.

(11.) Design an algorithm to input the names and ranges for several musical instruments. Print out the range(s) which represent the pitches which are possible by at least one of the instruments. Note that the resulting range may be continuous or fragmented; there may be gaps which are not covered by any instrument.

There are other tuning scales which predate the tempered scale which are also based on mathematical relations between different notes in the scale. The <u>just intonation scale</u> is built on the following ratios for an octave beginning with C:

C = 1/1	E = 5/4	G# = 25/16	C = 2/1
C# = 25/24	F = 4/3	A = 5/3	
D = 9/8	F# = 45/32	A# = 225/128	
D# = 75/64	G = 3/2	B = 15/8	

That is, given the frequency, FREQ, for a pitch C, the frequency for a pitch F will be 4/3 * FREQ. Similarly, the frequency for G# will be 25/16 * FREQ. This scale is seldom used today because of several difficulties. Because there is not a fixed ratio between any pair of successive notes, a user must compute all frequencies based on a starting octave pitch. The same note, say D5, will have different calculated frequencies depending on the starting octave pitch used.

(12.) Design an algorithm to enter and store the just intonation ratios. Enter a starting pitch frequency and print out a table of frequencies for each of the notes in once octave starting with the entered frequency. Print the note name and the frequency for each pitch.

(13.) Design an algorithm to enter and store the just intonation ratios. Compute and print out a table showing the frequency ratio between each of the 12 successive notes in one octave.

(14.) Design an algorithm to enter two different starting frequencies and print out a table of frequencies for one octave for each of the starting frequencies. Notice if the same pitches have different frequencies in the two tables. Use C4 = 261.63 and F4 = 348.84 in one test, and C4 = 261.63 and D4 = 294.33 for another test.

(15.) Design an algorithm to enter a starting pitch, say C4 = 261.63, and print out a table of frequencies for one octave using the just intonation scale and the tempered scale. For each note, print out also the "error" between the two different values and the percent of error assuming the tempered scale is the "correct" value.

All the previous projects have assumed a scale composed of 12 distinct pitches per octave. Musicians and cultures have built scales using other number of pitches per octave. If each such scale is constructed using the principles of a tempered scale then the calculation of frequencies will be very simple; the ratio between any successive pair of pitches in a system with N pitches per octave will be the Nth root of 2.

(16.) Design an algorithm to enter an integer, N, and a starting frequency. Compute and print out a table showing the frequency for each pitch of a one octave scale having N different pitches using the tempered scale. If N=12 then the results should match the 12-tone tempered scale.

(17.) Design an algorithm to enter an integer, N, and a starting frequency. Compute the frequencies for each pitch in a one octave scale having N different pitches using the tempered scale. For each pitch in the N-tone scale, determine which pitch in the 12-tone tempered scale is closest in frequency. Print out this pitch from the 12-tone scale and the percentage of deviation of the N-tone pitch from its closest 12-tone pitch. Run your program with N values of 13 to 40.

Musical Sound Production

Many versions of BASIC include a PLAY command which allows a user to specify a single pitch or a series of pitches to be "played" on the speaker system of the computer. A typical PLAY command might look like the following:

```
PLAY "03 C D E F G2 F2 E2 D2 C"
```

In this version, "03" defines the octave being used and the other letters specify the sequence of pitches within that octave that are to be played. The "2" following certain pitches gives a relative length for those pitches; G2 will be one half as long as the pitches with no "2" following them. Many other options are available with the PLAY commands of various vendors. The exercises in this section are designed for users with access to a BASIC system who wish to investigate the PLAY statement further.

(18.) Write a BASIC program to allow a string to be read in and used as the command string for a PLAY command. Use this program to investigate the range of pitches which can be played on that system.

(19.) Use the same program to investigate the shortest and longest duration possible for a pitch in that system.

(20.) Use the program to investigate how to produce a sequence of pitches with one PLAY command.

(21.) Use the program to investigate how to produce a sequence of pitches which encompass more than one octave.

(22.) Use the program to investigate how to create accidentals such as Bb or F#.

(23.) Use the program to investigate whether 2 identical pitches played back to back have a noticeable break in the sound between them or if the result is simply equivalent to playing one pitch for twice as long. Does the system have any facilities for inserting a break or controlling how long it is?

(24.) Use the knowledge you have learned to create a string representing a melody line from a song. Enter it into a program and debug it until it sounds correct.

(25.) Investigate whether your system could permit a tempo (speed) control to be specified or changed at run time so that a given string could be played faster or slower without reentering the entire string. This might require a considerable amount of string processing.

(26.) Design a system which would permit a given melody to be transposed to a higher or lower range automatically. The melody string would be stored in a string variable and a numeric offset value would be read in. All pitches in the melody string would be adjusted up or down the number of pitches specified by the offset value.

(27.) Design an algorithm to play "The Twelve Days of Christmas" with all 12 verses. Your program should use repeated loops as much as possible so that the number of melody strings which must be stored would be as small as possible.

(28.) Design an algorithm which would store melody strings in a data file on disk. Allow the user to specify a desired string and then retrieve it from the disk file and play it. The user should be able to add and delete melody strings to the file.

(29.) Design an algorithm to allow a user to modify melody strings stored in a disk file. The user should be able to add, change, and delete individual notes in a specified melody string as well as listen to the string played. Thus, if a melody string had been stored before it was totally correct, the user may adjust it and store it back on the disk.

(30.) Label a set of keys on the keyboard to represent the keys on a piano keyboard. For example, the keys on the second row (ASDFGHJKL;') could represent the white keys and a portion of the keys above that row could be the corresponding black keys. Design an algorithm which would read in a series of keystrokes one at a time. Each time a "white" or "black" key is pressed, have the computer play the corresponding note for a given length of time. Continue reading and playing notes until the user strikes a specified key which denotes end of song.

Many versions of BASIC and Pascal for microcomputers include a SOUND command which will produce a sound of a specified frequency. In BASIC, the typical SOUND command has two parameters: an integer frequency value and an integer length value.

Turbo Pascal has a SOUND command or procedure which includes only an integer frequency argument. A complementary NOSOUND command with no arguments is necessary to terminate the sound begun by the SOUND command. The duration of the sound may be controlled by the use of a DELAY command which includes a single argument specifying the length of the delay. Thus a typical application in Turbo Pascal would require:

```
SOUND(Frequency_Value)
DELAY(Time_Length)
NOSOUND
```

(31.) Investigate the BASIC or Pascal system available to you. Determine the time units used for the Duration parameter of the SOUND command or DELAY command.

(32.) Design an algorithm to request a frequency from the user and produce a pitch of that frequency. Use the program to determine the range of audible pitches which your computer speaker can produce.

(33.) If you are using Turbo Pascal or a similar product using a SOUND-NOSOUND combination to specify duration, write a procedure called SOUND2 which has 2 parameters: frequency and duration. In future exercises, then, you may use SOUND2 in a manner similar to the BASIC SOUND command.

(34.) Use the SOUND, (or SOUND2), command to generate a siren which produces a continuous range of increasing and then decreasing frequencies. Experiment with the speed at which the frequencies should change and the range of frequencies in order to get a "pleasing" pattern.

(35.) Design an algorithm to enter a pitch name, A to G, and produce a sound of that pitch (in any suitable octave) for a reasonable time interval using the tempered scale.

(36.) Design an algorithm to enter a pitch name with a possible accidental attached such as A#, B or Eb and produce a sound of that pitch in any suitable octave for a reasonable time interval using the tempered scale.

(37.) Design an algorithm like (36.) but include an octave number such as A#3, B5, or Eb4.

(38.) Label a set of keys on the keyboard to represent the white and black notes of a piano. Design an algorithm to input a sequence of single character inputs and have the computer produce a sound of a given duration each time an input character matches a key defined in your "piano keyboard". Define a "stopping" key which will cause the program to terminate when that key is pressed.

(39.) Redo project (38.) to have a pitch continue sounding until another key is pressed. This will allow a melody to have pitches of different time lengths. You may want to set up just one key, (such as the space bar), which would cause the previous pitch to cease but not have another pitch begin.

(40.) Design a data structure using arrays which will allow you to store a series of note names such as A#3 in one character array and a series of durations in another integer array. This will define a melody line such that the first note name is to be played for the length of time defined by the first duration value, the second note is to be played for the length of time defined by the second duration value, etc. The two arrays used to store the notes and the durations are often referred to as parallel arrays.

(41.) Using the structure of (40.), design an algorithm to read in a set of values for notes and durations and store them in the arrays. Then have the program play the melody by examining each note/duration combination one at a time.

(42.) Design an algorithm to store the arrays of project (41.) onto a disk file after they have been created. Request the user to enter the desired file name.

(43.) Design an algorithm to enter a desired file, read in the array data from that file, and play the song represented by the data on that file.

(44.) Write an editing program which will allow a user to examine an existing song file. Each note/duration combination should be displayed on the screen along with its sequence number. (The first note has sequence number 1, the second note is number 2, etc.)

(45.) Expand the editing program of (44.) to allow a user to change the note and/or duration for any given sequence number. After all such changes are made, rewrite the data back onto the disk file.

(46.) Expand the editing program of (44.) to allow a user to add or delete note/duration entries. When a note/duration entry is added or deleted, refresh the screen display to show the new status of the song. The sequence numbers will now be different and the internal arrays will be different. After all such changes are made, rewrite the data back onto the disk file.

(47.) Combine all of the projects from (40.)-(46.) into one project which will allow a user to enter a melody, play a melody, retrieve a melody from disk, edit a melody, or write a melody onto disk.

(48.) Combine the project of (47.) with the keyboard playing project (38.) to allow the user to enter a melody from the "piano keyboard" and have it stored in the note/duration arrays. The user will still have to enter the duration values manually, but the entry of the note names will be much faster using the "piano keyboard" technique.

(49.) Using the program from (42.), (or any subsequent variation of that program), allow the user to transpose the melody up or down by N half-steps where N is read in by the user. If N = 3, for example, then the melody would be raised 3 half-steps. One half-step represents the interval between any 2 successive keys on the keyboard. Therefore, one half-step up from D3 would be D#3. Two half-steps up from D3 would be E3. Change the note values in the array to conform to the transposed note values so that the next time that melody is played, the new transposed notes will be used.

(50.) Write a new version of the transposition program in (49.) so that the user can enter the new starting note rather than the number of half-steps. Therefore, if a melody started with a D3, then the user could get the melody transposed up 3 half-steps by entering the new starting note of F3.

(51.) Modify the program from (49.) so that the user can input the desired transpose value, N, and have the melody played immediately in that transposed system. Do not change the original array values but simply play each note after applying the correct transpose shift to it.

(52.) Examine a melody like "Three Blind Mice" which has more than one repeated melody phrase. Design a program to permit each repeated phrase to be stored only once and then play the entire song by having the program play each phrase in the desired order. One possibility would be to have a different set of array names for each phrase. A more interesting possibility would be to design a play procedure which would play all the note/duration values of an array starting with sequence number START and continuing through sequence number STOP, where START and STOP are supplied to the procedure as parameters along with the array names. In this approach, the separate phrases could be stored back to back in just on.. set of arrays.

(53.) Examine the melody "The Twelve Days of Christmas". In this song, the melody covers Day 1, and then Day2 and Day1, and then Day 3 and Day2 and Day1, and so on. In addition, Day6 through Day 12 are identical. Devise an efficient collection of note/duration phrases to be stored in an array, and a program segment to play these phrases in order to create the entire song melody.

paper

Turning Point for Korean Computer Educators: Introducing LogoWriter as a Thinking Tool

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Key words: LogoWriter, problem solving, teacher-mediated learning, thinking skills

Abstract

Although most Korean schools still remain traditional "fill the vessel" learning environments, educators have agreed that there is a need for developing new learning tools and teaching methods to improve students' problem solving and critical thinking skills. This is a pioneer study to introduce LogoWriter to Korea. In this study, LogoWriter was used as a tool to teach problem solving and thinking skills to students. Teacher-mediated learning was also structured to help students monitor their thinking processes.

Theoretical background

As new information and technology emerge in society, the need for teaching students critical thinking skills and independent problem solving skills is dramatically increasing. Since computer education has become part of the school curriculum, educators have suggested that computers be utilized to teach thinking skills and problem solving skills.

For decades, it has been claimed that the nature of Logo provides a learning environment in which students can develop higher order thinking skills and problem solving strategies (Lee, 1991; Swan & Black, 1989; Papert, 1993; Watt, 1982). Visual turtle graphics in Logo encourage students to monitor on-going thinking processes and to explain how they think. The Logo environment is a miniature reality that allows students to explore their ideas and test their thinking. Thus, Logo has been considered a powerful programming tool which provides students with the opportunity to develop self-monitoring skills and problem solving skills.

However, there is conflicting evidence for this claim. Many empirical studies of the effectiveness of Logo programming on problem solving skills indicated that Logo alone is not enough to guide students toward the development of problem solving strategies. It has been indicated that Logo programming combined with teacher-mediated learning helps students develop higher order thinking skills and problem solving skills (Bambeger, 1984; Grangenett, 1988; Lee, 1991; Seidman, 1987; Swan & Black 1989). A teacher-mediated learning approach to teach Logo programming has been discussed as a method to encourage the transfer of problem solving skills to other learning domains.

In teacher-mediated learning, the teacher increases the students' responsibilities as they gain knowledge to perform complex tasks. As learning progresses, students gradually become independent from the teacher centered problem solving activities. They gradually control their on-going cognitive activities. Thus, teacher- mediated learning can assist students in focusing on the complex problem, to search for helpful information systematically, to develop insight, and to monitor their on-going activities (Feuerstein, Jensen, Hoffman, & Rand, 1985; Lee, 1991; Samuels, 1986).

Although most schools in Korea remain traditional 'fill the vessel' learning environments, Korean educators need to take a first step to adopt new learning tools and innovative teaching methods in order to teach students to become independent thinkers and problem solvers. Since Korean society is becoming increasingly complex, teaching students higher order thinking skills and problem solving skills is of major concern for educators. Particularly, computer educators have claimed that technology should be utilized as a turning point for Korean computer education.

Although educational hardware and software are outdated in Korean schools, some students have a chance to access new technology through private computer education institutes. However, most private computer education institutes focus on teaching technical skills, such as Basic programming, MS-DOS, word-processing, and graphics. Most private instructors have a background in computer science. Only a few instructors have a background in education. Thus, computer instructors have not utilized technology to teach students problem solving skills and thinking skills.

This study has been conducted as a pioneer step of introducing LogoWriter in Korea. Computer educators in Korea are not familiar with the Logo programming language The Basic programming language has been emphasized in the schools, as well as, in private computer education institutes. The study examined the use of LogoWriter as a potential tool for teaching problem solving skills. Since the study has been conducted as a pioneer step, the results reported are based on anecdotal comments, interviews. and observation.

For this study, a new learning environment was utilized. First, LogoWriter was introduced as a new learning tool. Second, a teacher-mediated learning environment was provided to guide students to become independent problem solvers. The teacher-mediated learning adopted in this study consisted of three pedagogical elements. First, LogoWriter was selected as a thinking tool to encourage students to monitor their thinking processes. Second, specific problem solving steps were provided in the Logo environment, such as decomposing, planning, detecting errors, and debugging. Third, teacher-mediated intervention guided students to apply specific problem solving strategies. The teacher-mediated learning environment employed a Socratic Dialogue method to encourage students to mindfully approach problems and monitor their problem solving process.

LogoWriter-based teacher-mediated learning model

With the supportive evidence of teacher-mediated learning and Logo programming, LogoWriter-based teacher-mediated learning was structured. In the teacher-mediated learning model, the following components of specific problem solving skills were utilized in learning LogoWriter.

Decomposing : This process refers to breaking a complex Logo problem into smaller, manageable subproblems. The decomposing process allows students to simplify the complex programming procedure. Students were able to think 'mind-size bits' through the decomposing process.

Planning : This process refers to efficient solution strategies needed in order to accomplish a problem goal. Students were encouraged not only to plan the solution of a LogoWriter problem, but also to examine other possibilities for the solution and to select the most efficient turtle trip.

Detecting errors : This process refers to comparing the actual outcomes with the original problem, to locating possible errors in the procedures, and to explaining why the error occurred. This procedure is an extremely important problem solving process since it alerts students to note their misconceptions and misunderstandings. Logo provides an excellent environment to improve detecting error skills since it provides students with immediate graphic depiction of errors and explicit error messages.

Debugging : The debugging process refers to correcting detected errors. In this step, students were allowed to correct Logo programming commands on the computer.

Students needed to follow these problem solving steps continuously until the given problem was solved. These problem solving strategies were selected because they fit most naturally to the Logo environment.

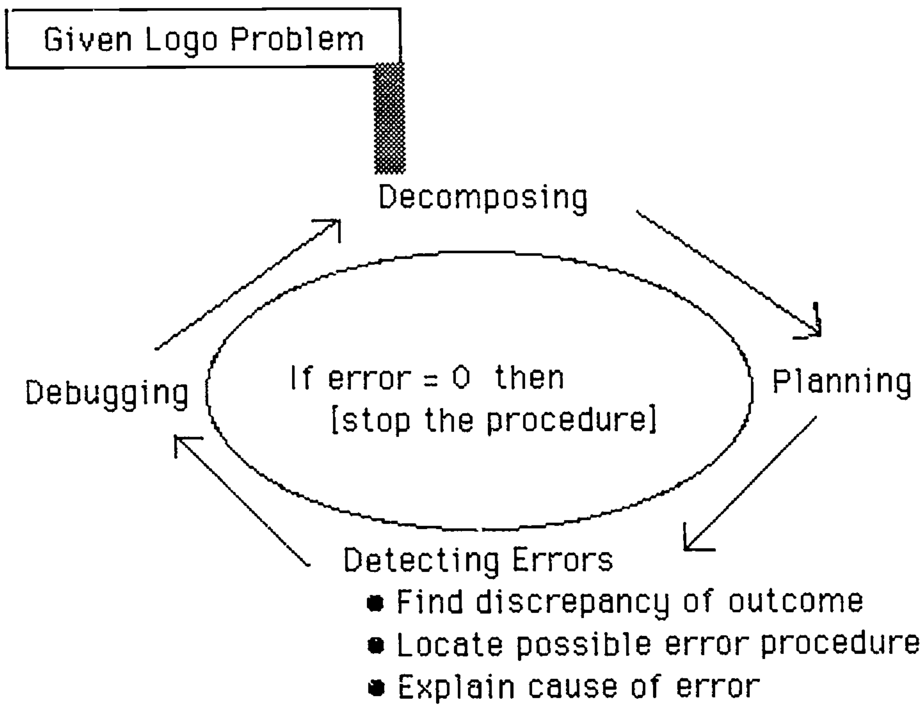

Figure 1. Recursive Problem Solving Process

Procedure

Sample

Forty-seven students and adult learners participated in this study. The study was sponsored by Saema-ul training center which was a government organization. Saema-ul headquarters opened a continuing education program in 1992. The LogoWriter program was selected, and was taught as part of computer education. The twenty-nine students ranged from second grade through middle school. This learning program was an extra curricular activity. About fifty percent of the students were fourth and fifth graders. About thirty percent had some computer experience. Only two students had learned the Basic programming language and were able to write short programs.

Eighteen were adult learners. Most of them were parents of students who participated in this study. Ninety-five percent of the adult learners had no experience with computers. Most of them had at least a high school diploma. Adult learners' ages ranged from thirty to fifty-five years old.

The Korean adult learners had limited English learning experience. The Korean elementary school students had no English background. Yet, the English version of LogoWriter was introduced.

Instructional procedure

The initial demographic questionnaire was given to the students and the adult learners before the instruction began. There were three sections of LogoWriter: Adult learner group, young student group, and old student group. The instruction was given three days a week. Students received two hours of LogoWriter instruction a day. LogoWriter instruction began in March, 1992 and continued through June, 1992. Two instructors were assigned to each session. Twenty three IBM compatible computers with VGA monitor were provided.

Each LogoWriter session consisted of the following procedures: (1) New Logo commands were introduced. (2) Students were given non-Logo activities or games so they could understand new commands better. (3) Then, a Logo problem was given and the instructors guided students to use explicit problem solving strategies. (4) Another Logo problem was given to all students. They worked individually to solve the problem and were encouraged to follow explicit problem solving steps on the activity sheet (Figure 2). (5) Finally, students were allowed to design their own project.

When students worked on their own project, they had to write each step of their problem solving activities. This way, when they had problems, the instructor was able to use Socratic dialogue to help the students find errors. The instructors could not give direct answers when students asked questions. Instead, they encouraged students to monitor their on-going thinking processes by using Socratic questioning.

Instructional materials

Each LogoWriter lesson unit involved Five main sections; exploration, co-construction, journey through problem solving, and working together.

1. Exploration

New LogoWriter commands were introduced to the students. Then, the instructor provided students with games and activities to help the students understand new commands easily. Since the English version of LogoWriter was used with Korean students, these activities were necessary. In this exploration unit, students were allowed to move around. Sometimes, students were divided into several groups and created their own games and activities using new LogoWriter commands. Some students even made a song using new commands.

2. Co-construction of problem solving skills

The instructors framed four explicit problem solving steps in the LogoWriter activity sheets (Figure 2). Then, the instructor carefully guided students to focus on each step thoughtfully. In this unit, learning Logo programming was emphasized less. The instructor used Socratic dialogue intensively to activate the students' thinking for an efficient decomposing, planning, detecting errors, and debugging. In the co-construction of problem solving skills, the instructor worked with students and they learned from each other. Then, students were given a new LogoWriter problem. They worked individually with the utilization of the learned problem solving strategies. The instructors continuously monitored students to see whether they used learned problem solving processes or not.

3. Journey through problem solving skills

In this step, each student was encouraged to design their own project. An empty activity sheet with explicit problem solving steps was given to the students. Students needed to design a specific project and to fill out the activity sheet as they developed the project. This activity sheet helped the instructor to communicate with students efficiently when they had problems. The problem solving strategy sheet also helped students monitor their thinking processes. Students were allowed to help each other and to discuss their problems with their peer group.

4. Working together

At the end of each month, a LogoWriter festival was held. Groups of three students designed a complex LogoWriter project and presented it to the whole group. They invited parents, friends, teachers, and relatives to the festival. Each group project was shown on the screen and visitors judged the final grand project. This 'Working together' unit enhanced the cooperative learning environment. Since the Korean school system is highly focused on competition, this unit provided a new aspect to the educational environment in Korea.

Results

Since this was the first time LogoWriter had been used in Korea, anecdotal data was gathered and reported as the results of the study. The teacher observation data indicated that students attempted to apply learned problem solving strategies to new learning domains. The problem solving strategies of decomposing-Planning-detecting errors-debugging became part of the students' thinking processes. However, the instructors struggled when introducing the problem solving model during the first few weeks since students were accustomed to a traditional learning environment where an answer was given immediately, memorizing content was highly encouraged, and high competition existed.

The instructors also indicated that students who participated in this study tended to think more carefully and explain their answers more logically than other students when non-Logo problems were given. Students themselves reported that whenever problems occurred, the learned problem solving strategies were automatically activated in their thinking processes. They also reported that they were able to use the problem solving strategies in their school work. This report encouraged LogoWriter instructors and parents.

Since all of the students experienced new software, various computer experience levels and grade levels did not cause great problems in learning LogoWriter. In fact two students who had previous Basic programming experience struggled the most to adopt the teacher-mediated learning. They wanted step-by-step instruction with direct answers. They learned technical skills, such as coding and operating systems very fast. However, they were impatient when the instructors guided them to use problem solving steps.

Adult learners who participated in this study reported that the LogoWriter should be introduced in school education as part of the curriculum. They also reported that learning LogoWriter brought a new and exciting learning experience to them. Their anxiety toward computers was reduced dramatically. Adult learners indicated that they applied the learned problem solving skills to every day life situations.

Attitudes toward LogoWriter were extremely positive. They enjoyed working on their own project. Even though students did not know English, the language barrier didn't seem to interfere with their learning experience. Even very young students were able to write structured Logo programs. Some of their projects were more creative than the adults' projects.

Recommendations for further study

It was difficult to conduct empirical research since LogoWriter was introduced to Korean students for the first time. However, anecdotal reports and observation data indicated a promising future for LogoWriter in Korean computer education. Without a doubt, LogoWriter contributed as a great tool in teaching explicit problem solving skills. The study clearly indicated that computers in the school should be used as a possible learning tool to teach thinking skills and problem solving skills.

As LogoWriter is introduced as a new promising learning tool, changing teachers' minds toward learning and teaching becomes the main issue in Korean schools. Along with this issue, instructional methodology in educational computing is another area to be researched.

Korean educators are facing the fundamental issue of teaching transferable skills to help students become independent learners and problem solvers in order to keep up with a rapidly changing society. Introducing LogoWriter with teacher-mediated learning to the public schools can be a major turning point for educators in Korea. This study demonstrated a successful instructional technique for developing problem solving strategies through LogoWriter.

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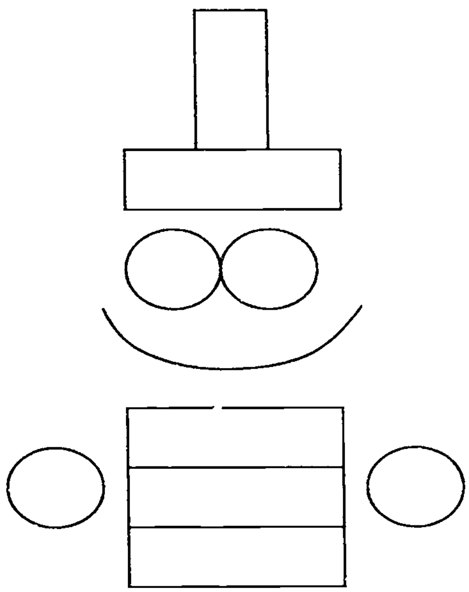
Activity Sheet 21



Decompose:

Plan:

Describe discrepancy between the given graphic and the actual outcome:

Find errors in the procedure:

Describe the causes of errors:

Debug:

Figure 2. Problem Solving Activity Sheet

paper

ToonTalk™ — An Animated Programming Environment for Children

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Keywords: computer programming, children, video games, concurrent programming

Abstract

Seymour Papert once described the design of the Logo programming language as taking the best ideas in computer science about programming language design and "child engineering" them (Papert 1977). Twenty-five years after Logo's birth, there has been tremendous progress in programming language research and in computer-human interfaces. Programming languages exist now that are very expressive and mathematically very elegant and yet are difficult to learn and master. We believe the time is now ripe to attempt to repeat the success of the designers of Logo by child engineering one of these modern languages.

When Logo was first built, a critical aspect was taking the computational constructs of the Lisp programming language and designing a child friendly syntax for them. Lisp's "CAR" was replaced by "FIRST", "DEFUN" by "TO", parentheses were eliminated, and so on. Today there are totally visual languages in which programs exist as pictures and not as text. We believe this is a step in the right direction, but even better than visual programs are animated programs. Animation is much better suited for dealing with the dynamics of computer programs than static icons or diagrams. While there has been substantial progress in graphical user interfaces in the last twenty-five years, we chose to look not primarily at the desktop metaphor for ideas but instead at video games. Video games are typically more direct, more concrete, and easier to learn than other software. And more fun too.

We have constructed a general-purpose concurrent programming system, ToonTalk, in which the source code is animated and the programming environment is a video game. Every abstract computational aspect is mapped into a concrete metaphor. For example, a computation is a city, an active object or agent is a house, birds carry messages between houses, a method or clause is a robot trained by the user and so on. The programmer controls a "programmer persona" in this video world to construct, run, debug and modify programs. We believe that ToonTalk is especially well suited for giving children the opportunity to build real programs in a manner that is easy to learn and fun to do.

Goal Number 1: *A Self-teaching* Programming System for Kids

Programming can be a fun and empowering activity, but it is accessible only to those who manage to surmount a large initial hurdle. This hurdle includes learning a formal programming language and computational concepts such as variables, procedures, and flow of control. If this hurdle could be minimized and overcoming what remains can be made fun, then children and curious adults would be able to creatively mold computers into whatever they want. Learning to use computers without learning to program, is like learning to read without learning how to write.

Our goal is to create a computer system which children can use to build a very wide variety of programs without being taught how to use it. Many believe that any system that is easy enough to learn to use without the help of a teacher will have to be very limited. ToonTalk, however, is a self-teaching system that is flexible and expressive. A wide range of programs can be constructed ranging from games like Pong, Hangman and PacMan to programs for controlling motors and sensors of Lego and other construction toys to conventional programming examples like factorial and parallel quick sort.

There is precedent for powerful, yet self-teaching, systems outside of computer programming. Children, for example, learn on their own how to build complex Lego constructions. They master video games that require exploration and problem solving in complex fictional worlds. Analysis of video games and Lego systems has provided many of the ideas that make ToonTalk easy to learn (Malone 1980; Provenzo 1991).

Some of the design principles derived from good construction toys and video games include:

1. Make the initial experience simple and gradually increase complexity.
2. Encourage exploration and curiosity.
3. Provide and maintain appealing fantasies.
4. Continually challenge without frustrating.
5. Frequent use of animation and film techniques and principles (video games only).

In constructing the ToonTalk programming system, we strove to follow these principles. We also borrowed heavily from the *technology* of video games. For example, we copy the way that video games frequently put the player into the game world by providing a persona or avatar in that world that the player controls and identifies with. Children react to events as if they were, for example, one of the Mario brothers when they play the Mario Brothers games. In ToonTalk, the programmer is an animated character building, testing and debugging programs.

The Logo community is also interested in giving children the ability to program for epistemological reasons (Papert 1993). They argue that programming is a rich soil for learning fundamental thinking and problem-solving skills. Children learn about representation, problem decomposition, abstraction, debugging and so on. This can happen while learning programming and it is very important, but unfortunately it is not the typical result of learning Logo (Yoder 1994). While we hope that this kind of learning will be more frequent with ToonTalk, we will be satisfied if the outcome is simply to empower children to creatively master computers.

Goal number 2: A *Powerful* Programming System for Kids

ToonTalk was built to be both very easy to learn and to be a very powerful and flexible programming tool. These are usually considered conflicting goals that require compromises. A language like C++ is very flexible and powerful but it is also very complex and difficult to learn. HyperTalk, in contrast, has been learned and used by many non-programmers but it has many inherent limitations. Kids can pretend to help in the garden with toy shovels and rakes, but if they really want to do gardening they should have real tools that have been adapted to their special requirements.

Theory based programming language design has produced many languages that are small yet powerful. Most functional and logic programming languages are examples as are some object-oriented programming languages. The problem is that languages like Scheme, ML, Prolog, Flat Guarded Horn Clauses (FGHC) and SmallTalk80, while small and elegant, are difficult for even computer science students to learn. It would seem absurd to expect second graders to master a programming language that professional programmers find very difficult.

But maybe the difficulty is not in the concepts *per se* but their lack of accessible metaphors. Consider as an example the concept of communication channels found in many concurrent systems. Associated with these channels are read and write privileges. Some support the notion that an attempt to read from an empty channel will suspend until something is written. These concepts are usually taught in an advanced computer science course. But these difficult abstract concepts can be replaced by exactly equivalent everyday concrete analogs. In ToonTalk birds and nests are the communication channels. The ability to write on a channel is a bird who behaves like a carrier pigeon. Read access to that channel is the nest of that bird. Birds can be copied and each copy has the same nest (i.e., each bird copy is a write capability on the same channel). The behavior of birds implements the operational semantics of channels. When a bird is given a message it flies to its nest, leaves the message on the nest, and flies back to where it was. If there already are things on its nest it puts the new item under those items (this implements a first-in first-out semantics for the queued messages). If another bird is busy putting something there it waits for its turn (this provides arbitration between multiple writers on the same channel). A bird finds its nest even if it has been moved (so a read capability will continue to work even if it has been transferred). These rules of behavior for birds are not very hard for a seven-year old to understand.

ToonTalk is based upon a concurrent constraint language (Saraswat 1993) similar to Janus (Saraswat, Kahn and Levy 1990). We chose concurrent constraint programming as the underlying foundation of ToonTalk for many reasons. One reason is that over ten years of use at many research centers has demonstrated that there is no risk that the language will be inadequate for building a wide variety of large programs (Shapiro 1989). The languages are small yet very powerful. This has lead to a much simpler design for ToonTalk than had it been based upon conventional languages.

Another reason for the choice is that these languages are inherently concurrent. Many find it surprising that a concurrent language would be better for children than a sequential language. They see sequential programming as hard enough without having to consider multiple interacting sequential programs. However, sequential languages extended to be concurrent are very complex but languages designed from scratch to be concurrent can be very elegant.

Programs typically model the world and the world is concurrent. Sequential programming languages provide a world in which only one thing can happen at a time. This is a very strange world. Children when first exposed to programming, especially object-oriented programming, expect it to be concurrent. Most of the programs that children want to write are naturally concurrent. A Pong game, for example, consists of at least a paddle, a ball and a score keeper. Good object-oriented design indicates that each should be handled by an independent computational component. Kids (and most non-programmers when introduced to an object-oriented programming system) expect that each object is running all the time. How weird to have to switch attention between controlling the paddle, ball and score keeper instead of just letting each one do its thing. But anarchy results unless components can communicate and synchronize. Making conventional languages concurrent with communication and synchronization facilities leads to a complex mess that gives concurrent programming its reputation for being very hard. A new concurrent programming language with a good semantically motivated design can avoid this mess.

Resnick attempted to introduce concurrency to children by extending the Logo programming language to support multiple concurrent threads (Resnick 1988). The language was too complex, but the research confirmed the appropriateness of concurrent programming languages for children. Resnick also built a parallel form of Logo called Star Logo which had the simplifying but severe limitation that only multiple instances of the same program can run in parallel. More recently LCSI's MicroWorlds Logo introduced a very simple form of parallelism to Logo. While sometimes useful it is very limited in its ability to describe communication and synchronization between these parallel activities.

Animated Source Code

The fundamental idea behind ToonTalk is that source code is animated. (ToonTalk is so named because one is "talking" in (car)toons.) This does not mean that we take a visual programming language and replace some static icons by animated icons. It means that animation is the means of communicating to both humans and computers the entire meaning of a program. Given the dynamic nature of computation animation is especially well-suited for this.

Even small children have no troubles producing a range of sophisticated animations when playing games like Mario Brothers. While the range is, of course, very limited relative to a general animation authoring tool, video game style animation is fine for the purposes of communicating programs to computers. If, for example, a program fragment needs to swap the values of two locations, what can be more natural and easy than grasping the contents of one, setting it down, grasping the contents of the other, placing it at the first location and then moving the original item to the second location? (See figure 1.) This is something a very young child can understand and do while only a programmer can write the following equivalent code:

```
temp := x;
x := y;
y := temp;
```

Once the step is taken to use video game technology for the construction of source code, it is easy to see other uses of video game technology for browsing, editing, executing and debugging programs. Other ideas from video games can be borrowed. Some video games have animated characters whose purpose is to provide help to users. These characters can play the role of on-line help and tutorial systems.

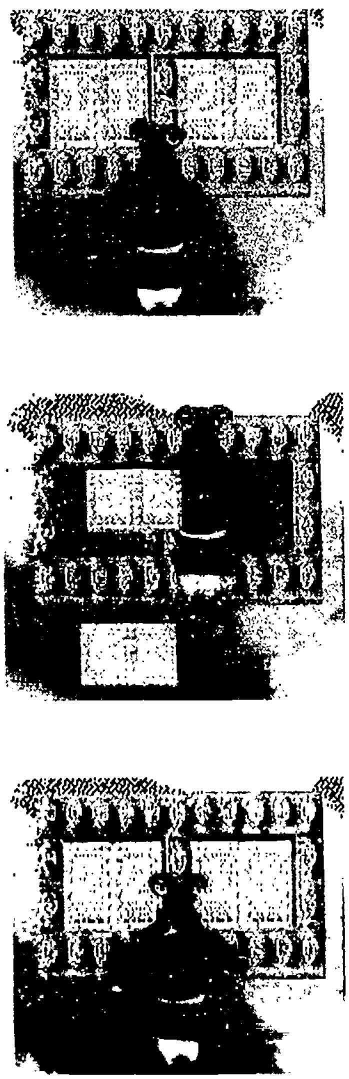

Figure 1 — Snapshots from swapping two elements. (color original)

ToonTalk — The Language and Metaphor

Video games, especially adventure and role-playing ones, place the user in an artificial universe. The laws of such universes are designed to meet constraints of game play, learnability, and entertainment. While playing these games the user learns whether gravity exists, if doors need keys to open, if one's health can be restored by obtaining and consuming herbs, and so on. What if the laws of the game universe were designed to be capable of general purpose computing, in addition to meeting the constraints of good gaming?

It seems that no one has ever tried to do this. (And when we figured out how to, we applied for a patent on the invention.) Rocky's Boots and Robot Odyssey were two games from The Learning Company in the early 1980s that excited many computer scientists. In these games, one can build arbitrary logic circuits and use them to program robots. This is all done in the context of a video game. The user persona in the game can explore a city with robot helpers. Frequently in order to proceed the user must build (in an interactive animated fashion) a logic circuit for the robots to solve the current problem. ToonTalk is pushing the ideas behind Robot Odyssey to an extreme, capable of supporting arbitrary user computations (not just the Boolean computations of Robot Odyssey).

Computer scientists strive to find good abstractions for computation. Here, in addition, we are striving to find good "concretizations" of those abstractions. The challenges are twofold: to provide high-level powerful constructs for expressing programs and to provide concrete, intuitive, easy-to-learn, systematic game analogs to every construct provided.

The ToonTalk world resembles a twentieth century city. There are helicopters, trucks, houses, streets, bike pumps, toolboxes, dust busters, boxes, and robots. Wildlife is limited to birds and their nests. This is just one of many consistent themes that could underlie a programming system like ToonTalk. A space theme with shuttle craft, teleporters and like would work as well. So would a medieval magical theme or an Alice in Wonderland theme.

An entire ToonTalk computation is a city. Most of the action in ToonTalk takes places in houses. Communication between houses (and to built-in capabilities) is accomplished by birds (kind of like homing pigeons). Birds accept things, fly to their nest, leave them there, and fly back. Typically houses contain robots that have been trained to accomplish some small task. Robots have thought bubbles that contain pictures of what the local state should be like before they perform their task. Local state is held in cubby holes (i.e. boxes). Cubbies also are used for messages and compound data (i.e., tuples). If a robot is given a cubby containing everything that is in its thought bubble, it will proceed and repeat the actions it was taught. Abstraction arises because the picture in the thought bubble can leave things out and it will still match. A robot corresponds roughly to a method in an object-oriented language or a conditional. A line of robots provides something like an "if then else" capability. Animated scales can be placed in a compartment of a box. The scale will tip down on the side whose neighboring compartment is greater than (or if text, alphabetically after) the compartment on the other side. By placing scales tipped one way or another the conditionals can include less than, equal or greater than tests.

The behavior of a robot is exactly what it was trained to do by the programmer. This training corresponds in traditional terms to defining the body of a method or clause. The actions possible are:

- sending a message by giving a box or pad to a bird,
- spawning a new agent by dropping a box and a team of robots into a truck,
- performing simple primitive operations such as addition or multiplication,
- copying an item by using a magician's wand,
- terminating an agent by setting off a bomb,
- changing the contents of the compartments of a box.

When the user controls the robot to perform the actions she is acting upon concrete values. This has much in common with keyboard macro programming and programming by example (Smith 1975). The hard problem for programming by example systems is how to abstract the example to introduce variables for generality. ToonTalk does no induction or learning. Instead the user explicitly abstracts a program fragment by removing detail from the thought bubble. The preconditions are thus relaxed. The actions in the body are general since they have been recorded with respect to which compartment of the box was acted upon, not what items happened to occupy the box.

If a user never turned off their computer nor wanted to share a program with another then this world with houses, robots, etc., would be adequate. To provide permanent storage we have introduced notebooks into ToonTalk. A programmer can use notebooks to store anything they've built. Notebooks can contain notebooks to provide a hierarchical storage system. Notebooks provide an interface to the essential functionality of the file system without leaving the ToonTalk metaphor. The initial notebook contains sample programs and access to facilities like animation and sounds.

Beyond the Programming Language

The Logo programming language isn't just a child-engineered version of Lisp, but also includes turtle graphics. While Logo is sometimes used to perform numerical or textual computations, its primary appeal has been in its turtle graphics package. While turtle graphics is still appealing and many modern Logo implementations have extended the idea to have multiple turtles with different appearances, it does not have the same appeal as game programming has with children. While game programming is possible using turtle graphics, it is difficult.

ToonTalk does not currently support turtle graphics — instead, effort was made to provide support for game programming. The lowest level of support is a message-passing interface to a *sprite* library. Sprites are animated graphical elements that are composed to make a game. Mario is a sprite, as is a mushroom he might eat, and so on. A sprite's appearance is selected from a set of animation loops. A sprite's size and location changes can be animated as well. A mechanism is provided for detecting and acting upon collisions between sprites. A ToonTalk message-passing interface to such functionality means that one can obtain a bird for a sprite and give that bird messages that mean things like "move up 10 units", or "change size to 20", "set speed to 30" or "are you colliding with anyone?". This interface is very general and powerful but it turned out to be too awkward and clumsy for doing simple things.

In addition to the message passing interface ToonTalk provides a direct control of sprites. A sprite can be flipped over. Initially on the back side is just a notebook which contains remote controls for that sprite. For example, its width control can be obtained from the notebook. As the width of the sprite is changed the number in the control changes as well. Also the user can change the value of the number and the sprite's width automatically changes accordingly. There are currently remote controls for position, speed, size, collision detection, and appearance selection.

For example, one can train a robot to repeatedly increment a number and put that robot to work on the speed of the sprite and the sprite will accelerate. One can place this robot and remote control on the back side of a picture and then flip the sprite back over. If this sprite is copied or saved and later retrieved from a notebook, this acceleration behavior will still be on the flip side of the sprite and active. This enables one to build a nice library of useful behaviors for sprites like bouncing off of walls or tracking the mouse. Sprites can be composed simply by placing one on top of another. (The hand vacuum is necessary for separating them later.) Behaviors can be copied and combined directly.

In addition to turtle graphics, many Logo implementations include libraries for controlling motors and sensors in a Lego, Fisher Technic or Capsula construction set (Papert 1993). This enables children to build toys with behaviors. Children have made things ranging from robots, to cars that follow lines drawn on the floor, to household machines like toy washing machines that stop when the door is opened, to traffic lights that change color and respond to a pedestrian button. As with LegoLogo, ToonTalk provides an interface for turning on and off motors and lights and reading sensors. Currently, only a message-passing interface exists but another interface based upon remote controls is planned. While our experience with this is limited, it does seem that the underlying concurrency of ToonTalk enables much more modular control than Logo does. A ToonTalk house can be built with robots for controlling a traffic light, another for a car which stops at red lights, and so on. In contrast, in Logo a sequential program must alternate its attention between different elements.

Building a Pong-like Game in ToonTalk

In an attempt to provide a more detailed understanding of ToonTalk, the full-length version of this paper describes how a child builds a Pong-like game from scratch. ToonTalk is started and the user finds herself (or himself) flying in a helicopter over a city. Houses can be seen below. She lands in front of a house and enters the front door. Following her everywhere is a toolbox character. Inside, there is a friendly Martian ready to offer tours or coaching, but she ignores him since she's used the system a bit and feels confident she can build a simple Pong-like game on her own. (See Figure 2.) She sits down on the floor and her toolbox scurries in front of her and opens. Four characters emerge. A notebook flies out. A hand-held vacuum with legs runs out. A bike pump hops away. And a magic wand floats out. Remaining in the toolbox are eight kinds of things that the programmer will use to construct her game: number pads, text pads, cubby holes, bird nests, scales, robots, construction trucks and bombs. (See Figure 3.)

Figure 2 — Programmer and toolbox inside

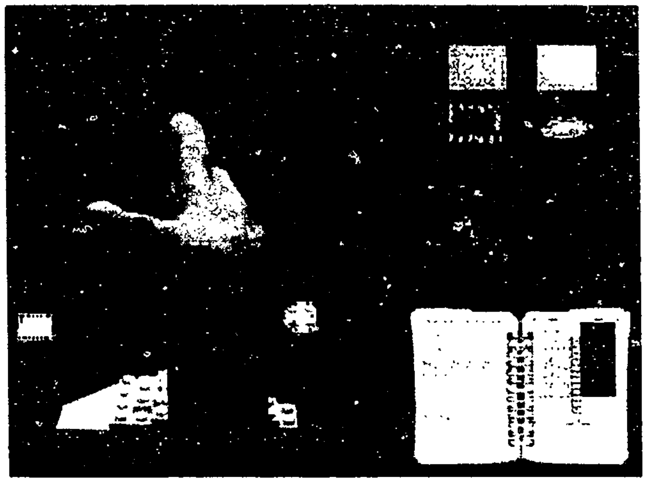

Figure 3 — Floor view after sitting

Briefly, she begins by building a paddle that follows the vertical movements of the mouse. She trains a robot to copy the mouse's vertical speed over to the paddle's vertical speed. She puts the robot on the back side of the paddle and gives it a cubby containing a mouse sensor and speed control. She then trains a robot to respond to collisions of the ball. She trains another robot to deal with the ball missing the paddle and moving off the left side of the screen. She adds sound effects and plays with her game.

Summary and Future Plans

We have presented what we believe is the first system to support an animated source code and to use video game technology to support general purpose programming. As of February 1995, ToonTalk has operational versions of all of the constructs described above. The Martian character is operational as a coach and help system but not yet as a tutor. .

Testing of ToonTalk in a fourth-grade class and in some homes began in January. Several children have played with ToonTalk for an hour or so. One encouraging observation from this casual use by children is that it seems to be succeeding in providing an entertaining way of constructing programs. Children like to play with the birds, hand-held vacuum, bike pump and magic wand, watch houses being built and destroyed, fly around in the helicopter and so on even if they are not constructing a useful program. Today it is too early to evaluate how well children can use ToonTalk to build programs, but it every encouraging that they find that just playing around with the equivalent of the program editor lots of fun.

ToonTalk runs on 386 or better PC running Microsoft Windows 3.1 or better. A Mac port should not be too hard.

ToonTalk variants can easily be imagined. A virtual reality version of ToonTalk would enable one to build programs from inside VR. Since ToonTalk is built upon a concurrent foundation, a modem-based or networked version would be a natural extension. Multi-user games could be built and programmers could work together in the same world. I often think about what a professional version of ToonTalk would be like. A compiler could augment the system's interpreter and would make more ambitious programs much faster and smaller.

ToonTalk is a real programming environment and yet it does not rely upon a keyboard. A keyboard is handy for various accelerators but one can get by with just a game pad, joystick or mouse. This opens up the possibility of a port to a game machine. We are excited by the possibility that the millions of kids around the world who have a game machine at home might be able to use it to make their own games and do real programming.

Acknowledgments

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Internet access to the full-size version of this paper is available via anonymous ftp from csli.stanford.edu. The ToonTalk entry in pub/Preprints/INDEX contains more information.

project
Technological Triads in Teacher Education

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Abstract
Purpose of Project
This project describes a year-long initiative, funded through a local college grant, to get five triads, each composed of student teachers, cooperating teachers, and college supervisors, to communicate electronically with each other via portable computers. Each triad has two portable computers equipped with modems (PowerBook 150, 4MB, hard disk 120), one shared between the student teacher and the cooperating teacher and one for the college supervisor, in order to use e–mail and conferencing.

The purpose of using electronic communication is threefold: (1) to improve the student teaching experience as a result of increased communication between supervisors and student teachers; (2) to improve supervisors' skills in reporting what they observe and to encourage more frequent and more substantive interactions with student teachers; and (3) to assist cooperating teachers in becoming more effective in providing feedback and support to student teachers as a result of their frequent communication with assigned supervisors.

Activities of Project
Two half-day orientations prepare five triads to: use electronic communication in a Macintosh environment; practice sending messages to each other; practice conferencing; and understand writing assignments related to their respective roles. Each triad communicates as follows: student teacher to supervisor–twice a week; supervisor to student teacher–twice a week; cooperating teacher to supervisor–once a week; supervisor to cooperating teacher–once a week. By the end of the twelve-week period, each supervisor will have sent a minimum of 24 electronic messages to a student teacher (and vice versa), and 12 to a cooperating teacher (and vice versa). Moreover, each triad will conference together at least five times. The college supervisor is responsible for printing out all communication for his/her triad. The five triads attend an end-of-semester half-day session to assess, through discussion across triads in role-alike groups and through self-created assessment forms, the value of this form of communication for field experience supervision.

Outcomes of Project
A major anticipated outcome is community building that supports each role during the student teaching experience. In building this community, there will be an increased number of requests for help/sharing and, as a result, evidence of self-reflection and more written discussion about issues related to education. A second major anticipated outcome is noted improvement in each role: student teachers will show greater improvement than nonparticipants in lesson plan development and execution, classroom management, confidence and risk-taking; supervisors will develop more comprehensive profiles of their student teachers' performance in the classroom; and cooperating teachers will provide more appropriate support and feedback to student teachers.

Since the first year of this project ended May, 1995, the presenters will highlight issues related to planning and implementation and describe outcomes to date. A handout describing details of the project process will be distributed.

panel

Use of Computer-mediated Communications as an Instructional Technique for Regular On-campus Graduate-level Courses

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Key words: university, college, computer, conferencing, communication, instruction

This project presentation presents several instructional techniques being used at Texas Tech University which involve computer-mediated communications in the conduct of regular campus-based courses. These techniques are being used on an experimental basis in an effort to improve instructional practices by incorporating modern technology into regular courses. Each technique listed below will be described and examples will be provided.

1. Use of E-Mail Distribution Lists for asynchronous Class Discussions. EDIT 5319 Computer Applications in Classroom & School Management, is a graduate course which deals with both hands-on computer applications in class and school management and issues/problems related to the use of Technology in education. Students are assigned a scenario or discussion question each week. Class discussions are held on-line using simple e-mail on the campus academic computing network. Students are encouraged to participate in discussions from home or place of work using modems and dial-up lines. They may also access the campus network by using terminals located at one of the computing labs located on campus. After assignment of the weeks discussion question, they are asked to enter an answer to the question within three days after each weekly class. They read all student's answers to the question and respond to one or more class members on-line before the next class. This approach encourages all students to participate in discussions and allows limited class time to be used for purposes other than discussions. Almost any network which includes e-mail can use this technique.

2. Use of Internet News Conferences for Class Discussions. EDIT 5395 Administration of the Instructional Technology Program, is currently using a specifically designated conference on the internet news service to conduct class discussions. The conference is open and unmoderated. The model described in 1 above is employed and the technique is similar. However, individuals and groups other than class members, both on and off campus may also participate in class discussions. An added benefit is that students learn to use other internet news groups which currently approximately 4,000 since the access technique is identical to that used for the class.

3. Use of VaxNotes for Problem Solving in use of Authoring Systems. EDIT 5322 Authoring Systems, is a course which covers techniques of creating computer applications using an authoring system such as HyperCard. Students are encouraged to ask questions and assist one another in solving programming problems and developing techniques by using a class electronic bulletin board system. Questions can be posted by any class member. Any class member or the instructor may respond. Students are also encouraged to share ideas that they believe would be of interest to others.

4. Use of Idea Web Software in Business Education Classes for Shared Inquiry. The Idea Web is a HyperCard application developed by Dr. Terence Ahern. It provides for communications which may be anonymous. Messages may be sent to individuals or to the group. The software runs on either a stand-alone Macintosh computer or a network. It saves messages and keeps records of interactions. Business Education classes at Texas Tech, including accounting methods and business communications have used the Idea Web to allow students explore general topics of interest such as computer security, privacy, and regulation. The instructor provided several initial scenarios and related questions for discussion. Students were required to participate regularly. The instructor participated in the discussion and provided guidance and information from time to time. Students were found to express feeling more openly using this method than in traditional class discussions. A study of this application was recently published in The Journal of Research on Computing in Education.

project

E-GEMS: Electronic Games for Education in Math and Science

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Key words: interactive, multimedia, games, education, mathematics, human-computer interaction

Abstract

E-GEMS is a collaborative effort by scientists, educators, and professional video game and educational software developers to develop and do research on interactive multimedia and curriculum materials that integrate electronic games and related activities with existing classroom practices for teaching mathematics and science. The aim of E-GEMS is to increase the proportion of children who enjoy learning, mastering, and using concepts of math and science. The organizations participating in E-GEMS include the University of British Columbia, Electronic Arts, Queen's University, Apple Canada, several elementary schools, and Science World BC.

E-GEMS is especially interested in children who fail to be interested in and/or fail to learn math and science in conventional school settings. Studies show that the intermediate grades are a critical period for loss of interest in math and science, hence our concentration on materials for this age group. There are several reasons for focusing on using electronic games to address this problem, including the attractiveness of these games to many children, and the pervasiveness of these games in children's cultures. Moreover, the exploratory and interactive nature of electronic games is well suited to encouraging the exploration of mathematical and scientific concepts, and electronic environments facilitate concept visualizations and manipulations difficult to achieve with concrete materials.

E-GEMS preliminary research efforts were aimed at increasing our understanding of how children interact with electronic games and environments. Because many existing electronic games are less attractive to girls, and because a disproportionate number ot girls lose interest in math and science during the intermediate grades, we were particularly interested in exploring gender differences in preferences and playing styles. This understanding was important in order to create electronic math and science activities that would be attractive to both boys and girls. In our initial study, researchers spent two months observing thousands of children playing video and computer games at Science World BC, a public science museum in Vancouver. Results indicated that both boys and girls enjoyed playing electronic games, especially when playing collaboratively, but they often preferred different features in games. Girls tended to be attracted by storyline, characters, creative activities and worthwhile social goals. Boys tended to seek out adventure, challenge, fast action, and novelty.

Following the initial study, E-GEMS has engaged in four major types of activities: long term broad-based investigations on the integration of electronic games into classrooms, shorter-term studies on specific issues related to the use of electronic games in education, development and evaluation of prototype electronic games and activities for mathematics education, and design of commercial electronic games for mathematics education.

Our long term classroom investigations are occurring over a three-year period in four classrooms (in different schools) with grades 3–8. Each classroom has been equipped with four computers loaded with a variety of commercial and prototype games/activities. The four classroom teachers were chosen so that they differ in their teaching and computer experience. Each classroom has a designated E-GEMS researcher who visits weekly to observe students using the computer games and activities The E-GEMS researcher also explores various approaches for integrating electronic activities with non-computer classroom learning, and discusses a wide variety of research issues with the teacher and students.

Teachers found that electronic games could be effective in engaging students in sustained discussion of mathematical concepts. Electronic games were also useful as a dynamic assessment tool of students' understanding. A number of accepted "rules" in the field of human-computer interaction seem questionable when applied to electronic learning environments. For example, intuitive and easy-to-use interfaces are highly valued in most computer applications, but they may not be as effective in learning contexts. Specifically, a less intuitive interface may force the learner to reflect on a particular concept, and thus facilitate learning of that concept.

A shorter-term study investigated cooperative behavior among children (ages 9–13) playing an educational computer game called *The Incredible Machine*, and its impact on performance achievement in the game. Particular attention was paid to gender groupings, and whether a pair of players shared a single computer or used two computers. Perhaps the most dramatic result from this study was the significantly enhanced performance of pairs of girls sharing a single computer compared to that of pairs of girls working on two separate computers.

Another study is investigating issues associated with the first E-GEMS commercial product, *Counting on Frank* This CD-ROM math education product, published by EA*Kids, engages the player in solving mathematical word problems in order to

gain clues to solve the overall goal of the game. It also contains independent mathematical games and many humorous click-ons. The study explores whether playing the game enhances achievement and/or attitude in doing word problems. We are also interested in how children spend their time while playing such a game (e.g. doing word-problems versus exploring the humorous click-ons or playing the other mathematical games). By using a modified version of the software that records all of the player's actions we are able to compare playing behavior in a variety of situations.

project

GEM: Gender Equity in Mathematics–Study of Gender Equity in Mathematics Teacher Education with Videodisc Media

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Keywords: gender equity, teacher education, laserdisc

We are all aware of the under-representation of women in mathematics and science careers. Studies have identified teachers' interactions with students as a strong influence on young women's expectations and aspirations. Teachers' subtle expressions of gender bias accumulate so that many girls feel disempowered.

There is increasing evidence that teachers unconsciously favor the males in their classes in a number of ways. Males are naturally more aggressive, and this "hand-waving" behavior is usually rewarded by the teacher calling on them. Females are likely to have been socialized to sit quietly until called upon; this may seldom happen because the males are so much more vocal. There is also evidence that many teachers are more encouraging to the males. Males tend to be asked more in-depth questions, and to be "coaxed" to give a fuller answer more often than are females. In classrooms that are competitive rather than cooperative, the more aggressive boys tend to dominate, and girls are discouraged. Again, this is inadvertent in most cases, and teachers are frequently unaware that their behavior that discriminates against the female students in their classes. Perhaps the most effective way to influence prospective teachers is to have them examine and discuss many different models of teacher-student interactions.

In order to properly instruct preservice teachers in this area, we need many and varied examples of both good and bad classroom interactions. While it may be difficult to find "glaring" gender discrimination in most high school classrooms, there are a multitude of subtle interactions that occur every day and add up to a monumental cumulation of inequity. There is a great need for materials to illustrate these behaviors for preservice teachers. Only through awareness and careful attention will teachers begin to create classrooms that are completely fair to both boys and girls.

This project involved the design and production of an instructional laserdisc, which we call GEM: Gender Equity in Mathematics. This 30-minute disk contains a series of short video clips of teacher-student verbal interactions in high school mathematics courses with a number of different teachers and classes. Particular attention is given to teacher questions and student verbal and nonverbal responses.

The primary use of this multimedia tool is as a demonstration of various types of interactions, both positive and negative. It is currently used in a preservice teacher education course as a whole-class activity, with the vignettes accessed by barcodes. This activity is followed by small group discussion and reflection. When students are able to see the actions in a real classroom setting, it is easier for them to visualize the action as a part of their own classroom. This type of activity stimulates young women to remember and relate their own experiences in high school classes. Students are usually quite interested in discussing this topic and planning for an equitable classroom atmosphere of their own.

Production of this project began with video taping a number of high school student teachers as they conducted classes. These tapes were then edited and reduced to 30 minutes of "snapshots" of classroom interactions. Six teachers' lessons of five minutes each were included. Once the edited video was completed, the next step was to send it to a company that made the actual laserdisc. When the laserdisc was available, it was watched carefully and scripted by frame numbers. Then short clips were isolated to show either positive or negative interactions. Using barcoding software, these clips were coded so that they are easily accessible. In this mode, the laserdisc is useful as a classroom teaching tool, where the instructor discusses a particular interaction mode and then is able to show two or three examples of it in a real classroom. The laserdisc can also be used in the development of interactive individual activities, using *HyperCard* to access the particular frames or sequences.

project

Supercomputers and Middle School Mathematics: Using 3-D Environments to Learn Geometry

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Key words: geometry, supercomputing, underrepresented, middle school

Abstract

The purpose of the SuperKids project is to create a flexible educational environment in which middle school students can learn and become conceptually literate in three dimensional geometry. To create such an environment, SuperKids uses *Wireman* visualization software and the National Education Supercomputer Program (NESP). *Wireman* is a geometric microworld in which users have the capability to manipulate an object's features (e.g., size, texture, spatial location) as well as an observer's view of the object (through the use of viewpoint locations and a camera). The goals of SuperKids are to: improve middle school students' attitudes toward mathematics (especially those of female and ethnic minority students) and confidence in their ability to excel in academics; and develop an educational environment that takes advantage of powerful computing technology, yet focuses on learning.

Currently an extra-curricular activity, SuperKids is a seven-week Saturday program conducted by Ames Laboratory Educational Programs and Iowa State University's College of Education. Student participants are identified through local schools and community-based educational organizations; specifically, upper elementary and middle school teachers are asked to identify female, minority, and/or disadvantaged students who appear to be working below their ability in mathematics and science.

The approach of the SuperKids program is exploratory and hands-on in nature. In the first two weeks of the program, students use mathematics manipulatives to learn basic geometry and algebra concepts. In addition, students are introduced to the Macintosh computer system, local area networks, Internet, and supercomputers; they learn to log on and off of the systems and to use electronic mail.

During weeks three and four, students are taught the basics of *Wireman* visualization software. *Wireman* is a software environment in which students create and manipulate wire frames to design animations. After creating the wire frames, students use the snapshot feature to visually record the sequenced movements of the wire frames. To produce movies, students implement file transfer protocol procedures to electronically send the wire frames to the National Education Supercomputer (located at Lawrence Livermore National Laboratory in California). The supercomputer puts "skin" (i.e., color, texture, etc.) on the wire frames and creates a movie of the snapshots taken by the students. The students electronically retrieve the movie version of their projects from the supercomputer and view them on their individual computers. This process is known as rendering a movie.

Because students initially use wire frames to create their movies, understanding three-dimensional geometry as well as the X, Y, and Z axes is essential. The effective use of *Wireman* requires students to employ the algebra and the geometry concepts taught during weeks one and two. At the conclusion of the third week, the students have produced a wire frame animation and rendered a movie via the supercomputer.

During the fourth, fifth, and sixth weeks, the students are engaged in project planning and design as they further develop their understanding of and ability to function in three-dimensional space via the use of *Wireman*. Using general specification guidelines, students plan, develop, and refine their final *Wireman* movie projects which may consist of 10-30 objects and include the sequencing of 200 or more frames for animation. For the seventh session of the project, students present their projects to their parents and peers.

The partnership between the computer technology and the hands-on activities has been productive. The limitations of the *Wireman* program were met by both the activities and a focused effort to help students connect the concepts of the activities to the *Wireman* program. The students became competent at integrating the software program with the mathematical concepts.

They also became accustomed to using the "language" of three-dimensional geometry. Future efforts will be aimed at increasing the translation of the activities to the effective use of the software and integrating the program into a school setting.

project
Technology in the Investigations in Number, Data, and Space Project

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Key words: mathematics, geometry, Logo, elementary

Abstract

A dramatic shift in how elementary mathematics is perceived, taught, and learned has been recommended by teachers, organizations such as the National Teachers of Mathematics, and recent governmental reports. How can materials be developed that embody the changes in mathematics teaching and learning advocated by recent national committees and be maximally helpful to teachers? These are the problems being addressed by a project funded by the National Science Foundation. "Investigations in Number, Data, and Space" is a cooperative project between the Technical Education Research Center, the State University of Buffalo, and Kent State University. The 5-year curriculum development effort emphasizes meaningful mathematical problems and depth rather than exposure.

For this project, we have fully developed four different software environments, each corresponding to one unit of instruction. Like the remainder of the curriculum, these environments have been designed considering both the available research and curricular considerations. As they were being developed, they were discussed and critiqued by the large Investigations development team and then extensively classroom tested.

Our aim for this project presentation is to reveal how the features of each environment reflect our educational philosophy, roots in research, connections to the mathematics curriculum, and classroom testing. We will demonstrate the software and present results from the field tests of the environments.

- *Geo-Logo.* Several of the environments are based on a new, enhanced version of Logo, *Geo-Logo.* Features include measurement tools, dynamic dual-direction connections between symbols (Logo code) and graphics, aids for defining, changing, and stepping, through procedures, and tools for geometric transformations such as rigid motions and scaling. This environment is used in two completed units (*Turtle Paths* and *Sunken Ships and Grid Patterns)* and several others still under development.
- *Tumbling Tetrominoes.* This is a modification of the popular game, *Tetris,* with features that make the game more educationally significant. The instructional unit in which it is used is *"Flips, Turns, and Area."*
- *Shapes* is a computer manipulative, software version of an enhanced set of pattern blocks or tangrams, that extends the potential actions students can make on these shapes. Students choose from one of the sets of shapes. They then transform those shapes with iconic tools or "machines". For example, they can size (scaling), decompose, compose (combine, group), slide, turn, flip, and duplicate the shapes.
- *Trips* (with TERC staff). Students work with a set of commands with variable inputs to conduct on-screen races between a bicyclist and a skater. The overarching theme is change–changing speeds, starting positions, ending positions, and so on. The data can be displayed in both table and graph form.

In general, our classroom-based research shows that the environments' features and activities encourage students to step back from what they know intuitively–to take a more abstract and mathematical look at what they're doing. The computer helps children connect the concrete and the physical with the abstract and formal. We have evidence that this leads to higher levels of mathematical achievement and higher levels of thinking. We will share brief vignettes to support these statements.

project
How Special is, "Special?"

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Key words: special education, language, survival skills, self-esteem, whole language

Abstract

"Seeing is believing" and "A picture is worth a thousand words" are sayings my special education students at MS (Middle School) 88 may express when they use the computer, video, and VCR to learn speech and language. The student population comprises learning disabled, neurologically impaired, physically handicapped, and emotionally disturbed children. My caseload is about 56 students.

When learning language skills, special students experience more apprehension, anxiety, and feelings of insecurity than the average student. Therefore, our approach must include more patience and attempt to create an environment that encourages active participation while we remain aware of their psychological and emotional needs. We achieve this goal by using "whole language."

The object of the project is to develop skills necessary for everyday living, such as getting dressed for school, using the telephone, and shopping for food. Auditory and visual memory, auditory and visual recognition, and sequencing are the language skills we want to develop.

Word processing becomes part of the planning and organization of our project. Students correspond with penpals in Japan and China. The students also learn how to operate the video recorder. One group videotapes, and the other group is video-recorded. The end result: we have a videotape to watch for peer and self evaluation.

The lessons are fun and natural. This allows for the development of self-esteem and personal worth.

project
Casting the Nets for Community Partnerships

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Key words: user groups, females, telecommunications, grant writing

The AppleNet Educational User Group in our community is sending out a safety net to rescue those left behind on the information superhighway. Adolescent females, high school dropouts, single parents, and the elderly use a technology center located in a middle school building for telecommunication projects. Projects with Girl Scouts, an adult GED program, and senior citizens will be shared. The session will describe the annual Apple Computer UG Awards, offer tips for setting up a training center, and discuss strategies for building community partnerships.

societysession

Project ImpactCS: Defining Curriculum Standards for Teaching Ethics and Social Impact in Computer Science

A SIGCAS Session

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Key words: CS curriculum, social impact, computer ethics

The purpose of the ImpactCS Project funded by the National Science Foundation is to define the core content and to develop materials for integrating social impact and ethics topics across the computer science curriculum. The first report completed by Project ImpactCS, which presents the core content definition, curriculum standards, and pedagogical strategies for a integrating ethics and social impact topics in computer science, will be presented.

Background Information

The purpose of the three-year ImpactCS Project funded by the National Science Foundation is to define the core content and develop materials for integrating social impact and ethics topics across the computer science curriculum. It addresses the three major problems that hamper the implementation of an across-the-board curricular change: the lack of formal definition of the foundation material in the area, the lack of materials that can be adapted or adopted into the existing CS curriculum, and the lack of awareness and expertise on the part of most CS faculty regarding the need and methodology for presenting such material in their courses. Therefore, the project will tackle three interrelated tasks: 1) define the core content for teaching modules to be developed that will facilitate the presentation of these topics; 2) develop the actual modules that can be disseminated as a teaching kit to interested CS departments and faculty members; and 3) develop a pilot faculty enhancement seminar that can be presented for interested CS faculty members to prepare them to use the materials.

The first task to define the core content and propose curriculum standards has been completed. In August, 1994, 25 experts in ethics, social impact, and computer science curriculum were called together in a two-day meeting to form a steering committee to develop the core content for ethics and social impact in computer science. By the end of that meeting, a philosophical and pedagogical framework had been developed that became the basis for the report that will be presented at NECC. The report presents a two-dimensional context within which the systematic analysis of ethical issues and social impact related to technology can be taught. The curriculum standards are defined in terms of learning objectives expressed as ethical principles, ethical analysis skills, social principles and social analysis skills. Pedagogical strategies are presented for each learning objective. The presenters will describe how the development of teaching materials is progressing, and how all of the information from the project is being made available on the World Wide Web.

societysession

MIDAS Project (Multimedia Industry Development of Academic Software)

An ISTE Session

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Key words: multimedia, interactive, interdisciplinary, student-centered, thematic, problem solving, global

Overview

In 1991, a group of representatives from the Department of Business, Economic Development and Tourism (DBEDT), Department of Education (DOE) and the Hawaii Chamber of Commerce met to discuss ways to prepare Hawaii's youth for the future. A Planning Group was formed which included representation from private industry to expand and develop plans and ideas about technology in education and Hawaii's economic future.

DBEDT submitted an initiative to the State Legislature requesting funding to stimulate the development of a multimedia software industry in Hawaii. The State Legislature funded $450,000 matched by private sector's monies to create a minimum of $900,000 for Hawaii's multimedia software development industry. This legislation established the MIDAS Project.

Purpose:

1. to develop and expand multimedia industry in Hawaii
2. to design and develop integrated multimedia-based curriculum on a thematic approach
3. to provide technological opportunities for students to better prepare them with skills for the 21st century

Goals:

1. to support and assist schools in acquiring the necessary technology
2. to provide students and teachers with opportunities to utilize computers and related technology to accomplish tasks more efficiently and to enhance the learning environment

Objectives:

1. establish a wide variety of media for students to use in giving presentations on what they have learned by using computers to integrate video, graphics, audio and printed media
2. enhance problem-solving and critical thinking skills through the use of technology
3. provide opportunities for students to use interactive software and to take responsibility for learning.
4. offer opportunities for students to share information electronically; whether from external sources or information created by students and teachers.

The MIDAS Project will provide training for teachers. Both formative and evaluation of the projects will be done throughout the preliminary classroom testing. Teacher and student feedback will provide information on effective use in the classroom. The projects will offer the capability for designing, developing and producing electronic media presentations created by students. Creative lesson plans and adaptive curriculum will be developed that meets the needs of the students.

MIDAS Projects

Rising Wave-Bruce Campbell, Project Coordinator

OurStory-Caravan is a way of organizing and integrating a child's curiosity and self awareness to achieve learning. It has world-wide application and can link students and classrooms around the world. OurStory-Caravan offers students, teachers, and researchers a performance-based authentic assessment tool for student's work. OurStory Caravan is an integrated multimedia framework into which specific educational modules can be placed. Each module is a set of developmentally appropriate tools, directives, and examples that empower a class of students to explore their personal and shared experiences. They begin in the early years with a focus on the self, family, and school. The scope progressively widens and deepens to include the community, state, region and nation. Within the framework of OurStory-Caravan, using the "Generations" module, the members of a class could individually explore their family history, including how and from where their family arrived in the local community. Collectively they would create a digital storyboard, containing each of the individual histories, accessed by pointing and clicking and useful in providing incentives to learn geography, cultural diversity, history and economics. Caravan, (using the internet) the networking component, allows individuals and classes to exchange their stories, with other schools locally, nationally and globally, allowing for collegiality for both students and teachers.

Manoa Interactive Productions, Inc. Brad F. Denis, President

"Exploring Environmental Science" is an integrated multimedia environment science curriculum that addresses themes for ecosystems, biosphere, human population, water, air and land management, atmosphere and climate, food production biodiversity and energy consumption and conservation. Intermediate and high schools students will explore these databases and have a hands-on opportunity to investigate and develop their own scenarios and hypotheses about environmental science.

Moanalua Gardens Foundation-Dr. Robert Moeng, Project Director

"Sea Search" is a marine science resource developed for students in fifth grade through high school. This program included over 300 color slides, video, text, animal sounds and educational activities on animals, plants and coastal habitats. A computerized database will provide students with information about the status, habitat, adaptations and behaviors of each marine organism. The program integrates science, math, social studies and language arts under the themes of adaptations, interdependence and conservation. A "reef rap" provided an appealing animated entrance into the database. Interactive mysteries will challenge students to apply critical thinking and problem solving skills.

society session

Results and Products from Working Conferences on Labs and Multimedia

A SIGCSE/SIGCUE Session

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Keywords: laboratories, multimedia, computer science education, computer uses in education

The ACM Special Interest Groups on Computer Science Education (SIGCSE) and Computer Uses in Education (SIGCUE) will jointly sponsor two working sessions prior to NECC '95. The sessions will focus on integrating the use of computing technology into the delivery of computer science education. During the two days of working meeting, participants will produce useful guidelines and demonstration modules in one aspect of technology in computer science education.

The workshop themes are:

Effetive Multimedia in CS Classrooms
Hands-on Laboratories in Computer Science

At this session, the results of these workshops will be presented to NECC attendees. There will be an opportunity to comment on the materials produced during the workshops and copies of the workshop output will be available.

classroom demonstration

The Anatomy of Music: A Learning Tool for Listening

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Keywords: music, multimedia, teacher education

All introductory music courses share one primary objective: providing the learner with information that relates directly to music. This truism remains valid even if the stated objective concerns more esoteric concepts such as love for music, aesthetic discrimination, and music and social issues.

This musical information is commonly drawn from many different sub-disciplines, including such diverse subjects as history, fundamentals of music, biographies, and above all, samples of music literature. Of the above, only samples of music literature cannot be conveyed verbally[1]. This underlies a main difficulty in designing a pedagogically meaningful introduction to music course.

Because of the vastness and diversity of music and musical information, a detailed study of it at an introductory level becomes impossible and thus presents a two-part problem. Not only must our sights be raised from details to a level of more general governing principles, but these general principles must be presented to a group of learners who have had no musical preparation, and are musically illiterate. The questions become: first, what are some general governing principles of music? And second, how can we make a learner, who has no recourse to the musical score, cognizant of specific musical events during real-time listening to a composition? Obviously, it matters little how enlightening our discussion of a composition's salient features might be if we cannot enable the learner to observe those features auditorily so he/she can relate them to the discussion[2].

The linear ordering of musical ideas is one of the meanings for the term musical form. Even though it is possible that a composition's genesis may have been spawned by a harmonic progression or a rhythmic figure in the composer's mind, the completed composition ultimately must be in some linearly ordered form. These ensuing forms were then given names. These names were often attached after the form had existed for some time. For example, the sonata form existed long before G.J. Vogler, H.C. Koch or A.F.C. Kollmann first named it in their writings in the 1780's and 1790's.

Although there are many compositions that do not fit the mold of any conventional musical form, I maintain that musical forms are abstract prototypes of whole classes of compositions. These prototypes incorporate the necessary and sufficient conditions needed for a composition to be categorized in a certain class.

Since form is an essential element in the music selected for this course, I suggest that it is a general governing principle and can be used advantageously for the design of an introductory course. But recognizing it as a general principle is only part of the answer. The difficulty is not in conveying to the student the concept of musical form, but in enabling the student to observe the unfolding form aurally. We have to teach our students to track a composition's form through proactive listening and anticipation of formal events, even when listening to unfamiliar pieces. Just as the composers of selected periods adhered to generally accepted compositional rules, the listener can be taught to observe these aurally as they are manipulated by the composer. Having attained the skill to follow a composition's form auditorily, the learner has been empowered to locate musical events under discussion and thus to coordinate the verbal with the non-verbal in a meaningful manner.

This leads to the second part of the question. How can we make a learner, who has no recourse to the musical score, cognizant of specific musical events during real-time listening to a composition?

What most listeners remember or recognize of a familiar musical composition are several "tunes" or melodic fragments or some thematic material. Remember when recognizing the beginnings of a number of compositions was considered to be musically educated? I have come to believe that remembering thematic materials or chunks of music is the key to proactive listening.

I designed *The Anatomy of Music* as a multimedia interactive learning tool for listening. Roughly, the term multimedia means using a computer to integrate audio and visual presentations. This technology enabled me for the first time to show my students (in graphics and sound) what it was that I wanted them to observe. The results were quite dramatic.

With *The Anatomy of Music* , students can develop mental scaffolding by conceptualizing chunks of music as elements of musical form and relate what is heard to the abstract prototype. It clearly has transferability and can be done without requiring an understanding of theory or harmony. Obviously, it is easier for the musically illiterate student to recognize that the A and the B of a minuet are different. than it is to explain what the differences are. Eventually, A and B become conceptualized as elements of form. I neither expect nor require verbalization of these concepts. On the contrary, the main purpose of this program is to provide the student with a tool that facilitates ostensive definitions.

I have been using the program for the past three years at Northeastern University in Boston. It is the main content of a self-paced introduction to music course named "Music: A Listening Experience." The program is praised by the students. Not only do they enjoy working with it. but they demonstrate their comprehension by posing insightful questions concerning the music itself.

classroom demonstration

Scanning Techniques for Music Reading Software

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Keywords: music-scanning software applications

Abstract

Music reading software is a revolutionary software process of generating TIFF files of music manuscript via a 24-bit scanner and image-editing software and then converting the TIFF files into standard MIDI files where they will be edited and prepared for transfer into a music notation software program of your choice. Music reading software products that will be demonstrated are: MIDISCAN by Musitek and NoteScan by Temporal Acuity Products. The music scanning process is an excellent method for archiving music into multitrack MIDI files by automatically capturing musical arrangements in minutes. There are also significant educational implications for use of this process. All aspects of music scanning will be demonstrated, including the differences of the standard MIDI file transfer into popular music notation software products, such as Final by Coda Music, Encore by Passport Designs, Nightingale , and MusicPrinter Plus by Temporal Acuity Products.

classroom demonstration

Redesigning Mathematics Instruction for Human Learners

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Keywords: computer-based instruction, courseware, inductive learning, mathematics, algebra

We "teach" a computer to execute a complex algorithm by stating it precisely in an appropriate language. The computer reliably translates and executes the algorithm. It has, however, proved difficult to teach computers to emulate various human abilities such as interpreting the data in a visual field or inferring the vocabulary and grammar from instances of a spoken language. Human beings, conversely, have great difficulty in learning to implement formally stated algorithms for non-trivial operations. While computers learn from abstract instructions how to perform concrete operations, humans learn best via concrete examples, from which they readily infer abstract patterns and general principles.

Mathematics is traditionally taught by an instructor with a class of 20 (or 200) students and a blackboard. The instructor states and explains definitions, axioms and theorems (with or without proof), and appropriate algorithms for performing desired operations, with examples as time permits. The students then supposedly apply these algorithms to the solution of problems to develop their skills. In practice, students usually emulate sample problems in preference to applying the formal algorithms, which they find much more difficult. The traditional instructional model reflects the abstract-to-concrete orientation of research mathematics. It would be better suited to teaching computers than it is to teaching human students. However, it is not obvious how to implement a concrete-to-abstract learning model within the constraints of the single-instructor-plus-blackboard environment.

A more effective instructional model relies on appropriate courseware for the initial presentation of basic concepts, but concentrating on concrete problems. This courseware should:

- Cover all topics needed in the course.
- Avoid mathematical formalism.
- Include a vast range of carefully graduated problems.
- Begin with sample problems.
- Accept step-by-step solutions.

- Offer solved sample problems during solution entry.
- Provide "next step" hints upon request.
- Permit all errors possible when using a blank sheet of paper.
- Respond constructively to all possible errors.
- Support creative and original problem solving methods.
- Offer to complete solutions even after unusual steps.
- Modify solution strategies based on the student's work.
- Accept various correct final answers to each problem.
- Offer a range of difficulty levels.
- Review earlier topics as student performance dictates.

The pathetic, but typical, fill-in-the-blanks, multiple choice, and single-final-answer student input schemes are hopelessly inadequate to the demands of this instructional model.

Students use such courseware to build up their concrete mastery of relevant operations and manipulations as the first step in their acquisition of conceptual mastery of underlying principles. The instructor, freed by such courseware from the traditional responsibilities of initial presentation to all students, serves initially as a tutor, coach, and cheerleader, concentrating on those problems of individual students that may be too subtle for the courseware to diagnose. Later, the instructor provides enrichment for the better students, helping them to master concepts at a more abstract level after they have acquired a thorough and concrete understanding of basic principles using the courseware. Many more students can understand the distributive law, for example, after they have learned to add similar terms and to multiply and factor polynomials than ever understand it when it is presented in the first week of elementary algebra.

Preliminary testing, using an earlier version of this courseware, has suggested that students require significantly less time to learn as much as students in traditional classrooms. Creative instructors can then use the extra time for a variety of individualized enrichment strategies.

Although most educational institutions still cannot afford a computer for each mathematics student, we should be planning for that possibility. We should "humanize" instruction, by designing it to reflect how students actually learn, and at the same time free instructors to do what they do best–to use their human expertise to respond to the individual needs of each student.

The latest version of the courseware used in this testing will be demonstrated and offered without cost to session attendees.

classroom demonstration

Teachers and Kids–Partners on the Information Superhighway

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Key words: Internet, video conferencing, telecommunications, educational technology, collaborative research, WWW

Abstract

The Global Schoolhouse Project is an internationally recognized educational activity which networks classrooms across the United States and in international sites to demonstrate the use of the Internet in the K-12 environment. The project uses the capabilities of personal computers and the Internet to construct a virtual school with classroom locations around the world linked via video and audio during live video conferences. Cornell University's *CU-SeeMe* video conferencing software allows students to sit at their classroom computer and work with students, teachers, scientists, policy makers, and content experts around the world. Collaborative projects are organized around a content theme and are researched by the students within a

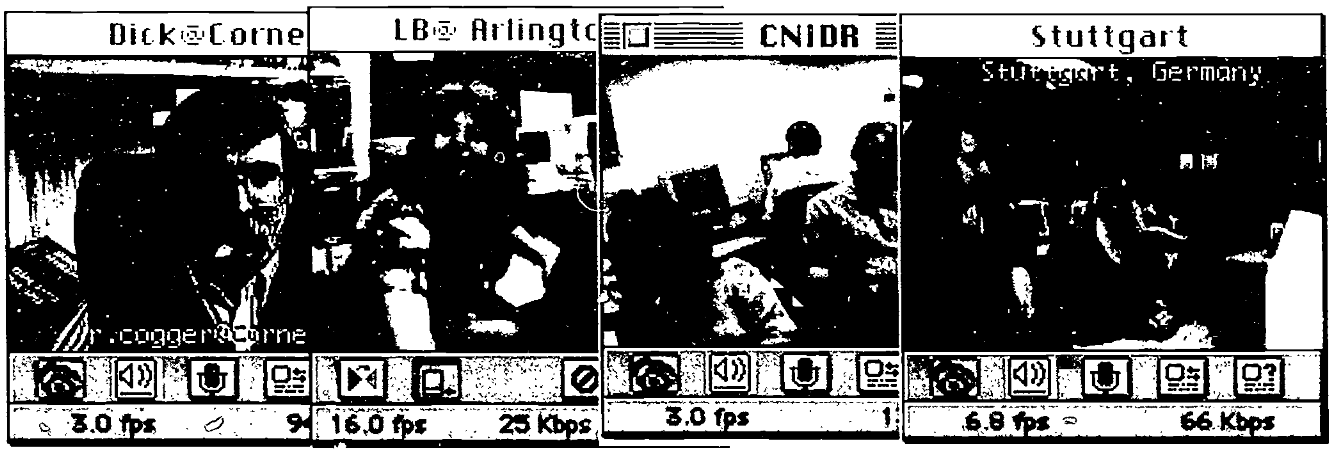
clusters of schools. Teachers work side-by-side with their students to search the Internet for resources (using WWW browsers such as Netscape), share ideas with co-collaborators, participate in online conferencing, and publish information in traditional as well as electronic formats. Allowing educators and students the access to both information and people as sources of information has been a powerful enhancement to the educational process for schools involved in the project.

To access the GSH Home Page: http://k12.cnidr.org/gsh/gshwelcome.html.

For more information about the presenter's work with the Weather Cluster Schools: http://k12.cnidr.org/gsh/projects/weather.html.

For information about the Presidential Awardees' Internet Pilot Project: http://k12.cnidr.org/pa/pa.html

Figure 1: Desktop Video Conferencing Utilizing *CU-SeeMe*



project
A Description of T3: A Statewide Organization Dedicated to Computer Training Initiatives in West Virginia Teacher Education

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Abstract
Introduction

T3 (Technology, Teacher Education, Tomorrow) was born on April 30th, 1994. The purposes of the organization are:

1. To support the effective integration of technology into instruction in West Virginia schools by enhancing the use of

technology in teacher preparation.

2. To bridge the gap between technology research and teacher preparation through informed and critical scholarship.
3. To facilitate faculty networking across campuses.

Membership includes representatives from higher education, the public schools, and any West Virginian interested in technology and teacher education. The Board of Directors consists of dean-appointed college and university representatives, elected K-12 representatives, and other appointees designated by the board. General membership meetings are held to conduct business, educational sessions, seminars, and workshops.

Financial Support

T3 received a $44,000 grant from the WV Higher Education Office to fund 3 workshops. These workshops were to provide opportunities and materials for higher education faculty interested in the integration of technology into their teacher preparation courses. These workshops were designed based on the Project RETOOL model, a project in Special Education developed to provide training in technology for Special Education faculty.

Needs Assessment

Once funding was obtained, a needs assessment was conducted to determine the preferred workshop topics. This form presented five topics: telecommunications, authoring, distance learning, productivity tools, and presentation tools.

The results of the 73 returned forms indicated that educators elt the most need for a workshop on the use of presentation tools. Need for a telecommunications workshop ranked second, and a workshop on the use of productivity tools ranked third. The educators rated distance learning as the least desired topic for a workshop.

Workshops

The three faculty training workshops were presented in October, March, and April during the 1994/95 school year. The topic for the first workshop, integration of technology into the curriculum, was chosen before the needs assessment was completed. However, the topic was well-received by teacher educators. The second workshop centered on telecommunications, and the third workshop topic was teaching in the electronic classroom (productivity tools). Participants of these workshops were appointed by the dean of teacher education at their respective colleges and represented different regions of the state.

Each of the workshops provided practical and high-quality training by offering opportunities to see technology used as well as opportunities for "hands-on" practice. The participants were furnished with training materials and software to take back to their campuses.

Future Directions

The three workshops presented in 1994/95 helped to meet the goals of T3 by providing much needed technology training to teacher educators and by providing opportunities for people interested in technology to meet and establish contacts. T3 has made a good beginning to promote technology integration in teacher education. We hope to obtain further funding to continue the workshops and search for more ways to promote technology in education.

panel

InforMNs–Internet for Minnesota Schools: Lessons Learned in Providing a Statewide K-12 Internet Service

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Key words: Internet, K-12, telecommunications, SLIP

Abstract

The InforMNs Service

InforMNs–Internet for Minnesota Schools is a statewide service, providing state-of-the-art, toll free dial-up Internet access to all Minnesota schools. InforMNs is available to teachers, administrators, and staff from any school district, public or private, in Minnesota. An annual subscription fee of $240 provides up to 30 hours of toll free access per month per subscriber. Software, user guides, and a toll free helpline for on-going support are included. One day of training is provided for one person in each subscribing school building to prepare that person to give on-site assistance to his or her colleagues.

InforMNs provides full Internet access using Serial Line Internet Protocol (SLIP) which delivers the same kind of full function Internet access using an ordinary phone line and a modem as a user would have on a directly connected local or wide area network (LAN or WAN).

The InforMNs Project

In its 1993 session, the Minnesota Legislature appropriated seed funding to the Minnesota Department of Education (MDE) to provide an Internet service accessible to every school in the state. The state appropriation subsidizes the cost of providing the service so that toll free dial-up access is ensured from any school in the state, regardless of its location. Like many states, Minnesota's population is split between a few high-density metropolitan centers and large, sparsely populated rural areas. Approximately half of InforMNs users connect to the network via local calls in three of the largest population centers, and half use the toll free access number.

As of February 1995, approximately 1,700 K–12 educators in 800 schools subscribe to the service. 600 K–12 teachers and staff have attended training sessions held at regional locations around the state. The project is staffed by 14 full and part time personnel from the three partner organizations.

The InforMNs Teaching and Learning Environment

InforMNs' dial-up access and its Gopher and WWW information servers provide the Internet infrastructure that connects Minnesota schools with the following grants and classroom projects. Without InforMNs, several of these grants could not have been proposed, much less funded, and Minnesota teachers and students would not be able to participate in these and other innovative curriculum projects.

TOPS (Teacher On-line ProjectS) is a rural telecomputing project directed by TIES and funded by the CPB/Annenberg Science and Mathematics Education Program that involves teachers, community members, and students in a community-based science and math research project.

From Access to Application: Bringing the Internet into the Science and Mathematics Classroom, a three-year project of SciMathMN, funded by a $700,000 grant from the Eisenhower National Program for Science and Mathematics Education will develop a model professional development program that promotes teachers' competence and confidence in using the facilities and resources of the Internet in the science and mathematics classroom.

Envision It! Computational Science for Teaching and Learning is a three-year project of the Minneapolis-St. Paul Metro ECSU funded by the National Science Foundation for high school science and math teachers, where they will learn about computational science and how to incorporate it into their classrooms.

Advantage Internet is a cooperative effort of SciMathMN and the Minnesota Council of Teachers of Mathematics (MCTM), the Minnesota Science Teachers Association (MSTA), and TIES to provide training in the use of the Internet to MCTM and MSTA members and to provide support in identifying Internet resources in science and mathematics for the InforMNs Gopher and WWW servers.

Interactive Democracy combined the League of Women Voter's curriculum guide, *We've got the power: Skills for Democracy*, the Internet, and Minnesota's public access cable TV network to create a high tech classroom environment that enabled students and teachers to take part in the full spectrum of the political process. Interactive Democracy: Minnesota Vote '94 focused on the fall elections and Interactive Democracy: The '95 Legislative Session focuses on the legislative process through the winter and spring.

In January 1995, the MayaQuest team of cyclists led by Minnesotan Dan Buettner embarked upon a wholly kid-directed expedition into the Maya world of Central America, into Guatemala, Mexico, Belize and Honduras. Laptop computers and satellite equipment linked the cyclists to schools and homes where kids directed the three month expedition using the Internet. Compilations of the communications between kids and the cyclists is archived on the InforMNs WWW and Gopher servers.

Journey North is an Internet-based learning adventure that will engage students in a global study of wildlife migration. Beginning on Groundhog's Day 1995, students followed spring as it swept northward across the continent of North America. Up-to-the-minute news about migration will be exchanged between classrooms as students report observations from their own home towns.

The Wolf Study Project directed from the International Wolf Center in Ely, MN provides information about wolves' feeding habits, migration patterns, habitat, etc. via the InforMNs Gopher and WWW servers to teachers and their students across Minnesota and the world. Researchers at the International Wolf Center in Ely have been corresponding via e-mail with teachers and students since early 1993.

panel

Hypermedia and Lifelong Learning: 50 Years after Vannevar Bush...and Beyond

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Abstract

Near the end of World War II, Vannevar Bush (President Roosevelt's Director of the Office of Scientific Research and Development and the forefather of the National Science Foundation and the National Institutes of Health) published a visionary article in the *Atlantic Monthly*, entitled "As We May Think." This paper foresaw the human problems of dealing with an increasingly complex world and an accompanying, ever-expanding knowledge explosion. Bush foresaw the needs for new kinds of computers and knowledge manipulation technologies that could help people cope with these issues. This article and Bush's dreams of creating a Memex, an associatively-based personal knowledge assistant, foreshadowed a future revolution in information and communications technologies. His vision also heavily influenced the ideas and designs of many early key pioneers in the personal computer and information industry (e.g., Doug Engelbart, Alan Kay, and Ted Nelson).

This panel will look back to Bush's vision, with an eye on how far this vision has come to pass and how it may develop in the future with the convergence of multiple digital technologies, such as: growth of World Wide Web-based hypermedia and electronic publishing on the Internet; accredited "virtual universities"; multi-player hypermedia virtual reality games and simulations; low-cost home and school access to next-generation multimedia/video game systems, interactive television, and adaptive personal tutors and digital assistants. The panel will explore many issues related to the impact of these technologies on learning (including demonstrations of some currently available products and systems), focusing on how hypermedia can both enable–and sometimes inhibit– effective learning.

Here are some thoughts and interests of the panelists that will frame their presentations and discussions:

Ted Kahn

"Where is the Life we have lost in living?
Where is the wisdom we have lost in knowledge?
Where is the knowledge we have lost in information?"
—T.S. Eliot

"If computers are universal control devices, let's give our children universes to control.."
—Ted Nelson

Are students and teachers linking to more information, but learning less of lasting value? What is the cost to students, adults, and society when speed of access to information, quickness of response and an emphasis on quantity of information acquired take precedence over reflection, childlike playfulness, quality of meaning-making and a quest for deeper understanding? Does hypermedia just tend to accentuate "hyper-activity?" What will be the next form of literacy after information and media literacy, and how can we really use these new technologies to foster the growth of successful, lifelong learning communities?

Sara Armstrong

The Internet offers educators access to a vast collection of resources and people that might not be available in any other way. Rather than prodding students along a single path towards a single right answer, teachers help students formulate questions and search strategies, and guide students through analyses of the sources they find. With World Wide Web browsers such as Mosaic and Netscape, students and teachers participate in new thinking and learning paradigms as they explore presentation techniques for information they encounter, or information they themselves develop to share with the world community. New metaphors for learning and teaching are emerging that affect educational reform activities, as well as the future of education itself.

Bob Mohl

One of the new skills that we all need to acquire in the digital age is "learning where the truth lies." When we manipulate information, we are often manipulating people as well.

We all know digital convergence is inevitable, but there is a big difference between having a computer in your TV and having a TV in your computer. If we don't pay more attention on our way to the best of all worlds, we may end up with the worst of all worlds.

Some people think the only difference between being wired and being weird is how you spell it.

Stephen Marcus: Technology and the Vertigo of Freedom

Guy Kawasaki thinks kids should start their computer use at age one. Alan Kay is concerned that people are in danger of becoming mouse potatoes. Papert warns about technocentricity. And don't even ASK what Neil Postman thinks about all this. Fifty years after Vannevar Bush, attempts to implement his vision now provide us with an opportunity to re-learn the wisdom that cautions us to be careful of what we wish for.

Debra Pollard

Debra will demonstrate and discuss the use of some of Microsoft's CD-ROM-based multimedia and hypermedia products in K-12 classrooms.

Ted Kahn suggested that NECC get permission to reprint Vannevar Bush's article "As We May Think." It was a good suggestion, and we did it. That article follows. —editor

As We May Think

by Vannevar Bush

This article was originally published in July, 1945. It is reprinted here with permission of The Atlantic Monthly.

Of what lasting benefit has been man's use of science and of the new instruments which his research brought into existence? First, they have increased his control of his material environment. They have improved his food, his clothing, his shelter; they have increased his security and released him partly from the bondage of bare existence. They have given him increased knowledge of his own biological processes so that he has had a progressive freedom from disease and an increased span of life. They are illuminating the interactions of his physiological and psychological functions, giving promise of an improved mental health.

Science has provided the swiftest communication between individuals; it has provided a record of ideas and has enabled man to manipulate and to make extracts from that record so that knowledge evolves and endures throughout the life of a race rather than that of an individual.

There is a growing mountain of research. But there is increased evidence that we are being bogged down today as specialization extends. The investigator is staggered by the findings and conclusions of thousands of other workers—conclusions which he cannot find time to grasp, much less to remember, as they appear. Yet specialization becomes increasingly necessary for progress, and the effort to bridge between disciplines is correspondingly superficial.

Professionally, our methods of transmitting and reviewing the results of research are generations old and by now are totally inadequate for their purposes. If the aggregate time spent in writing scholarly works and in reading them could be evaluated, the ratio between these amounts of time might well be startling. Those who conscientiously attempt to keep abreast of current thought, even in restricted fields, by close and continuous reading might well shy away from an examination calculated to show how much of the previous month's efforts could be produced on call. Mendel's concept of the laws of genetics was lost to the world for a generation because his publication did not reach the few who were capable of grasping and extending it; and this sort of catastrophe is undoubtedly being repeated all about us, as truly significant attainments become lost in the mass of the inconsequential.

The difficulty seems to be not so much that we publish unduly in view of the extent and variety of present-day interests, but rather that publication has been extended far beyond our present ability to make real use of the record. The summation of human experience is being expanded at a prodigious rate, and the means we use for threading through the consequent maze to the momentarily important item is the same as was used in the days of square-rigged ships.

But there are signs of a change as new and powerful instrumentalities come into use. Photocells capable of seeing things in a physical sense, advanced photography which can record what is seen or even what is not, thermionic tubes capable of controlling potent forces under the guidance of less power than a mosquito used to vibrate his wings, cathode ray tubes rendering visible an occurrence so brief that by comparison a microsecond is a long time, relay combinations which will carry out involved sequences of movements more reliably than any human operator and thousands of times as fast—there is plenty of mechanical aids with which to effect a transformation in scientific records.

Two centuries ago Leibnitz invented a calculating machine which embodied most of the essential features of recent keyboard devices, but it could not then come into use. The economics of the situation were against it: the labor involved in constructing it, before the days of mass production, exceeded the labor to be saved by its use, since all it could accomplish could be duplicated by sufficient use of pencil and paper. Moreover, it would have been subject to frequent breakdown, so that it could not have been depended upon; for at that time and long after, complexity and unreliability were synonymous.

Babbage, even with remarkably generous support for his time, could not produce his great arithmetical machine. His idea was sound enough, but construction and maintenance costs were then too heavy. Had a Pharaoh been given detailed and explicit designs of an automobile, and had he understood them completely, it would have taxed the resources of his kingdom to have fashioned the thousands of parts for a single car, and that car would have broken down on the first trip to Giza.

Machines with interchangeable parts can now be constructed with great economy of effort. In spite of much complexity, they perform reliably. Witness the humble typewriter, or the movie camera, or the automobile. Electrical contacts have ceased to stick—note the automatic telephone exchange, which has hundreds of thousands of such contacts, and yet is reliable. A spider web of metal, sealed in a thin glass container, a wire heated to a brilliant glow, in short, the thermionic tube of radio sets, is made by the hundred million, tossed about in packages, plugged into sockets—and it works! Its gossamer parts, the precise location and alignment involved in its construction, would have occupied a master craftsman of the guild for months; now it is built for thirty cents. The world has arrived at an age of cheap complex devices of great reliability; and something is bound to come of it.

A record, if it is to be useful to science, must be continuously extended, it must be stored, and above all it must be consulted. Today we make the record conventionally by writing and photography, followed by printing; but we also record on film, on wax disks, and on magnetic wires. Even if utterly new recording procedures do not appear, these present ones are certainly in the process of modification and extension.

Certainly progress in photography is not going to stop. Faster material and lenses, more automatic cameras, finer-grained sensitive compounds to allow an extension of the minicamera idea, are all imminent. Let us project this trend ahead to a logical, if not inevitable, outcome. The camera hound of the future wears on his forehead a lump a little larger than a walnut. It takes pictures 3 millimeters square, later to be projected or enlarged, which after all involves only a factor of 10 beyond present practice. The lens is of universal focus, down to any distance accommodated by the unaided eye, simply because it is of short focal length. There is a built-in photocell on the walnut such as we now have on at least one camera, which automatically adjusts exposure for a wide range of illumination. There is film in the walnut for a hundred exposures, and the spring for operating its shutter and shifting its film is wound once and for all when the film clip is inserted. It produces its result in full color. It may well be stereoscopic, and record with two spaced glass eyes, for striking improvements in stereoscopic techniques are just around the corner.

The cord which trips its shutter may extend down a man's sleeve within easy reach of his fingers. A quick squeeze, and the picture is taken. On a pair of ordinary glasses is a square of fine lines near the top of one lens, where it is out of the way of ordinary vision. When an object appears in that square, it is lined up for its picture. As the scientist of the future moves about he laboratory or the field, every time he looks at something worthy of the record, he trips the shutter and in it goes, without even an audible click. Is this all fantastic? The only fantastic thing about it is the idea of making as many pictures as would result from its use

Will there be dry photography? It is already here in two forms. When Brady made his Civil War pictures, the plate had to be wet at the time of exposure. Now it has to be wet during development instead. In the future, perhaps it need not be wetted at all. There have long been films impregnated with diazo dyes which form a picture without development, so that it is already there as soon as the camera has been operated. An exposure to ammonia gas destroys the unexposed dye, and the picture can then be taken out into the light and examined. The process is now slow, but someone may speed it up, and it has no grain difficulties such as now keep photographic researchers busy. Often it would be advantageous to be able to snap the camera and to look at the picture immediately.

Another process now in use is also slow, and more or less clumsy. For fifty years impregnated papers have been used which turn dark at every point where an electrical contact touches them, by reason of the chemical change thus produced in an iodine compound included in the paper. They have been used to make records, for a pointer moving across them can leave a trail behind. If the electrical potential on the pointer is varied as it moves, the line becomes light or dark in accordance with the potential.

This scheme is now used in facsimile transmission. The pointer draws a set of closely spaced lines across the paper one after another. As it moves, its potential is varied in accordance with a varying current received over wires from a distant station, where these variations are produced by a photocell which is similarly scanning a picture. At every instant the darkness of the line being drawn is made equal to the darkness of the point on the picture being observed by the photocell. Thus, when the whole picture has been covered, a replica appears at the receiving end.

A scene itself can be just as well looked over line-by-line by the photocell in this way as can a photograph of the scene. This whole apparatus constitutes a camera, with the added feature, which can be dispensed with if desired, of making its picture at a distance. It is slow, and the picture is poor in detail. Still, it does give another process of dry photography, in which the picture is finished as soon as it is taken.

It would be a brave man who would predict that such a process will always remain clumsy, slow, and faulty in detail. Television equipment today transmits sixteen reasonably good pictures a second, and it involves only two essential differences from the process described above. For one, the record is made by a moving beam of electrons rather than a moving pointer, for the reason that an electron beam can sweep across the picture very rapidly indeed. The other difference involves merely the use of a screen which glows momentarily when the electrons hit, rather than a chemically treated paper or film which is permanently altered. This speed is necessary in television, for motion pictures rather than stills are the object.

Use chemically treated film in place of the glowing screen, allow the apparatus to transmit one picture only rather than a succession, and use a rapid camera for dry photography. The treated film needs to be far faster in action than present examples, but it probably could be. More serious is the objection that this scheme would involve putting the film inside a vacuum chamber, for electron beams behave normally only in such a rarefied environment. This difficulty could be avoided by allowing the electron beam to play on one side of a partition, and by pressing the film against the other side, if this partition were such as to allow the electrons to go through perpendicular to its surface, and to prevent them from spreading out sideways. Such partitions, in crude form, could certainly be constructed, and they will hardly hold up the general development.

Like dry photography, microphotography still has a long way to go. The basic scheme of reducing the size of the record, and examining it by projection rather than directly, has possibilities too great to be ignored. The combination of optical projection and photographic reduction is already producing some results in microfilm for scholarly purposes, and the potentialities are highly suggestive. Today, with microfilm, reductions by a linear factor of 20 can be employed and still produce full clarity when the material is re-enlarged for examination. The limits are set by the graininess of the film, the excellence of the optical system, and the efficiency of the light sources employed. All of these are rapidly improving.

Assume a linear ratio of 100 for future use. Consider film of the same thickness as paper, although thinner film will certainly be usable. Even under these conditions there would be a total factor of 10,000 between the bulk of the ordinary record in books and its microfilm replica. The *Encyclopaedia Britannica* could be reduced to the volume of a matchbox. The library of a million volumes could be compressed into one end of a desk. If the human race has produced since the invention of movable type a total record, in the form of magazines, newspapers, books, tracts, advertising blurbs, correspondence, having a volume corresponding to a billion books, the whole affair, assembled and compressed, could be lugged off in a moving van. Mere compression, of course, is not enough; one needs not only to make and store a record but also be able to consult it, and this aspect of the matter comes later. Even the modern great library is not generally consulted; it is nibbled at by a few.

Compression is important, however, when it comes to costs. The material for the microfilm *Britannica* would cost a nickel, and it could be mailed anywhere for a cent. What would it cost to print a million copies? To print a sheet of newspaper, in a large edition, costs a small fraction of a cent. The entire material of the *Britannica* in reduced microfilm form would go on a sheet eight and one-half by eleven inches. Once it is available, with the photographic reproduction methods of the future, duplicates in large quantities could probably be turned out for a cent apiece beyond the cost of materials. The preparation of the original copy? That introduces the next aspect of the subject.

To make the record, we now push a pencil or tap a typewriter. Then comes the process of digestion and correction, followed by an intricate process of typesetting, printing, and distribution. To consider the first stage of the procedure, will the author of the future cease writing by hand or typewriter and talk directly to the record? He does so indirectly, by talking to a stenographer or a wax cylinder; but the elements are all present if he wishes to have his talk directly produce a typed record. All he needs to do is to take advantage of existing mechanisms and to alter his language.

At a recent World Fair a machine called a Voder was shown. A girl stroked its keys and it emitted recognizable speech. No human vocal cords entered into the procedure at any point; the keys simply combined some electrically produced vibrations and passed these on to a loudspeaker. In the Bell Laboratories there is the converse of this machine, called a Vocoder. The loudspeaker is replaced by a microphone, which picks up sound. Speak to it, and the corresponding keys move. This may be one element of the postulated system.

The other element is found in the stenotype, that somewhat disconcerting device encountered usually at public meetings. A girl strokes its keys languidly and looks about the room and sometimes at the speaker with a disquieting gaze. From it emerges a typed strip which records in a phonetically simplified language a record of what the speaker is supposed to have said. Later this strip is retyped into ordinary language, for in its nascent form it is intelligible only to the initiated. Combine these two elements, let the Vocoder run the stenotype, and the result is a machine which types when talked to.

Our present languages are not especially adapted to this sort of mechanization, it is true. It is strange that the inventors of universal languages have not seized upon the idea of producing one which better fitted the technique for transmitting and recording speech. Mechanization may yet force the issue, especially in the scientific field; whereupon scientific jargon would become still less intelligible to the layman.

One can now picture a future investigator in his laboratory. His hands are free, and he is not anchored. As he moves about and observes, he photographs and comments. Time is automatically recorded to tie the two records together. If he goes into the field, he may be connected by radio to his recorder. As he ponders over his notes in the evening, he again talks his comments into the record. His typed record, as well as his photographs, may both be in miniature, so that he projects them for examination.

Much needs to occur, however, between the collection of data and observations, the extraction of parallel material from the existing record, and the final insertion of new material into the general body of the common record. For mature thought there is no mechanical substitute. But creative thought and essentially repetitive thought are very different things. For the latter there are, and may be, powerful mechanical aids.

Adding a column of figures is a repetitive thought process, and it was long ago properly relegated to the machine. True, the machine is sometimes controlled by a keyboard, and thought of a sort enters in reading the figures and poking the corresponding keys, but even this is avoidable. Machines have been made which will read typed figures by photocells and then depress the corresponding keys; these are combinations of photocells for scanning the type, electric circuits for sorting the consequent variations, and relay circuits for interpreting the result into the action of solenoids to pull the keys down.

All this complication is needed because of the clumsy way in which we have learned to write figures. If we recorded them positionally, simply by the configuration of a set of dots on a card, the automatic reading mechanism would become comparatively simple. In fact, if the dots are holes, we have the punched-card machine long ago produced by Hollorith for the purposes of the census, and now used throughout business. Some types of complex businesses could hardly operate without these machines.

Adding is only one operation. To perform arithmetical computation involves also subtraction, multiplication, and division, and in addition some method for temporary storage of results, removal from storage for further manipulation, and recording of final results by printing. Machines for these purposes are now of two types: keyboard machines for accounting and the like, manually controlled for the insertion of data, and usually automatically controlled as far as the sequence of operations is concerned; and punched-card machines in which separate operations are usually delegated to a series of machines, and the cards then transferred bodily from one to another. Both forms are very useful; but as far as complex computations are concerned, both are still in embryo.

Rapid electrical counting appeared soon after the physicists found it desirable to count cosmic rays. For their own purposes the physicists promptly constructed thermionic-tube equipment capable of counting electrical impulses at the rate of 100,000 a second. The advanced arithmetical machines of the future will be electrical in nature, and they will perform at 100 times present speeds, or more.

Moreover, they will be far more versatile than present commercial machines, so that they may readily be adapted for a wide variety of operations. They will be controlled by a control card or film, they will select their own data and manipulate it in accordance with the instructions thus inserted, they will perform complex arithmetical computations at exceedingly high speed, and they will record results in such form as to be readily available for distribution or for later further manipulation. Such machines will have enormous appetites. One of them will take instructions and data from a whole roomful of people armed with simple keyboard punches, and will deliver sheets of computed results every few minutes. There will always be plenty of things to compute in the detailed affairs of millions of people doing complicated things.

The repetitive processes of thought are not confined, however, to matters of arithmetic and statistics. In fact, every time one combines and records facts in accordance with established logical processes, the creative aspect of thinking is concerned only with the selection of the data and the process to be employed, and the manipulation thereafter is repetitive in nature and hence a fit matter to be relegated to the machines. Not so much has been done along these lines, beyond the bounds of arithmetic, as might be done, primarily because of the economics of the situation. The needs of business, and the extensive market obviously waiting, assured the advent of mass-produced arithmetical machines just as soon as production methods were sufficiently advanced.

With machines for advanced analysis, no such situation existed; for there was and is no extensive market; the users of advanced methods of manipulating data are a very small part of the population. There are, however, machines for solving differential equations—and functional and integral equations, for that matter. There are many special machines, such as the harmonic synthesizer which predicts the tides. There will be many more, appearing certainly first in the hands of the scientist and in small numbers.

If scientific reasoning were limited to the logical processes of arithmetic, we should not get far in our understanding of the physical world. One might as well attempt to grasp the game of poker entirely by the use of the mathematics of probability. The abacus, with its beads strung on parallel wires, led the Arabs to positional numeration and the concept of zero many centuries before the rest of the world; and it was a useful tool—so useful that it still exists.

It is a far cry from the abacus to the modern keyboard accounting machine. It will be an equal step to the arithmetical machine of the future. But even this new machine will not take the scientist where he needs to go. Relief must be secured from laborious detailed manipulation of higher mathematics as well, if the users of it are to free their brains for something more than repetitive detailed transformations in accordance with established rules. A mathematician is not a man who can readily manipulate figures; often he cannot. He is not even a man who can readily perform the transformations of equations by the use of calculus. He is primarily an individual who is skilled in the use of symbolic logic on a high plane, and especially he is a man of intuitive judgment in the choice of the manipulative processes he employs.

All else he should be able to turn over to his mechanic, just as confidently as he turns over the propelling of his car to the intricate mechanism under the hood. Only then will mathematics be practically effective in bringing the growing knowledge of atomistics to the useful solution of the advanced problems of chemistry, metallurgy, and biology. For this reason there will come more machines to handle advanced mathematics for the scientist. Some of them will be sufficiently bizarre to suit the most fastidious connoisseur of the present artifacts of civilization.

The scientist, however, is not the only person who manipulates data and examines the world about him by the use of logical processes, although he sometimes preserves this appearance by adopting into the fold anyone who becomes logical, much in the manner in which a British labor leader is elevated to knighthood. Whenever logical processes of thought are employed—that is, whenever thought for a time runs along an accepted groove—there is an opportunity for the machine. Formal logic used to be a keen instrument in the hands of the teacher in his trying of students' souls. It is readily possible to construct a machine which will manipulate premises in accordance with formal logic, simply by the clever use of relay circuits. Put a set of premises into such a device and turn the crank, and it will readily pass out conclusion after conclusion, all in accordance with logical law, and with no more slips than would be expected by a keyboard adding machine.

Logic can become enormously difficult, and it would undoubtedly be well to produce more assurance in its use. The machines for higher analysis have usually been equation solvers. Ideas are beginning to appear for equation transformers, which will rearrange the relationship expressed by an equation in accordance with strict and rather advanced logic. Progress is inhibited by the exceedingly crude way in which mathematicians express their relationships. They employ a symbolism which grew like Topsy and has little consistency; a strange fact in that most logical field.

A new symbolism, probably positional, must apparently precede the reduction of mathematical transformations to machine processes. Then, on beyond the strict logic of the mathematician, lies the application of logic in everyday affairs. We may some day click off arguments on a machine with the same assurance that we now enter sales on a cash register. But the machine of logic will not look like a cash register, even of the streamlined model.

So much for the manipulation of ideas and their insertion into the record. Thus far we seem to be worse off than before—for we can enormously extend the record; yet even in its present bulk we can hardly consult it. This is a much larger matter than merely the extraction of data for the purposes of scientific research; it involves the entire process by which man profits by his inheritance of acquired knowledge. The prime action of use is selection, and here we are halting indeed. There may be millions of fine thoughts, and the account of the experience on which they are based, all encased within stone walls of acceptable architectural form; but if the scholar can get at only one a week by diligent search, his syntheses are not likely to keep up with the current scene.

Selection, in this broad sense, is a stone adze in the hands of a cabinetmaker. Yet, in a narrow sense and in other areas, something has already been done mechanically on selection. The personnel officer of a factory drops a stack of a few thousand employee cards into a selecting machine, sets a code in accordance with an established convention, and produces in a short time a list of all employees who live in Trenton and know Spanish. Even such devices are much too slow when it comes, for example, to matching a set of fingerprints with one of five million on file. Selection devices of this sort will soon be speeded up from their present rate of reviewing data at a few hundred a minute. By the use of photocells and microfilm they will survey items at the rate of a thousand a second, and will print out duplicates of those selected.

This process, however, is simple selection: it proceeds by examining in turn every one of a large set of items, and by picking out those which have certain specified characteristics. There is another form of selection best illustrated by the automatic telephone exchange. You dial a number and the machine selects and connects just one of a million possible stations. It does not run over them all. It pays attention only to a class given by a first digit, then only to a subclass of this given by the second digit, and so on; and thus proceeds rapidly and almost unerringly to the selected station. It requires a few seconds to make the selection, although the process could be speeded up if increased speed were economically warranted. If necessary, it could be made extremely fast by substituting thermionic-tube switching for mechanical switching, so that the full selection could be made in one onehundredth of a second. No one would wish to spend the money necessary to make this change in the telephone system, but the general idea is applicable elsewhere.

Take the prosaic problem of the great department store. Every time a charge sale is made, there are a number of things to be done. The inventory needs to be revised, the salesman needs to be given credit for the sale, the general accounts need an entry, and, most important, the customer needs to be charged. A central records device has been developed in which much of this work is done conveniently. The salesman places on a stand the customer's identification card, his own card, and the card taken from the article sold—all punched cards. When he pulls a lever, contacts are made through the holes, machinery at a central point makes the necessary computations and entries, and the proper receipt is printed for the salesman to pass to the customer.

But there may be 10,000 charge customers doing business with the store, and before the full operation can be completed someone has to select the right card and insert it at the central office. Now rapid selection can slide just the proper card into position in an instant or two, and return it afterward. Another difficulty occurs, however. Someone must read a total on the card, so that the machine can add its computed item to it. Conceivably the cards might be of the dry photography type I have described. Existing totals could then be read by photocell, and the new total entered by an electron beam.

The cards may be in miniature, so that they occupy little space. They must move quickly. They need not be transferred far, but merely into position so that the photocell and recorder can operate on them. Positional dots can enter the data. At the end of the month a machine can readily be made to read these and to print an ordinary bill. With tube selection, in which no mechanical parts are involved in the switches, little time need be occupied in bringing the correct card into use—a second should suffice for the entire operation. The whole record on the card may be made by magnetic dots on a steel sheet if desired, instead of dots to be observed optically, following the scheme by which Poulsen long ago put speech on a magnetic wire. This method has the advantage of simplicity and ease of erasure. By using photography, however, one can arrange to project the record in enlarged form, and at a distance by using the process common in television equipment.

One can consider rapid selection of this form and distance projection for other purposes. To be able to key one sheet of a million before an operator in a second or two, with the possibility of then adding notes thereto, is suggestive in many ways. It might even be of use in libraries, but that is another story. At any rate, there are now some interesting combinations possible. One might, for example, speak to a microphone, in the manner described in connection with the speech-controlled typewriter, and thus make his selections. It would certainly beat the usual file clerk.

The real heart of the matter of selection, however, goes deeper than a lag in the adoption of mechanisms by libraries, or a lack of development of devices for their use. Our ineptitude in getting at the record is largely caused by the artificiality of systems of indexing. When data of any sort are placed in storage, they are filed alphabetically or numerically, and information is found (when it is) by tracing it down from subclass to subclass. It can be in only one place, unless duplicates are used; one has to have rules as to which path will locate it, and the rules are cumbersome. Having found one item, moreover, one has to emerge from the system and re-enter 1 s on a new path.

The human mind does not work that way. It operates by association. With one item in its grasp, it snaps instantly to the next that is suggested by the association of thoughts, in accordance with some intricate web of trails carried by the cells of the brain. It has other characteristics, of course; trails that are not frequently followed are prone to fade, items are not fully permanent, memory is transitory. Yet the speed of action, the intricacy of trails, the detail of mental pictures, is awe-inspiring beyond all else in nature.

Man cannot hope fully to duplicate this mental process artificially, but he certainly ought to be able to learn from it. In minor ways he may even improve, for his records have relative permanency. The first idea, however, to be drawn from the analogy concerns selection. Selection by association, rather than by indexing, may yet be mechanized. One cannot hope thus to equal the speed and flexibility with which the mind follows an associative trail, but it should be possible to beat the mind decisively in regard to the permanence and clarity of the items resurrected from storage.

Consider a future device for individual use, which is a sort of mechanized private file and library. It needs a name, and, to coin one at random, "memex" will do. A memex is a device in which an individual stores his books, records, and communications, and which is mechanized so that it may be consulted with exceeding speed and flexibility. It is an enlarged intimate supplement to his memory.

It consists of a desk, and while it can presumably be operated from a distance, it is primarily the piece of furniture at which he works. On the top are slanting translucent screens, on which material can be projected for convenient reading. There is a keyboard, and sets of buttons and levers. Otherwise it looks like an ordinary desk.

In one end is the stored material. The matter of bulk is well taken care of by improved microfilm. Only a small part of the interior of the memex is devoted to storage, the rest to mechanism. Yet if the user inserted 5000 pages of material a day it would take him hundreds of years to fill the repository, so he can be profligate and enter material freely.

Most of the memex contents are purchased on microfilm ready for insertion. Books of all sorts, pictures, current periodicals, newspapers, are thus obtained and dropped into place. Business correspondence takes the same path. And there is provision for direct entry. On the top of the memex is a transparent platen. On this are placed longhand notes, photographs, memoranda, all sorts of things. When one is in place, the depression of a lever causes it to be photographed onto the next blank space in a section of the memex film, dry photography being employed.

There is, of course, provision for consultation of the record by the usual scheme of indexing. If the user wishes to consult a certain book, he taps its code on the keyboard, and the title page of the book promptly appears before him, projected onto one of his viewing positions. Frequently used codes are mnemonic, so that he seldom consults his code book; but when he does, a single tap of a key projects it for his use. Moreover, he has supplemental levers. On deflecting one of these levers to the right he runs through the book before him, each paper in turn being projected at a speed which just allows a recognizing glance at each. If he deflects it further to the right, he steps through the book 10 pages at a time; still further at 100 pages at a time. Deflection to the left gives him the same control backwards.

A special button transfers him immediately to the first page of the index. Any given book of his library can thus be called up and consulted with far greater facility than if it were taken from a shelf. As he has several projection positions, he can leave one item in position while he calls up another. He can add marginal notes and comments, taking advantage of one possible type of dry photography, and it could even be arranged so that he can do this by a stylus scheme, such as is now employed in the telautograph seen in railroad waiting rooms, just as though he had the physical page before him.

All this is conventional, except for the projection forward of present-day mechanisms and gadgetry. It affords an immediate step, however, to associative indexing, the basic idea of which is a provision whereby any item may be caused at will to select immediately and automatically another. This is the essential feature of the memex. The process of tying two items together is the important thing.

When the user is building a trail, he names it, inserts the name in his code book, and taps it out on his keyboard. Before him are the two items to be joined, projected onto adjacent viewing positions. At the bottom of each there are a number of blank code spaces, and a pointer is set to indicate one of these on each item. The user taps a single key, and the items are permanently joined. In each code space appears the code word. Out of view, but also in the code space, is inserted a set of dots for photocell viewing; and on each item these dots by their positions designate the index number of the other item.

Thereafter, at any time, when one of these items is in view, the other can be instantly recalled merely by tapping a button below the corresponding code space. Moreover, when numerous items have been thus joined together to form a trail, they can be reviewed in turn, rapidly or slowly, by deflecting a lever like that used for turning the pages of a book. It is exactly as though the physical items had been gathered together from widely separated sources and bound together to form a new book. It is more than this, for any item can be joined into numerous trails.

The owner of the memex, let us say, is interested in the origin and properties of the bow and arrow. Specifically he is studying why the short Turkish bow was apparently superior to the English long bow in the skirmishes of the Crusades. He has dozens of possibly pertinent books and articles in his memex. First he runs through an encyclopedia, finds an interesting but sketchy article, leaves it projected. Next, in a history, he finds another pertinent item, and ties the two together. Thus he goes, building a trail of many items. Occasionally he inserts a comment of his own, either linking it into the main trail or joining it by a side trail to a particular item. When it becomes evident that the elastic properties of available materials had a great deal to do with the bow, he branches off on a side trail which takes him through textbooks on elasticity and tables of physical constants. He inserts a page of longhand analysis of his own. Thus he builds a trail of his interest through the maze of materials available to him.

And his trails do not fade. Several years later, his talk with a friend turns to the queer ways in which a people resist innovations, even of vital interest. He has an example, in the fact that the outranged Europeans still failed to adopt the Turkish bow. In fact, he has a trail on it. A touch brings up the code book. Tapping a few keys projects the head of the trail. A lever runs through it at will, stopping at interesting items, going off on side excursions. It is an interesting trail, pertinent to the discussion. So he sets a reproducer in action, photographs the whole trail out, and passes it to his friend for insertion in his own memex, there to be linked into the more general trail.

Wholly new forms of encyclopedias will appear, ready-made with a mesh of associative trails running through them, ready to be dropped into the memex and there amplified. The lawyer has at his touch the associated opinions and decisions of his whole experience and of the experience of friends and authorities. The patent attorney has on call the millions of issued patents, with familiar trails to every point of his client's interest. The physician, puzzled by a patient's reactions, strikes the trail established in studying an earlier similar case, and runs rapidly through analogous case histories, with side references to the classics for the pertinent anatomy and histology. The chemist, struggling with the synthesis of an organic compound, has all the chemical literature before him in his laboratory, with trails following the analogies of compounds, the side trails to their physical and chemical behavior.

The historian, with a vast chronological account of a people, parallels it with a skip trail which stops only on the salient items, and can follow at any time contemporary trails which lead him all over civilization at a particular epoch. There is a new profession of trail blazers, those who find delight in the task of establishing useful trails through the enormous mass of the common record. The inheritance from the master becomes not only his additions to the world's record, but for his disciples the entire scaffolding by which they were erected.

Thus science may implement the ways in which man produces, stores, an consults the record of the race. It might be striking to outline the instrumentalities of the future more spectacularly, rather than to stick closely to methods and elements now known and undergoing rapid development, a has been done here. Technical difficulties of all sorts have been ignored, certainly, but also ignored are means as yet unknown which may come any day to accelerate technical progress as violently as did the advent of the thermionic tube. In order that the picture may not be too commonplace, by reason of sticking to present-day patterns, it may be well to mention one such possibility, not to prophesy but merely to suggest, for prophecy based on extension of the known has substance, while prophecy founded on the unknown is only a doubly involved guess.

All our steps in creating or absorbing material of the record proceed through one of the senses—the tactile when we touch keys, the oral when we speak or listen, the visual when we read. Is it not possible that some day the path may be established more directly?

We know that when the eye sees, all the consequent information is transmitted to the brain by means of electrical vibrations in the channel of the optic nerve. This is an exact analogy with the electrical vibrations which occur in the cable of a television set; they convey the picture from the photocells which see it to the radio transmitter from which it is broadcast. We know further that if we can approach that cable with the proper instruments, we do not need to touch it; we can pick up those vibrations by electrical induction and thus discover and reproduce the scene which is being transmitted, just as a telephone wire may be tapped for its message.

The impulses which flow in the arm nerves of a typist convey to her fingers that translated information which reaches her eye or ear, in order that the fingers may be caused to strike the proper keys. Might not these currents be intercepted, either in the original form in which information is conveyed to the brain, or in the marvelously metamorphosed form in which they then proceed to the hand?

By bone conduction we already introduce sounds into the nerve channels of the deaf in order that they may hear. Is it not possible that we may learn to introduce them without the present cumbersomeness of first transforming electrical vibrations to mechanical ones, which the human mechanism promptly transforms back to the electrical form? With a couple of electrodes on the skull the encephalograph now produces pen-and-ink traces which bear some relation to the electrical phenomena going on in the brain itself. True, the record is unintelligible, except as it points out certain gross misfunctioning of the cerebral mechanism; but who would now place bounds on where such a thing may lead?

In the outside world, all forms of intelligence, whether of sound or sight, have been reduced to the form of varying currents in an electric circuit in order that they may be transmitted. Inside the human frame exactly the same sort of process occurs. Must we always transform to mechanical movements in order to proceed from one electrical phenomenon to another? It is a suggestive thought, but it hardly warrants prediction without losing touch with reality and immediateness.

Presumably man's spirit should be elevated if he can better review his shady past and analyze more completely and objectively his present problems. He mechanize his records more fully if he is to push his experiment to its logical conclusion and not merely become bogged down party way there by overtaxing his limited memory. His excursions may be more enjoyable if he can reacquire the privilege of forgetting the manifold things he does not need to have immediately at hand, with some assurance that he can find them again if they prove important.

The applications of science have built man a well-supplied house, and are teaching him to live healthily therein. They have enabled him to throw masses of people against one another with cruel weapons. They may yet allow him truly to encompass the great record and to grow in the wisdom of race experience. He may perish in conflict before he learns to wield that record for his true good. Yet, in the application of science to the needs and desires of man, it would seem to be a singularly unfortunate stage at which to terminate the process, or to lose hope as to the outcome.

panel
Designing Software with Thought to Teaching Styles and Learning Styles

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Key words: design, multimedia, software

Abstract
The best of today's software and multimedia tools offer great opportunities for new and richer forms of learning and creative expression. They also have to be designed to support and encourage teachers and to appeal to a wide range of learning styles. When they work well, young people can regularly explore new ideas, relationships, and patterns not previously possible. They can think visually and metaphorically and use images and sounds, graphs and charts, and all kinds of representations to support and enhance their ideas. They can solve richly complex, multi-variable problems from multiple perspectives in a multitude of reasonable ways.

This panel will feature presentations by developers of some of the best current software products that illustrate through their quality a keen appreciation for teaching and learning styles. A moderated discussion, with audience participation, will follow.

panel
Introducing Parallel Processing into the Undergraduate and High School Curriculum

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Keywords: parallel processing, undergraduate, high school, languages, labs

Abstract

Participants in this session will discuss the problems and issues that must be addressed by those planning to incorporate parallel processing into the curriculum. We intend discussion to include, but not be limited to, issues relevant to programs at institutions with limited resources for parallel equipment. Topics for discussion include:

- Faculty development.
- Hardware and software resources.
- Curriculum development.
- Instructional materials.
- Topics to include in specific courses.
- Choosing parallel languages for use in the courses.
- Laboratory exercises.

Dr. Hartley teaches the concurrent programming and operating systems courses at Drexel University. Concurrent Programming is an undergraduate class that consists of the concurrent process material from the standard operating systems course and a little bit of parallel processing. He uses the SR concurrent programming language, from the University of Arizona, running on UNIX workstations, as the programming environment. Dr. Hartley has written a book on using SR in operating systems courses, to be published by Oxford University Press in 1995.

Dr. Mims has completed NSF faculty enhancement courses and curriculum development workshops on parallel processing at Colgate and Illinois State Universities. He has made presentations on utilizing transputers and the language OCCAM to teach concurrent programming on parallel systems. Dr. Mims has developed and offered a course on parallel processing at Sangamon State.

Dr. Robert M. Panoff is Senior Research Scientist in the Education Group at the National Center for Supercomputing Applications at the University of Illinois at Urbana-Champaign. As principal investigator on several NSF grants that seek to explore the interaction of high performance computing technologies and education, he is working to develop a series of interactive simulations that combine supercomputing resources and desktop computers. Besides developing and teaching a new course in Information Technologies, Dr. Panoff continues to pursue an active research program in parallel algorithms and computational condensed matter physics while defining and implementing educational initiatives at NCSA. A 1990 winner of the Cray Gigaflop Performance Award in supercomputing, Dr. Panoff has been a consultant at several national laboratories and is a frequent presenter at NSF- sponsored workshops on visualization, supercomputing, and networking. He has served on the advisory panel for Applications of Advanced Technology program at NSF.

Kathryn Sheary is a high school computer science teacher and is completing a Masters Degree. She has taken courses in parallel programming. During the spring semester 1996 she will be working on a project to introduce high school students to parallel processing. The equipment and software she will be utilizing is P4 running on Linux installed on a PC. She will discuss her experiences related to the project.

Carol Torsone has completed NSF faculty enhancement courses and curriculum development workshops on parallel processing at Colgate and Illinois State Universities. She has made presentations on teaching parallel programming utilizing transputers and the language OCCAM, the p4 system on a network of SUN workstations, and the language Parallaxis on PC's. Professor Torsone has developed and offered a course on parallel processing at St. John Fisher College, and addresses issues of concurrency and parallelism in courses on Data Structures, Computer Architecture, Concepts of Programming Languages, and Operating Systems.

panel

Technology Planning at the District Level

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Abstract

If the current Administration's vision is realized, all schools will be wired for telecommunications technology by the year 2000. As the U.S. Government and the states develop their implementation plans, they are asking local school districts to develop their implementation plans, they are asking local school districts to develop their own plans for integrating telecommunications and other technologies into the building-and into the curriculum.

This panel, comprised of experts on technology planning and content integration from the university, non-profit, and private sectors, is designed to help district technology coordinators and curriculum supervisors define their technology needs, link their technology planning with their curriculum objectives, and successfully write an effective district technology plan. Among the topics the panelists will discuss are:

- Organizing a technology planning team
- Assessing the current state of technology in your district
- Identifying and anticipating future wants and needs
- Assessing the options for technology and content
- Integrating technology into curriculum objectives
- Integrating your plan with your state's Goals 2000 objectives
- Writing an effective technology plan

The panelists are Jeff Sun, Director of Information Technology for the Northeast and Islands Regional Laboratory, who is involved with state technology planning efforts; Dennis Bybee, Associate Executive Officer of the International Society for Technology in Education; a leader in technology planning initiatives; John Newsom, Technology Coordinator, Bellevue School District, Bellevue, Washington; and Susan Merrit, Director of Development for Scholastic Network who has worked on technology planning with the U.S. Department of Education, as well as with states and local school districts. Connie Stout, director of the Texas Education Network (TENET) and convenor of the U.S. Department of Education State Workshop on technology planning in Austin, Texas last fall, will moderate.

paper

Establishing a Computer Literacy Requirement for All Students

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Key words: computer literacy, course design, computer-literacy requirement

Abstract

While many may feel that instruction in computer literacy is no longer necessary at the university level, several factors have convinced us of the necessity of formally requiring computer literacy. at the university. Computer literacy is a dynamic term which needs to be redefined as the expectations for literacy change. This paper discusses the reasoning for, development of and content of two computer literacy courses required of all freshmen. While these course only began in Fall 1994, early statistics lead us to believe the courses are fulfilling the needs of both the students and the faculty.

Introduction

As early as 1985 Spresser(1985) stated that computer literacy courses were no longer needed. Many assume that students come to universities with adequate computer skills, and since the computer is a tool for all disciplines the only additional instruction needed could be included in courses across the curriculum. This attitude seems to have spread and computer literacy courses are often viewed as unnecessary and obsolete.

In contract to the above, we have faced events which led us to believe that computer literacy is not only necessary but should be required for all students. First, students from many disciplines were coming back after graduation asking for a course in computer literacy. The skills they had acquired while completing their degree work were not sufficient to meet the minimum requirements of the workplace. Secondly, new courses in several disciplines were being designed to include a computer literacy component. In addition to the usual concern over unnecessary duplication, investigations revealed inconsistent and erroneous information was being presented.

These observations lead to the following questions concerning our obligations to all students:

- If students are graduating from a university without computer skills, are they prepared for the world?
- Is the duplication of information in several courses efficient?
- Who is best qualified to teach computer literacy?
- Would students perform better at the university if they acquired computer skills in their freshman year?

The Design

In the spring of 1991 a task force was established to study the problem of computer literacy. There was immediate consensus on the need to eliminate duplication of information, the need for computer literacy instruction and that the computer science department should teach such a course. This agrees with Dyck, et. al.(1987) who state "there is a clear consensus that all students should be expected to use the computer effectively as a productivity tool during their university career and that they should expect to interact more and more with computers once they finish university and enter the workplace."

Since the early 80s, we have tried to define computer literacy and what is a computer literate student. Attempts at definitions include "what a person needs to know to function in the world" or "being able to use the computer as an intellectual tool in a chosen field". The term "computer literacy" is generally accepted to be a dynamic term rather than a static term. Since the definition is dynamic we should review the definition and repeatedly redefine it as the standards of literacy change. Van Dyke (1987) feels we need to keep the purposes of computer literacy central in our definition as we define the term and the content of a computer literacy course, that is to be required of all students. Some of the questions we had to address in attempting to redefine computer literacy were:

- What do students need to know to function as a university student and after they graduate?
- Does a business student need the same skills as the humanities student
- or the science student?
- Is there a corpus of information that all students should possess
- What platform should be used? (Macintosh or DOS)
- Should all students take the same course on the same platform?
- How many credits should this course be?
- Is computer literacy really a university topic?
- Is more than computer awareness required?
- When should a student take a computer literacy course?

The final design consists of two courses of one credit each to be taken in the freshman year. These are not computer science courses, but rather computer literacy courses for all students. The first course contains computer awareness and knowledge we hope all students have upon entering the university. The course credit does not count towards graduation. The content includes practical knowledge and use of computer components, operating systems, word processing and computer graphics. The second course includes practical knowledge and use of spreadsheet, database, library database searching, telecommunications and Internet. These are the skills we determined would help a student succeed at the university and after graduation. This course does count for university credit. The following guidelines were agreed upon:

- In both courses the students would have to demonstrate ability on both the Macintosh and DOS platforms.
- The final exam would be entirely on the computer.
- The software would be the integrated package supported in all university computer labs, Microsoft Works.
- Students could challenge either or both courses by taking the exam for a small fee.
- 80% and above is a passing score on each exam.
- Each exam has a time limit of 90 minutes.
- A student must pass literacy I before attempting literacy II.
- A student may attempt an exam once a quarter. If they fail an exam they must wait until the next quarter to try again.

A more detailed explanation of the concepts covered in each course is included in the appendix.

The Exams

The exam for literacy I consists of three parts:

1. a self grading *HyperCard* stack that asks questions covering computer components, hardware, software, paint and drawing programs,
2. a document on the Macintosh and a list of operations to perform on that document. These include copying, renaming, spell checking, using the thesaurus, moving a paragraph, indenting, formatting and changing fonts, and
3. a document on the DOS machine and a similar list of operations to perform on the document.

The student has 90 minutes to complete the entire exam.

The exam for literacy II consists of three parts:

1. a spreadsheet with a list of operations including formatting and formulas and functions to define and enter,
2. a database with a list of queries to perform, and
3. a randomly chosen list of six questions from which the student must choose four to answer using the word processor.

The student may choose which platform to do the spreadsheet on and then must do the database on the opposite platform. This exam also has a 90 minute time limit.

The Course

The course consists of six one hour lectures in a large lecture section and nine one hour hands-on lab classes in a small lab section. In the lecture section concepts, theory, computer appreciation and societal issues are addressed. The Lab sections cover the hands-on skills. We are currently running the courses for three weeks with the fourth week for testing. The courses were piloted in Spring 1992. They were taught as regular courses beginning Fall 1993. In Fall 1994 they became required courses for all incoming freshmen. Based on initial feedback, we feel these courses are very successful.

The material the students learn in Computer Literacy I and Computer Literacy II courses is designed to provide a skill base on which all disciplines can build. Instructors should feel confident in requiring students to use computers in completing assignments. Many text books have accompanying software to complement the text. An instructor should feel comfortable in using these materials without adding a computer literacy component to a course.

Challenging the course

Similar exams are used for those students challenging the course as for the students taking the course. The exams are taken in a controlled lab setting.

Assessment

Assessment of courses required by all university freshman is important. With the help of our assessment director we devised an assessment plan. In their first lab, each student is asked to complete a perception survey using a Likert scale. The survey asks students to self-assess their computer abilities. The same perception survey is given to the students in the last lab. We will statistically analyze the results to see of there is a difference between the students perceived ability at the beginning of the course and at the end of the course. The ending perceptions are compared with the students actual performance on the final exam to determine if their perceptions match their actual performance. A question-by-question analysis will indicate the areas that need special attention.

Conclusion

We are still in the early stages of analyzing our courses. However we feel computer literacy is off to a very good start. The following are preliminary statistics.

Computer Literacy I

	Enrolled	Passed	Failed
Fall 94	279	73%	27%
Winter 95	216	67%	33%

	Challenged	Passed	Failed
Fall 94	106	61%	39%
Winter 95	7	100%	0%

Computer Literacy II

	Enrolled	Passed	Failed
Fall 94	163	92%	8%

	Challenged	Passed	Failed
Fall 94	5	80%	20%

The response of both the students and the faculty has been very positive. Area high schools have begun discussion with us, so that they may better prepare their students for entry in our institution.

By the spring of 1996 we plan to begin assessing the retention of the computer literacy skills by assessing the skills of students in subsequent courses.

APPENDIX

Computer Literacy I
CSCD 100
Course Concepts

- Computer components and peripheral devices
- Elements of software and hardware
- Use of electronic mail
- Operating System of DOS or Windows, and Mac platform
- Formatting disks
- Creating and displaying of sub directories and folders
- Copying files
- Renaming files
- Deleting files
- Word Processing on DOS or Windows, and Mac platform
- Creating and printing documents
- Formatting text
- Selecting fonts
- Use of spell checker
- Use of thesaurus
- Graphics on Mac platform
- Elements of paint and drawing programs
- Use of paint tools
- Use of drawing tools

Computer Literacy II
CSCD 101
Course Concepts

- Spreadsheet on DOS or Windows, and Mac platform
- Creating and printing spreadsheets
- Formatting spreadsheet data
- Elements of labels
- Elements of formulas and functions
- Creating graphs
- Database on DOS or Windows, and Mac platform
- Creating databases
- Elements of fields, records, and files
- Querying databases
- Generating reports
- Query of the library database
- Exploring the University Library database
- Telecommunication

Definition of telecommunication terms
Telecommunicating with another computer
Internet

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paper

Graphical User Interface Programming in Introductory Computer Science

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Abstract

Modern computing systems exploit graphical user interfaces for interaction with users. As a result, introductory computer science courses must begin to teach the principles underlying such interfaces. This paper presents an approach to graphical user interface implementation that is simple enough for beginning students to understand, yet rich enough to demonstrate many important concepts and trade-offs in computer science.

Introduction

A major problem confronting teachers of introductory computer science courses is that, while most computational environments that students are exposed to involve graphical user interfaces (GUIs), the I/O programming paradigm that they are typically introduced to is character based. The irony is that students are using and enjoying the flexibility of GUIs but from a programming point of view they could just as well be using teletype machines. It is clearly no longer acceptable to give students programming exercises where graphical information is output as lines of ASCII characters. Further, students restricted to character-based input quickly become bound up in the intricacies of awkward command languages, when a GUI interface would be more natural. At the same time, there are valid reasons for hesitating to teach GUI programming at the introductory level. Foremost is the additional complexity involved in doing event-loop programming, typically considered too difficult for the novice programmer.

While a strong case can be made for introducing GUI programming techniques into introductory computer science courses, this is not being done. The only introductory Computer Science text (of which we are aware) that integrates bit-mapped graphics is Roberts (1995). By including a graphics.h file in the C code, the programmer has access to a set of basic functions for producing bit-mapped output, e.g., MovePen, DrawLine, DrawArc. We are not aware of any introductory text (or course) that attempts to introduce both GUI input and output.

This paper will describe a simplified GUI interface that is implemented using a library of C macros and provides a display window that outputs bit-mapped graphics and inputs mouse actions. The input mouse actions can be used in a drawing framework and for the control of some (user specified) number of input buttons. The library of macros supports the MOTIF GUI interface standard, but could easily be converted to support other GUI standards. The macro calls and conventions will be described in the context of an implementation of Conway's Game of Life (Conway, 1970), a programming exercise found in many introductory texts. The macro library has been used in teaching the second computer science course at Rensselaer. The positive reactions of students have indicated to us that introducing this library to students in the course Introduction to Computer Science (CS1) would enhance this course as well. This paper will describe how this material could be introduced in CS1.

The GUI interface for the Game of Life program will be described in the first section, in order to provide a concrete example of the various capabilities of the simplified GUI library. The next section describes the life main() function that sets up the buttons and associated callback functions. The callback functions (and macro conventions for calling them) that are at the heart of the programming interface support are presented in the next section. The last section gives an example of a simple paint program that can also be creating using the GUI macro library. In all of these sections we consider how this material should be presented to CS1 students.

The Game of Life and its GUI Interface

In general, the GUI interface (as supported by the macro library) provides two regions of interaction with the program: a vertical strip of user definable buttons on the left and a larger display/drawing region to the right. For example, when the Game of Life program is invoked a window like that shown in Figure 1 appears on the screen. In the Game of Life, the graphical display/ drawing region may initially be all black, indicating that there are no live cells. The user can then drag the mouse in this region in order to draw in the cells (in white) that are considered to be alive. The Game of Life transition can now be applied to the initial array of live cells.

Basically, the Game of Life transition embodies simple rules of population support and crowding. For example, live cells stay alive if they are "sustained" by "just the right" (2 or 3) immediate neighboring cells that are alive, but if a live cell is crowded (4 or more neighbors) or too isolated (0 or 1 neighbors) then it dies. Similarly, cells can come to life if they have just the right s[illegible]t in their neighborhoods. What is interesting about this simple "game" is that a variety of stable configurations of "cooperating" cells tend to emerge, when successive transitions are applied to initial random configurations.

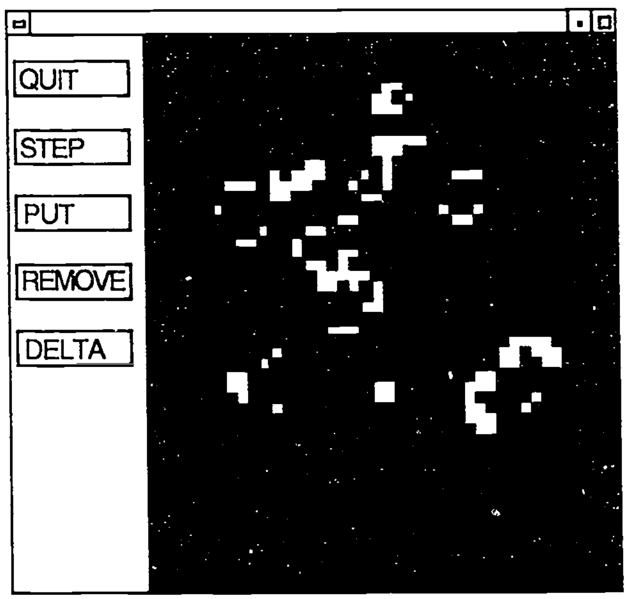

Figure 1. User initialized state of the GUI Game of Life interface

The user moves back and forth between changing states in the array using the mouse and clicking the "STEP" button to move the transition function ahead. The "PUT" and "REMOVE" buttons are used to toggle the effect of dragging the mouse across the graphics window: the "PUT" button sets a global variable that results in mouse movements bringing dead cells to life, while the "REMOVE" button sets the global variable so that live cells are removed as the mouse is dragged across the graphics window. The "DELTA" button causes program control to return to the standard input UNIX window, where the user is queried as to the number of generations to be computed whenever the "STEP" button is pressed. The default number of iterations is one. By setting the number of iterations to a value other than the default, the user creates the effect of animating the Game of Life transitions. Finally, the "QUIT" button is automatically supplied by the macro library and provides a means of exiting the program via the GUI interface (a control-C in the UNIX text window can also be used to exit the program).

When the Game of Life program is invoked the user may specify (via command line arguments) a file that initializes the array of live cells. In addition, the user can specify from standard input a sequence of coordinates of initially alive cells. The third mode of input (as described above) is via the mouse in the display/drawing region. We feel that the students benefit from exposure to all three modes of input. They need to see that a natural way to input cell states is via a mouse, but that sometimes a larger or algorithmically generated ASCII input file is more appropriate (e.g., as might be generated via a random initialization program) or that sometimes entering a few specific coordinates of alive cells is more natural (e.g., during debugging). We introduce more on UNIX filters and pipes than is typically covered in CS1 and compensate by covering named file I/O somewhat less. In addition, while pointers are not usually covered in CS1 we introduce them in the context of processing command line parameters (via argv and argc); that is, pointers are introduced solely for simple string manipulation, e.g., the students learn that argv[1] points to the string of characters comprising the first command line argument, which in turn makes a fine argument to fopen. We view it as an important general intellectual lesson that students appreciate how limiting I/O to a serial stream of characters is a strong intellectual restriction and, as such, at times is a significant limitation and at other times is a useful simplification of complexity. Thus, we are careful to ensure that students come away with some idea of key I/O trade-offs, as opposed to thinking that a GUI is always the best option or conversely that ASCII (standard or file) input is the only option. Finally, throughout the computation there is the option of communicating with the user via a stream of ASCII characters. This allowed us to choose a "minimal" set of GUI primitives to support via the macro library: a vertical array of buttons on the left and a display/drawing region to the right. With the capability to communicate with a user via buttons, a display/drawing region and standard I/O window we believe that there is sufficient coverage of the basic modalities of modern I/O interaction.

One reason that the Game of Life is often given as a programming example in many introductory texts is that it is inherently fascinating. At the same time, we have argued that a lack of true GUI programming makes interacting with one's program a frustrating experience. Beyond this issue, we often find that too many of the programming exercises in introductory texts are given in isolation and precious little is given concerning the larger scientific issues. Thus, students leave the isolated Game of Life exercise with a sense that it is "neat," but little more. In the CS1 course that we are teaching, we are approaching the teaching of this material via an integration with extensive case studies. The GUI toolkit is part of a larger project to develop an online hypermedia textbook (Skolnick & Spooner 1994) for introductory computer science courses for both majors and non-majors. This hypermedia textbook combines science and engineering case studies with workstation-based computing concepts and tools to provide students with the computing knowledge they need to successfully apply computing in their own disciplines. In the case of the Game of Life, it is a simple exercise to consider other variations on neighborhood transition functions, e.g., parity, min, average, max. This allows us to consider how these kinds of neighborhood cellular array computations are being used in areas such as image processing and as alternative scientific models of physical systems, e.g., in Toffoli and Margolus (1987) various kinds of neighborhood transitions are used to model basic thermodynamic systems. We can also approach more profound issues related to the nature of computation itself, i.e., when considering how to generalize the neighborhood transition function it is natural to consider the class of all such boolean functions, which leads to such issues as combinatorial explosion, search spaces, computational completeness and hardware boolean lookup tables.

We now consider how the GUI functionality is implemented at the programming level and will discuss the additional concepts that need to be introduced in CS1 to allow students to understand the basics of event-loop programming.

main() routine in GUI Life

Before considering the details of the code, it is useful to describe how the basic ideas of event-loop programming are presented to the students. The students are told that the event-loop program can be viewed as a mini-operating system, which handles much of the tedious details of the GUI interface. When a programmer wants to define a button, a function call must be made to the event-loop program. Certain essential information about the button must be passed to the event-loop program: the name to appear on the button and the name of the callback function to be invoked when the button is pressed. The event loop places the buttons onto the screen, detects which button is being pressed, graphically represents button presses and, most important to the programmer, transfers control to the appropriate callback function to process the actions associated with the button. Students are told that there are many different types of interface objects (widgets) that can be created, but we have provided a simple default class of such objects. They need only visualize the event-loop program as something they communicate with initially from within their main() routine and then the final action within main() is to transfer control to the event-loop, which will then be responsible for invoking the callback functions (defined by the programmer) in response to user actions.

How these issues are handled at the programming level can be seen in the main() program in Figure 2. All the Motif macro definitions and related global variables are defined in the main_gui.h include file. In the figure, macro calls are indicated by all upper case names and the absence of semi-colons at the end of the line. Since we use ANSI C, the function prototypes of the four user defined button callback functions are setup using DEF_BUTTON_FUNCS. (Some example callback function definitions will be considered below.) The purpose of the DEF_BUTTON_FUNCS macro is to hide some of the messy details of the Motif library, e.g., the expansion of the macro will result in the following prototype definition for the step function, "void step(Widget, Widget, XmPushButtonCallbackStruct *);". In general, we believe that there is benefit in covering macros more thoroughly and earlier in a CS1 course than is typically done (e.g., beyond #defines), since macros can be used to introduce basic functionality early on, providing a useful foil for the more intricate explanations of true functions and parameter passing. After processing any command line arguments–in ParseArgs–the first macro call, SETUP_MOTIF_WIDGETS, generates in the main program all the appropriate general widget definitions for the GUI interface. The four calls to the CREATE_BUTTON macro result–from the student's point of view–in the event loop having all the necessary information for managing the buttons, i.e., the names of the buttons and the associated callback functions. Next, the call to

CREATE_WINDOWS results in the GUI interface window appearing on the screen, with the four user defined buttons (and the default "quit" button) and an initially empty display/draw window to the right of the buttons. The InitWindow function is called to see if the user has specified (via command line arguments) a file that initializes the array of live cells.

```
#include "life.h"
#include "main_gui.h"

DEF_BUTTON_FUNCS(step, put,
        remove, delta)

void main(int argc, char *argv[])
{
   ParseArgs(&argc, argv);

   SETUP_MOTIF_WIDGETS
   CREATE_BUTTON("STEP",step)
   CREATE_BUTTON("PUT",put)
   CREATE_BUTTON("REMOVE",remove)
   CREATE_BUTTON("DELTA",delta)
   CREATE_WINDOWS

   InitWindow();

   TRANSFER_TO_EVENT_LOOP
}
```

Figure 2. The main() function of the Game of Life program.

The final macro call in main() is TRANSFER_TO_EVENT_LOOP, which turns over control to the event loop. This movement away from control residing in the main() program is exhilarating to many students but can be confusing to others. We find that this transition is smoother if students are introduced to programming from the very start within the context of a symbolic debugger (which we tell the students to view as the symbolic "inspector"–our attempt to counter the "pathological" perspective that debuggers are only useful when things don't work). Thus, since students are familiar with the notions of successive refinement and "plug" functions, they can verify in the "inspector" that when a button is pressed the associated callback function is indeed invoked.

We now briefly consider button callback functions followed by the callback function associated with mouse events in the display/draw portion of the GUI window.

Callback Functions

The simplest class of callback functions are those associated with buttons, because there is no information that needs to be passed by the event loop to the function. The callback function is simply called when a button is pushed. One (of the four) Game of Life callback functions is given in Figure 3. Note again the use of macro substitutions to hide some of the messy and irrelevant Motif parameters, e.g., BUTTON_ARGS.

The step function (in Figure 3) does the main work of the computation, determining the next generation of alive and dead cells (ComputeNextGeneration) and then updating the current generation and displaying any altered cells (CopyNextToCurrent). The parameters passed to these two functions–current_gen and next_gen–are arrays containing the information on alive and dead cells. Information on the programming interface for displaying the cells is given below in our discussion of the callback routine for the display/draw component of the GUI interface.

```
   void step(BUTTON_ARGS)
/* computes and displays the next
   sequence of generations */
{
   extern int NumIterations;
   int i;

   for (i=0; i<NumIterations; i++) {
```

```
        ComputeNextGeneration(current_gen,
                next_gen);
        CopyNextToCurrent(next_gen,
                current_gen);
    }
}
```

Figure 3. Two of the four button callback functions.

We now turn to the display callback function associated with actions in the graphical display/draw window. The display/draw window is where the graphical information is displayed as well as where the mouse events (used to set cells to be alive or dead) are detected. The display callback function, which handles responses to mouse events, is shown in Figure 4. Students are expected to have a display_callback function defined somewhere in their source file (or files). Thus, it is a special reserved function name that currently is "hardwired" in the gui.h macro library. It is invoked whenever a mouse down, mouse drag or mouse up event is sensed by the event loop. Note also that the gui_externs.h file contains all external references to the GUI variables that are defined in main() and any GUI macros that might be invoked by any function.

We have provided several macro definitions that allow the programmer to access mouse event information. In the display_callback function for GUI life, MOUSE_X and MOUSE_Y result respectively in the current x and y coordinates of the mouse. One of the arguments passed to display_callback (and defined in DISPLAY_CALLBACK_ARGS) is "XButtonEvent *_event"; _event is a pointer to the relevant mouse information. Thus, MOUSE_X is defined as _event->x. These kinds of macro definitions allow postponement of detailed explanations of pointers to structures until students are ready; when they are ready for this material they enjoy unfolding the meaning of the code generated by the macros.

```
#include "life.h"
#include "life_externs"
#include "gui_externs.h"

void
display_callback(DISPLAY_CALLBACK_ARGS)
{
int x,y; /* up-left corner of cell */
int row, col;

x = MOUSE_X-(MOUSE_X % Pixels_per_cell);
y = MOUSE_Y-(MOUSE_Y % Pixels_per_cell);
row = y / Pixels_per_cell;
col = x / Pixels/per_cell;
if (DrawingCell ) {
   XFillRectangle(DISPLAY_WIN, x, y,
      Pixels_per_cell, Pixels_per_cell);
   XFillRectangle(DISPLAY_BUF, x, y,
      Pixels_per_cell, Pixels_per_cell);
   current_gen[row][col] = ALIVE;
}
else { /* erasing cells */
   SET_FOREGROUND_BLACK
   XFillRectangle(DISPLAY_WIN, x, y,
      Pixels_per_cell, Pixels_per_cell);
   XFillRectangle(DISPLAY_BUF, x, y,
      Pixels_per_cell, Pixels_per_cell);
   SET_FOREGROUND_WHITE
   current_gen[row][col] = DEAD;
```

```
}
DISPLAY_WINDOW
} /* end of display_callback */
```

Figure 4. The display_callback function for the game of life GUI.

The first two executable lines of code in display_callback (Figure 4) compute the x and y coordinates of the upper-rightmost pixel of the rectangular region that represents the cell. The next two lines in the code compute the row and column of the cell where the mouse was clicked. If the user has set the mode to DrawingCells, the mouse click will result in a white rectangle being drawn on the screen and current_gen array that records alive and dead cells being updated. There are two calls to XFillRectangle, which is the XWindow function that draws the live cell as a white rectangle. The two calls to XFillRectangle are required because it is necessary to support two display buffers: DISPLAY_WIN refers to the display buffer containing the actual information being displayed, while DISPLAY_BUF refers to a "backup" buffer typically containing the same information. The reason for the two buffers is to deal with the refresh problem in windowing systems: whenever the current information in DISPLAY_WIN is written over by another window, there must be a "backup" buffer which is used to restore the window information when the covered window is made active again. Introducing this complexity in supporting GUI programming is necessary but students can be initially told to always have two invocations of any graphics routine, one to each buffer. (We will consider below how this additional complexity has some advantages in other settings.) There seems to be little problem in the students appreciating that if they don't write to DISPLAY_BUF (in addition to DISPLAY_WIN) then they will loose the information in the GUI display/draw window when it gets covered by some other window. Also, all of the internal details of handling this refresh issue are implemented within the macro library, so the students need not be concerned with any further implementation details. Another point concerning the design of the macro library is that there is an advantage in not hiding the fact that XFillRectangle is being called, e.g., by hiding it in a macro call or even condensing the two calls to XFillRectangle into one macro. We want to avoid the danger of abusing macros by creating an idiosyncratic version of C. In addition, there is a significant advantage in introducing students to the level of XWindow calls because they can then go to the manuals and discover many other useful graphics routines, e.g., XDrawLines, XDrawPoints, etc. It seems to us that we need to prepare CS1 students with knowledge that allows them to enter into deeper levels of system documentation. CS1 texts and courses have tended to ignore this issue.

One other application: a paint program

With the basic mechanisms of the macro library behind us, we would like to consider one final programming project that now falls within the range of a CS1 course. Figure 5 shows the screen produced by a simple paint program. The structure of the program follows that of the Game of Life program, with calls to XDrawLine and XDrawRectangle being made within display_callback. The "RECT" and "FREE" buttons set a global variable that determines the effect of mouse actions in the display/draw window.

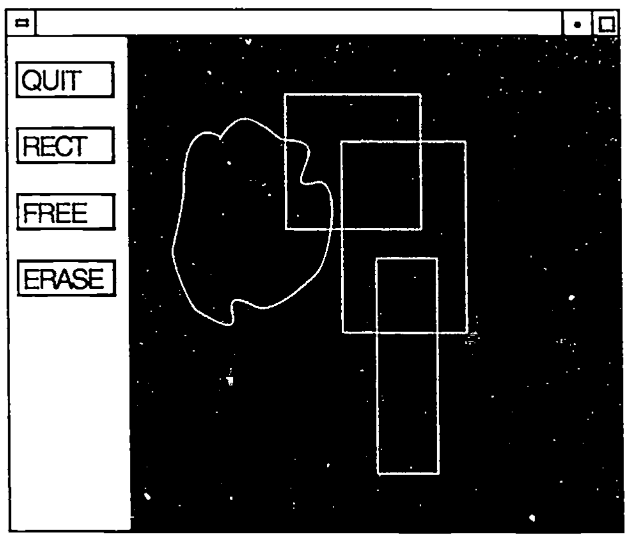

Figure 5. A sample screen of the paint program written using the macro library.

It is also worth noting that the double buffering scheme described above–involving DISPLAY_WIN and DISPLAY_BUF–has the advantage of allowing the animation of rectangle drawing motions, as well as more general animation effects. All students are expected to be able to program a simple non-animated draw function where, (1) an initial mouse down event (tested for via a MOUSE_DOWN macro predicate and associated with the left mouse button) positions the upper left corner of the rectangle, (2) mouse movement events (tested for via a MOUSE_MOVE macro predicate) result in no display changes, and (3) a final MOUSE_UP event (also tested for via a macro predicate) positions the lower right corner of the rectangle so that the rectangle can then be drawn with calls to XDrawRectangle. As a more difficult programming problem students may consider how to animate the draw, as is done in most drawing programs. This is accomplished by maintaining the state of the window prior to the mouse down event in DISPLAY_BUF and whenever a mouse movement is detected, DISPLAY_BUF is copied into DISPLAY_WIN and the rectangle defined by the current mouse position is drawn into DISPLAY_WIN. The effect is that as the mouse is dragged across the screen, the rectangle associated with the previous mouse position is erased and a new one is drawn. If the speed of buffer transfer is well matched to the speed at which the mouse is drawn across the screen, the effect is a smooth animation of the drawing. Students are truly amazed that such animation effects are within their programming skills and gain an appreciation of some basic tradeoffs between CPU power and the complexity of events that can be handled in a GUI interface.

Conclusion

In summary, the use of a simple GUI toolkit for teaching programming in an introductory computer science course offers several important advantages. It provides an exciting opportunity for students to exploit the newest functionality of modern computing technology, thereby increasing their interest and motivation to learn and experiment. It facilitates presentation of design and interface issues. And it allows students to begin to appreciate and understand the GUI components of the systems and application programs that they commonly use in other situations.

The GUI toolkit is available via anonymous ftp at "ftp.cs.rpi.edu". Use "anonymous" as the user name and your email address as the password. Once connected, change to the directory "pub/graphicslib". The "README" file in that directory contains the details of what is available and how to install and use it. In particular, the directory contains the macro library and sample code for the Game of Life and Paint programs.

Acknowledgments

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paper

Using E-mail in a Math/Computer Core Course

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Abstract

Computer literacy courses often aim to teach general principles of computer science. One problem with such courses is that students fail to see the relevance of the material and feel that they have not learned anything useful in the real world. In this paper we describe our experience with using e-mail in an introductory course for non-majors. The course itself is prin-

ciples based, but we found that the e-mail component afforded the students the chance to see the relevance of computer science, without detracting from the overall thrust of the class. The e-mail component provided an added dimension to the class, which the students found interesting and exciting.

Introduction

Most Computer Science departments offer an introductory course geared toward students who are not planning to major in computer science. This course is generally known as a "computer literacy" course, although there is no consensus on what "computer literacy" encompasses.

In many departments, this course is a simplified version of the standard CS1 course, the introductory course for computer science majors. In such a course, the focus is on programming techniques and algorithm development (for example, [Decker, 1992]). While such a course is intellectually challenging, nonmajors often feel disappointed that the course does not teach them anything that would be "useful" in their daily lives.

In other departments, the computer literacy course is designed to introduce students to microcomputer applications, such as word processors, electronic spreadsheets and database packages (for example, [Gau and Madison, 1993]). Although students perceive such instruction as useful, in practice the course often provides little more than vocational training. Students often are not prepared to use application packages other than the ones they used in class.

In recent years, there has been a reevaluation of the computer literacy class. The current trend is to emphasize principles and concepts rather than to concentrate on specific languages or applications. A plethora of principles based courses have been suggested, all of which are designed to be appropriate for students of diverse backgrounds ([Van Dyke, 1987], [Myers, 1989], [Bierman, 1990], [Allen et. al., 1990], [Goldweber, 1994]). Reading through the literature, one gets the impression that despite all the suggestions, the course is still trying to find itself. All of the proposed courses endeavor to present concepts and long-lasting skills, while at the same time stimulate and interest students, especially those who are not planning to major in Computer Science.

We have found that introducing students in a computer literacy class to electronic mail and remote file transfer can be a useful expedient in achieving these goals. In this paper we describe our experiences with adding an e-mail component to our computer literacy course. The course itself is a principles based course, in which the topics include propositional logic, probability, information representation, programming using a subset of Pascal, and software engineering principles.

The Brooklyn College Computer/Math Core Course

Brooklyn College is one of the nine senior colleges of the City University of New York. Beginning in 1981, all Brooklyn College undergraduate students have been required to complete a ten-course, 34 credit, core curriculum [Cheney, 1989]. Core courses are designed for nonspecialists and are suitable for nonmajors, but each is meant to introduce material of fundamental and lasting significance. Core courses aim at broadening awareness and widening horizons rather than at specific career preparation.

Core Studies 5 is a 3-hour, 3-credit course entitled *Introduction to Mathematical Reasoning and Computer Programming*. It was designed jointly by the Department of Mathematics and the Department of Computer and Information Science and is aimed at non-mathematics, non-computer science and, in general, non-science majors. The course introduces such students to mathematical concepts and reasoning and it provides them with hands-on programming experience to aid in understanding the nature and power of the modern computer. This course is required of all undergraduate students, with the exception of those who have taken more advanced courses in both mathematics and computer science. The bulletin description of the course is included in the Appendix. More detailed presentations are given in [Arnow, 1991, 1994].

Brooklyn College's core curriculum has attracted attention nationwide. With support from the Andrew W. Mellon Foundation, over sixty colleges have sent observers to Brooklyn College to study the core curriculum firsthand. The core is seen as being in the forefront of a general trend of "going back to the basics". Core Studies 5 has especially aroused interest in the academic community in its attempt to teach mathematics to non-science students and to ensure that all students are computer literate.

Advantages of Using E-mail

- The most compelling reason for introducing e-mail in a computer literacy class is that the students find it interesting and exciting. We have found that it arouses the interest of students who would otherwise tune out the class.
- Facility with electronic mail will be beneficial to all students, regardless of whether or not they pursue a major in Computer Science.
- Using an electronic mail package provides a natural way to introduce students to the concepts of text editing and file manipulation in a more enjoyable context than programming or word processing. It also serves to demonstrate that not all files are programs, and to illustrate the difference between text files and program files.
- It is especially beneficial for non-mathematics, non-computer science students to become acquainted with modern technology in a friendly setting, in order to reduce their mathematics and computer science anxiety.
- Having students communicate with the instructor and with each other via e-mail fosters a sense of community that extends beyond the classroom. Enhanced communication serves to encourage peer contact and group collaboration.
- Electronic mail provides an effective means of communication for students who are insecure and are reluctant to talk in class. This is especially true for women, ([Hanchy, 1993], [Moses, 1993], [Howell, 1993]) minorities [Olagunju, 1991], and

recent immigrants. These students also benefit from the socialization afforded through the use of e-mail.

- A unit on using electronic mail can be easily integrated into any type of computer literacy course - whether a traditional programming course, or a microcomputer applications course, or a principles based course.

The E-mail Component of Our Course

The e-mail assignment we used in our class consisted of several steps:

.The students first read an e-mail message sent by the professor and responded to it. They were then directed to send an e-mail message to at least one other student. Each student was required to save an e-mail message that was received and to print out a hardcopy of the message. These tasks served to familiarize the students with the e-mail software and to introduce basic file manipulation.

.As a way of introducing students to the vast resources available through the Internet, we compiled a list of files representing an eclectic mixture of topics (see [Krol, 1994]). We had the students transfer the files electronically, by sending an e-mail request to *ftp@decwrl.dec.com*. The list of choices included:

- a copy of the Declaration of Independence
- information about becoming an astronaut
- information about current Earth satellites
- information about abortion as an issue in the 1992 Presidential campaign
- a copy of the 1994 US Supreme Court decision *ABF Freight System, Inc. v. National Labor Relations Board*
- a copy of President Clinton's inaugural address
- information about weather conditions on the East Coast
- a copy of the 1994 State-of-the-Union address
- a copy of O'Henry's story, *The Gift of the Magi*
- recipes for eggplant, apple pie and chocolate cake
- a report on skiing conditions

We distributed a selection of readings about electronic mail and on-line information services. The selections were culled from the local press ([Baker, 1994], [Lewis, 1993], [Meyer, 1994], [Quinn, 1993], [Wade, 1994]). Some were chosen for topical interest, others were meant to be thought provoking.

.The final part of the assignment was to submit a written report. The class was asked to respond to the following:

It has been said that the "electronic village" will change our lives - it will change the way we do business, the way we manage our finances, even the way we socialize. Your assignment is to think about how electronic mail and electronic data retrieval might or might not be useful in your life. Do you find it fascinating or infuriating? Do you think that creating the "information superhighway" is something that the government should be sponsoring? Why or why not?

Results

The e-mail assignment ignited genuine sparks of interest. Students' questions and comments developed into animated classes regarding the wide spread of computer applications and the relevance of computers to non-scientists. The mood of the class was remarkable. The students worked and joked together, both on-line and in person.

Most students did not receive the ftp files. This failure, too, provided a learning experience. In some cases the files were not received because of spelling errors, which brought home the old programming adage GIGO (Garbage In Garbage Out). In other cases the files were not received because of problems with our LAN (Local Area Network), which generated many spirited class discussions about computer networks, on-line services, and issues of privacy and security.

We introduced e-mail in one section of Core Studies 5 during the Spring 1994 semester. Figure 1 shows the results of a survey conducted in that class. Due to the overwhelming response of that class, e-mail is currently being used in fourteen sections of the course.

The results of the survey show that 77% of the students in the class found the e-mail component of the course interesting or useful. Almost 60% of the class wished to retain their e-mail accounts after the semester ended. Overall, more than 80% of the students felt that they had gained something useful from the course.

These results are especially gratifying, because many of the students in the class are computer and math -phobic. While Core Studies 5 is meant to be a freshman course, many students wait until their senior year to register for the course. We found that this class was more interested and involved than those that we have taught during the past several years. The feelings of many students are aptly characterized in the words of a recent immigrant from the former Soviet Union:

When I was on the beginning of this class I wasn't so happy as now. Why? Because, I didn't know nothing about the computer, and also about logic. I am very proud to know that right now. I know a little bit, not a lot, but I'm only on the beginning of interesting years in the college. Thank you for give me a basic skills about the computer, I hope I'll need them on the future. ... I'm very sad about that. Our class will finish and I'll never again use the email letter. Why? I want to have a good friends and send them a email message. And also, receive a message from them too. What can I do without the E-mail???

1) I found the logic portion of the course interesting and/or useful.

agree: 22disagree: 5 no opinion: 4

2) I found the programming portion of the course interesting and/or useful.

agree: 26 disagree: 1 no opinion: 4

3) I found the probability portion of the course interesting and/or useful.

agree: 20 disagree: 6 no opinion: 4

4) I found using e-mail interesting and/or useful.

agree: 24 disagree: 3 no opinion: 4

5) If possible, would you like to retain your e-mail account after the semester ends?

yes: 18 no: 9 don't care: 4

6) I am planning to take another CS course.

yes: 9 no way: 9 maybe at some point: 12 (1 no answer)

7) This course made me more interested in CS.

yes: 16 no: 3 no difference: 12

8) I gained something useful from this course.

yes: 25 no: 2 no opinion: 4

9) The course was better than I had expected.

yes: 20 no: 2 no expectations: 9

Figure 1: Survey of Class Opinion

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Appendix

Core Studies 5: Introduction to Mathematical Reasoning and Computer Science, 3 hours; 3 credits

Mathematical reasoning, formal mathematical systems, algorithms, and problem-solving. The nature of the computer and the use of computers in problem-solving. Introduction to computer programming.

(Not open to students who are enrolled in, or have completed, any course in Computer and Information Science or to students who have completed a Mathematics course numbered 3.20 or higher with a grade of C or higher.)

Prerequisite: A high school course in intermediate algebra or Course 2 of the New York State Sequential Mathematics Curriculum, or Mathematics 0.35 or 0.44 with a grade of at least C, or Mathematics 0.36 or 0.04, or the equivalent.

Rationale

This course develops students' abilities to reason precisely and to express and analyze real-world problems in mathematical terms. It provides opportunities for students to explore the powerful concepts of a mathematical proof and of an algorithm, and to learn a variety of formal methods and problem-solving strategies.

An understanding of the nature of a computer and of computer programs emerges. Students are given hands-on experience formulating solutions to problems, and writing and running simple computer programs to implement algorithms.

The course develops methods of reasoning that will be useful in other courses in the curriculum. It also reinforces connections between computer science and mathematics by applying the techniques and power of computing to solve mathematical problems, and by making concrete the notion of formalization, whether of a mathematical concept in a proof or of an algorithm in a program.

Frequency of Offering

Core Studies 5 is offered each semester in the day and evening programs as well as during the summer. Currently there are 28 sections with approximately 1000 students scheduled per semester.

paper

Learner Control, Cognitive Processes, and Hypertext Learning Environments

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Key words: hypertext, learner control, cognitive processes, qualitative methods

Abstract

This qualitative study investigates the nature of the cognitive processes learners use in *HyperCard* environments: whether students' cognitive processes differ in learner-controlled versus program-controlled environments, and how much students learn in each. No overall dramatic differences between the learner- and program-controlled groups were found for cognitive processes in hypertext learning environments. The type of environment, learner- or program-controlled, did not appear to correlate with appreciable differences in learners' cognitive processes. Ability differences, however, were found to be significant. The results of this study supported previous findings that learner-controlled versions may be too difficult for low ability students. Qualitative participant differences (i.e., interests, preferences) were also found to be meaningful, regardless of learning environment differences.

Introduction

Previous research has shown that the type of computer-mediated environment, learner- or program-controlled, is not as significant as the learner's general academic ability in determining the success or failure of computer-assisted instruction (CAI) in general, and hypertext in particular. Cognitive processing in relation to learner control issues in hypertext learning environments, however, has not been examined. Therefore, my dissertation study investigated the nature of the cognitive processes learners use in *HyperCard* environments: whether students' cognitive processes differed in learner-controlled versus program-controlled environments, and how much students learned in each.

Method

Participants in this study were twenty undergraduate students in the College of Education at a large southwestern university. They were novices in using *HyperCard* and had limited knowledge of the buildings located on Congress Avenue, a main street in the city in which the university was located. Students were equally divided into two groups and asked to think aloud while learning information about historic buildings on Congress Avenue, using either learner- or program-controlled *HyperCard* programs. Participants were audio- and video-taped during the learning task. After finishing *HyperCard* learning, participants completed a recall of information posttest, were asked about what they had been thinking while watching video segments of their learning task, and were encouraged to answer questions regarding their opinions about the program.

Data Analysis

The collected data included: (1) responses on the self-report questionnaire regarding descriptive information about participants such as SAT scores and their experiences with the *HyperCard* program and content knowledge; (2) audio and videotapes presenting participants' learning behavior during the *HyperCard* learning; (3) recorded verbal data acquired from participants' think-aloud, stimulated-recall, and interview data; (4) learning paths and time on task identified from the *HyperCard* program; and (5) learning outcomes estimated from the results of posttests. Think-aloud and stimulated-recall protocols were analyzed with protocol analysis procedures (Ericsson & Simon, 1984) and interview data were analyzed using emergent theme analysis (Lincoln & Guba, 1985). For identifying group differences, statements on each type of cognitive process activity, time on task, and learning outcomes, were tested by a t-test, and rank-ordered and tested by the Mann-Whitney U Test (Siegel, 1956).* These statistics were used to examine the probability that observed differences would have occurred by chance. Low probabilities of chance occurrence (less than .20 chance) were used as support for group differences. For triangulation of statistical analysis results, t (by t-test), U and z scores (by the Mann-Whitney U Test) were reported simultaneously. The statistical analysis in this study was used as supporting evidence for the results of the qualitative analysis.

Results and Discussion

The analyses of cognitive processes in hypertext learning environments identified no overall substantial differences between the learner-controlled (LC) and program-controlled (PC) groups. In both groups, the verbalizations of metacognitive processes were most frequently stated within each type of cognitive process activity. The LC group produced 40% of all statements on metacognitive processes, 27% on reading processes, 18% on computer operation, 14% on parallel cognition, and 1% undecided, whereas the PC group showed 38%, 23%, 24%, 14%, and 1%, respectively.

Despite the absence of dramatic differences, certain subtle differences between the LC and PC groups were identified in statements about metacognitive processes, reading processes, and computer operation. Metacognitive processes in this study pertain to understanding processes themselves (e.g., "OK," "I understand it," "Wait," or "I like it"). LC group members were more involved in metacognitive processes in general ($t(12) = 1.84$, $p = .09$; $U = 11.0$, $z = -1.73$, $p = .08$), and control processes in particular, than PC group members ($t(12) = 2.08$, $p = .06$; $U = 7.0$, $z = -2.24$, $p = .03$). This suggests that LC group members were more active in higher-level metacognitive processes than PC group members as reflected in their evaluations of materials and decision-making processes. Reading processes in this study pertain to reading a text for understanding or comprehension of content (e.g., "opened a general store," or "Why does he have to build the things bigger than that?"). LC group members also made both more reading verbatim ($t(12) = 1.33$, $p = .21$; $U = 13.0$, $z = -1.47$, $p = .14$) and comprehension statements than PC group members ($t(12) = 1.31$, $p = .22$; $U = 12.5$, $z = -1.54$, $p = .12$). This suggests that LC group members dealt more actively with materials by reading and by comprehending information during *HyperCard* learning than PC group members. Computer operation statements, in this study, are comments made which generally concern how to do something with the Macintosh computer and/or the *HyperCard* program (e.g., "Click on (something)," or "Where do I go?"). No group difference was found in computer operation, indicating that participants in both groups devoted equivalent amounts of time to operating the program throughout the lesson. It is, therefore, possible that participants in both groups did not become more skillful in the use of the program as they progressed. Also, less time may have been devoted to metacognitive and reading processes during *HyperCard* learning due to participants' focus upon computer operation.

The learner-controlled nature of hypertext creates a number of possibilities in reading information and allows readers to decide what information to read and in what order (Charney, 1987; Conklin, 1987; Gay & Mazur, 1991). The learner-controlled version of the stack used in this study might have interfered with users' reading processes because participants may have had to attend more to operation of the program than the program's content (Conklin, 1987; Tomek, Khan, Mldner, Nassar, Novak, & Proszynski, 1991; Tsai, 1989). In contrast, the program-controlled version was structured in a way so that learners would not have to decide how to use the program. It was, therefore, expected that PC group members could have been more involved in reading the materials. However, in this study, LC group members turned out to be more involved in reading materials in hypertext learning than PC group members, whereas participants in both groups devoted as much time to operating the program. This indicates that the PC version did not help students operate the program as presumed and participants in both groups, despite the group to which they belonged, were confused during *HyperCard* learning.

Participants in this study were novices in *HyperCard* (the system) use and Congress Avenue (the content). Only a few students were familiar with one or two of the buildings on Congress Avenue before learning the lesson. Participants' lack of experience in *HyperCard* use and limited knowledge of the content may have caused them to be confused (or disoriented) about the operation of the program throughout the lesson (Conklin, 1987; Gay & Mazur, 1991; Halasz, 1988; Tomek, et al. 1991). Also, these novices were asked not only to read the new and specific information, but also to operate the program and memorize the texts on the screen for the impending test. These dual tasks of learning and navigating the program with lack of prior knowledge of the content and the system caused some participants, low ability students in particular, to become cognitively overloaded during *HyperCard* learning. This was explicitly expressed in think-aloud protocols (e.g., "getting dull," "there are so many here," "seems too long," or "I'm tired") and stimulated-recall and interview data results regarding the feeling of cognitive overload. For example, a low ability student expressed his feeling of cognitive overload:

I think by this time I felt I was getting almost overloaded with the information, because I've been going down the street now on probably the building eleven or ten or so and it was like all the history of each building, all the architecture of each building, and all that real locations. Probably everybody else could've handled it, but I thought it was quite a lot of information after a while. This supports previous research findings that using hypertext may be a problem for low ability students due to cognitive overload (Park, 1992; Tsai, 1989).

Although LC group members showed more active metacognitive processes and more actively dealt with materials in the program than PC group members, they did not perform any better on the test (14.9 out of 25) than PC group members (17.6). One possible reason is that LC group members, when compared to PC group members, did not seem to see all the available materials in the stack. This was supported by the time on task data results which revealed that LC group members took less time on task (19.1 minutes) than PC group members (27.7 minutes). However, PC group members, no matter how much they may have been confused about the program, had to go through all the materials, perhaps resulting in better performance on the test than LC group members. This suggests that program-controlled versions of hypertextual materials may help students remain longer in the program, thus assisting them to better recall information.

Another possible reason for group differences in recall is that the condition difference in this study was not extreme enough to make any distinction between the LC and PC groups in learners' cognitive processes. There are several learner control variables such as pace, sequence, and content (Gay, 1986; Milheim & Martin, 1991). The only condition difference provided in both versions of the program in this study was the sequence control levels (Gray, 1987). Participants in this study were heavily involved in operating the program throughout the lesson, as qualitative and quantitative results revealed, rather than being engaged in in-depth reading during *HyperCard* learning. These results were not expected, given previous research findings which stated that PC group members, given the PC structure, were less involved in computer operation than LC group members in hypertext learning environments (Tsai, 1989). However, the PC version in this study, when compared to the LC version, apparently did not make program operation easy enough to enable learners to concentrate only on reading the materials in the program. Thus, participants in both groups equally and steadily involved themselves in the operation of the program throughout the lesson.

There were ability differences displayed in learning outcomes in this study, but not condition differences. Participants in this study, instead of displaying differences in cognitive processes between the LC and PC groups, showed strong ability-related differences in learning outcomes. High ability students (those who got over 1100 in SAT in this study) took more time for *HyperCard* learning ($t(12) = -1.75$, $p = .11$), vocalized fewer computer operation statements ($t(12) = 1.85$, $p = .09$; $U = 10.5$, $z = -1.74$, $p = .08$), and performed better on the test ($t(12) = -1.59$, $p = .14$; $U = 12$, $z = -1.57$, $p = .12$) than low ability students (those who got less than 1100 in SAT). This suggests that high ability students had no difficulty in learning the content of the program. However, low ability students in the LC group had the lowest recall scores on the test, indicating that these students may not have been able to effectively use the LC version. This ability difference was more evident when combined with time on task and computer operation data. Low ability students in the LC group took similar amounts of time on task, yet recalled the information more poorly than those in the PC group ($t(6) = -1.59$, $p = .16$; $U = 3.5$, $z = -1.31$, $p = .19$). In addition, low ability students in the LC group had as many computer operation verbalizations as those in the PC group, yet performed more poorly than those in the PC group. This ability difference in combination with time on task and computer operation revealed that the LC version may have been ineffective for low ability students to use.

The findings associated with ability difference in this study confirmed previous research on CAI in general (Garhart & Hannafin, 1986; Gay, 1986; Gillingham, Garner, Guthrie, & Sawyer, 1989; Goetzfried & Hannafin, 1984; Hannafin, 1984; Lee & Lee, 1991; Steinberg, 1977, 1989) and hypertext in particular (Balajthy, 1990; Charney, 1987; Gay, Trumbull, & Mazur, 1991; Lanza & Roselli, 1991; Lee & Lee, 1991; Lee & Lehman, 1993; McGrath, 1992; Tsai, 1989). Researchers have postulated that less able students are not well suited for learner-controlled versions of hypertext learning environments. The freedom of navigation inherent in hypertext may be difficult to use, particularly for low ability students. However, the findings in this study indicated that low ability students in the PC group, although they devoted as much time to operating the program as those in the LC group, could do better on the test than those in the LC group. The PC version, therefore, may have been better for low ability students, whereas the LC structure may have been difficult for low ability students to use. This suggests that some PC versions might be effective for participants, low ability students in particular, in hypertext learning environments. For example, program-controlled instructional cues to view embedded information may be helpful to low ability students in hypertext environments (Lee & Lehman, 1993).

The findings of this study provide some suggestions for instructional design. Theoretically, hypertext is completely controlled by the user (Park, 1992). However, because learners who have choices may not fully use all aspects of each program, enhanced versions of hypertext combining both the learner-controlled and program-controlled structures can be used for instructional purposes. Although this particular *HyperCard* stack, as students pointed out during their interviews, may not be good for in-depth presentations, *HyperCard* and other easy authoring languages are expected to be useful for developing educational materials. A combination of LC and PC versions of hypertext learning environments may be able to reach out to more diverse target audiences. For example, high ability students could use learner-controlled versions, whereas low ability students should use enhanced versions of hypertext, combining both LC and PC structures

Another design consideration of hypertext learning environments is that navigational tools (or orientation aids) are required to help students (Gray & Shasha, 1989). Because students in this study were novices in *HyperCard* use and Congress Avenue, they sometimes tended to be disoriented and cognitively overloaded. This lack of experience caused them to be confused about the operation of the program throughout the lesson. This was confirmed by think-aloud data results that showed that participants in both groups did not become more skillful in program operation as they progressed through *HyperCard* learning. The map in the *HyperCard* stack, used as a navigational tool in this study, did not help those who lacked prior knowledge of Congress Avenue. More diverse navigational tools, therefore, should be incorporated, particularly as the content level becomes increasingly complex in hypertext learning environments. Various types of navigational tools such as guided tours, visual maps, fisheye views, browsers, and learning guides were suggested for use in previous studies (Conklin, 1987; Gay & Mazur, 1991; Gay, et al., 1991; Gray & Shasha, 1989; Halasz, 1988; McGrath, 1992; Park, 1992; Reynolds, Patterson, Skaggs, & Dansereau, 1991; Tsai, 1989; Tomek, et al., 1991).

The findings of this study also call for future work on cognitive processes unique to hypertextual environments (Marchionini, 1989; Kozma, 1991). In this study, each type of cognitive process activity, including metacognitive processes, reading processes, computer operation, and parallel cognition were classified based upon previous research done on reading and computer searching (Shell, Horn, Svoboda, & Dongilli, 1990; Shell, 1990). While revising scoring categories previously established for think-aloud data, I found it difficult to locate scoring categories that were unique to hypertext learning environments. Those categories were not related to existing reading or computer search categories, such as "my name is (something)" and "it says hello to you." Unique scoring categories should be developed for use in later research on cognitive learning in hypertext learning environments. As a result, perhaps a more detailed picture of the cognitive processes that learners employ in hypertext learning environments will be drawn.

In addition, there is a possibility that the subject matter domain in the program (historic buildings) was presented at an introductory level too basic for the study participants, which may have resulted in similarities between the LC and PC groups in verbalized cognitive processes. Perhaps recall of the information was limited because the content was basically verbal information. However, hypertext may be suitable for "ill-structured domains" which require more advanced level learning. With the help of hypertext, learners can explore the same phenomenon from multiple perspectives, which may lead to better comprehension (Spiro & Jehng, 1990). Presumably, this particular lesson did not provide the best means for examining learners' cognitive processes in hypertext learning environments (Alexander, Kulikowich, & Jetton, 1994; McGrath, 1992). Hypertext programs with subject matter which includes problem-solving (e.g., literature, psychology, social studies, science, mathematics, or computer science) could be more suitable for investigating future process-focused research on hypertext environments (Alexander, et al., 1994). Conclusion

I found that in this study, learners' cognitive processes did not differ much between the LC and PC groups. In other words, condition differences did not appear to create any appreciable differences in learners' cognitive processes in hypertext learning environments. However, ability differences, the secondary focus in the study, were found to be significant. In particular, this study supported previous findings that learner-controlled versions of hypertextual materials may be inappropriate for low ability students. Qualitative individual differences (i.e., interest, preferences) emerged and were also meaningful, regardless of condition differences. Individual learning styles and preferences along with ability levels, therefore, are presumed to affect the moment-to-moment selection of options in hypertext learning environments.

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paper

Hypermedia without Programming: Automatic Generation of Presentation Documents for Case-based Instruction

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Key words: hypermedia, medical education, case-based instruction

There is growing interest in methods of instruction which are based upon problem-solving cases drawn from real-world practice (Koschmann, 1994; Williams, 1992). One of the major impediments to implementing case-based curricula, however, is the scarcity of published teaching materials. Educators interested in introducing curricula of this kind must often produce their own materials, unlike the diverse offerings made available by the textbook industry for more traditional methods of instruction. To address this curricular need, some institutions have begun to produce hypertext and hypermedia representations of teaching problems. Often these computer-based methods of presentation are more compelling for students to use and are less labor-intensive to produce than paper-based materials (Koschmann, Myers, Feltovich, & Barrows, 1994).

Though it may be less labor intensive than generating a text, producing hypermedia teaching cases still involves a lot of work. Further, the people charged with doing curricular development may not necessarily possess the special technological skills required to construct hypermedia materials. A development team might include graphic artists, programmers domain specialists, and human factors engineers. An important part of this development includes usability evaluations to ensure that the materials are easy for students to use and understand. The objective of this project, therefore, was to develop a way of producing instructional materials such that once an acceptable design had been achieved, hypermedia documents could be easily generated with no additional programming or design effort.

MMT: A Hypermedia Case Presentation Document

The current project was undertaken to support a case-based instructional curriculum in medical education. Southern Illinois University offers a Problem-Based Learning (PBL) curriculum as an alternative to the traditional first two years of medical school (Barrows, 1994). Students within the PBL curriculum work in small teams (usually six students and a faculty "coach") addressing a series of clinical cases. Over the two-year course of the curriculum, students encounter about 100 clinical teaching cases.

All of the teaching cases have a common structure. Students are given the circumstances that led the patient to seek medical attention (i.e., the "presenting situation"). They must then "work up" the case by generating questions to ask the patient, selecting examination items, and requesting test and laboratory results. In the past this was done using a paper-based representation of the case, termed a PBLM, in which each data item (i.e., interview response, examination item, laboratory test) appears on a separate page (Distlehorst & Barrows, 1982). When the students wish to see a particular data item, they are given the page number in the PBLM and the result is read to the group.

In the computer-based implementation of a teaching case, which we term an MMT, the case is presented as a hypermedia document. MMTs are logically divided into sections related to a clinical encounter: patient interview, physical examination, and requested laboratory tests. As a presentation interface, the design of the MMT has three salient features—navigating among sections of the case, selecting individual data items within a section, and displaying available resources for a data item.

As shown in Figure 1, individual data cards have page tabs near the bottom of the window enabling users to navigate among sections of the document. These tabs operate like radio buttons allowing the student to move from one section to another. In the Interview section, students ask the patient questions; in the Examination section, students describe a physical examination to be performed; in the Test section, students describe a laboratory test to be performed. By structuring the document in this way, the student is provided with a logical way of dividing the components of a clinical work-up, one that is consistent with clinical practice.

The means by which students select individual items within a section of the MMT is designed to support an authentic process of inquiry (Barrows, 1990; Koschmann, et al., 1994). For example, students might enter a 'question' in the Doctor's Question field to illicit information from the patient. The program compares the request against possible responses within the current section. We term this approach *pattern-matching within a bounded context*. If an appropriate response is found then the information is displayed; otherwise, the user is prompted to try another request. This strategy has two instructionally important features: students must inquire all information and there is no queuing. Just as in a real clinical situation, students must generate their own questions without any help.

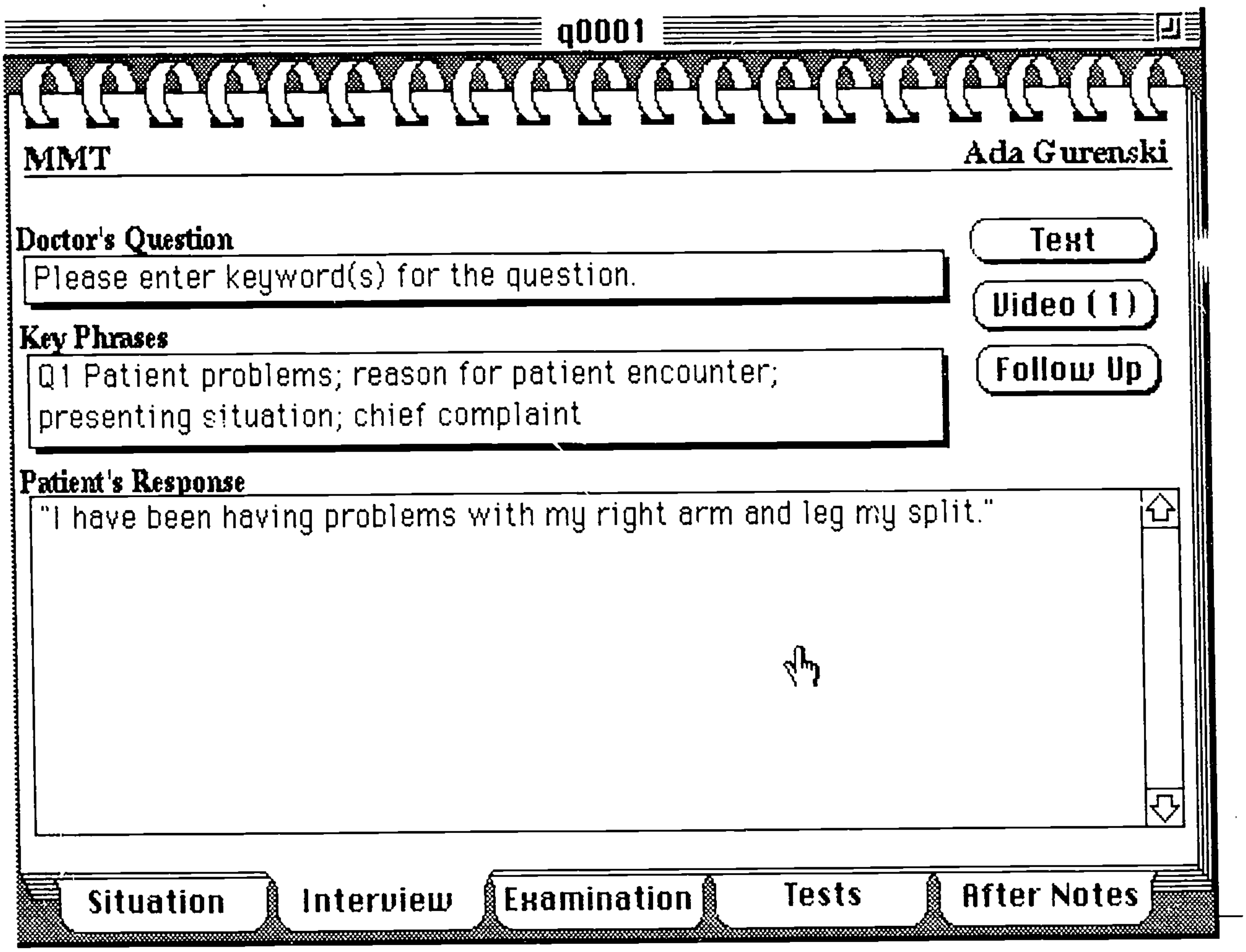

Figure 1. MMT data card.

Learning is also facilitated by the way available data, called *resources*, are presented. As shown in Figure 1, resources are selected using buttons that appear on the right side of the data card. A "Text" resource displays a textual response to the question. A "Video" resource contains one or more video segments to be played on an attached monitor. A "Consult" resource displays a specialist's interpretation of a test result. A "Normals" resource displays normal laboratory values for the current test result. A "Follow-Up" resource allows students to explore a symptom in greater depth (e.g., When did *it* begin? What makes *it* worse? What makes *it* better?). The division of the results into multiple resources was designed to facilitate group deliberation and to allow more opportunities for group discussion. For example, after looking at a test result for this patient (with the Text button) students might have a discussion about the range of normal values for this particular test before referring to the Normals resource.

The Teaching Case Library

PBLMs, the paper-based version of the teaching cases, are produced using word processing files—every case stored in a separate file. This makes it difficult to maintain the library of teaching cases, especially as the library grows. For example, searching through files seeking cases with particular data values is extremely cumbersome. Further, even though some data is common to all cases (e.g., the price of various diagnostic tests), it is stored redundantly in each teaching case file. A change to the common data must be made in each file instead of a central location.

For generating MMTs, we needed to design a common repository for case-related data (Koschmann, et al., 1994). This repository, which we term the Teaching Case Library (TCL), is implemented using a commercial, relational database management system. The structure of this database is shown in Figure 2.

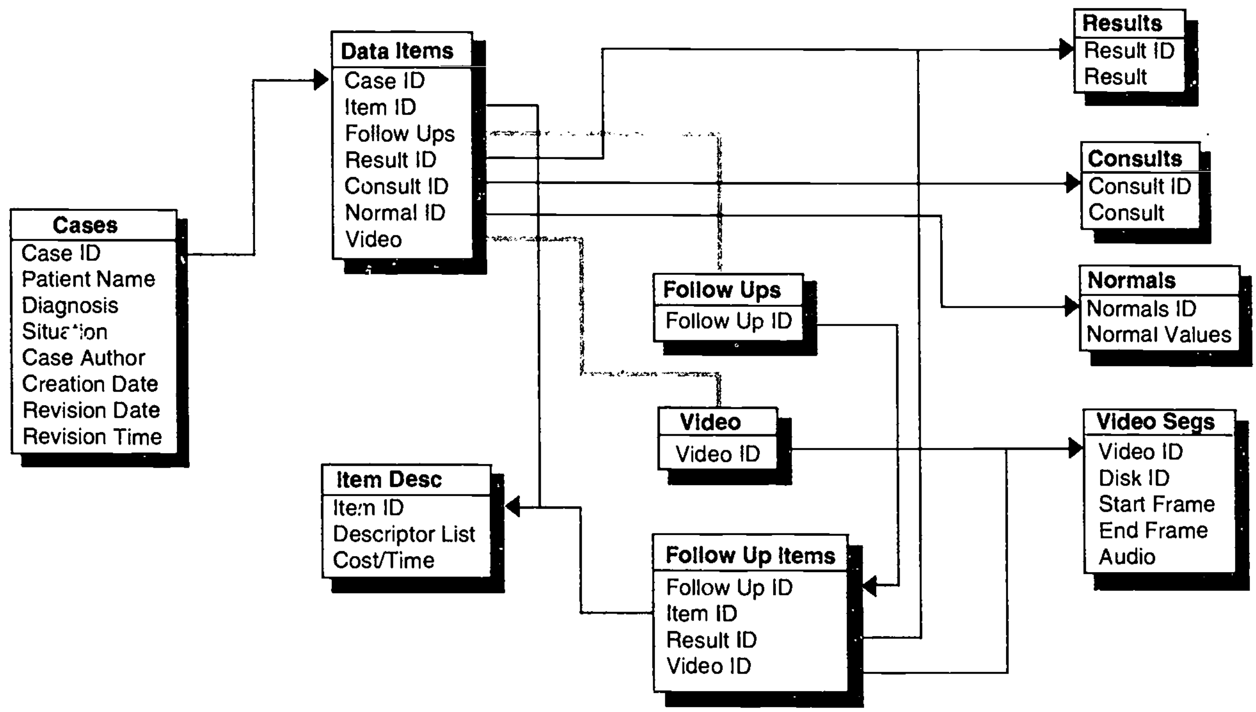

Figure 2: Structure of the Teaching Case Library.

Information pertaining to a teaching case is distributed across several data files. At the top level is global information pertaining to the whole case (e.g., patient name, patient age, presenting situation). Linked to the case record by the Case ID are a large number of data item records representing interview responses, examination results, and laboratory data. A set of descriptors is maintained for every possible data item in the Item Description data file. Data items may have one or more video segments or follow ups associated with them. Each of the data item records may have a number of resources associated with it as described previously for MMT data cards. For example, textual results for a data item are stored in the Results data file, specialist interpretations are stored in the Consults data file, laboratory normals are stored in the Normals data file, and individual video segments are stored in the Video Segs data file.

To produce teaching cases for student use, data records for a particular case must be selected, joined, and exported. As shown in Figure 3, cases can be presented to the students as an MMT or as a PBLM. In the next section we will look at the process for generating MMTs.

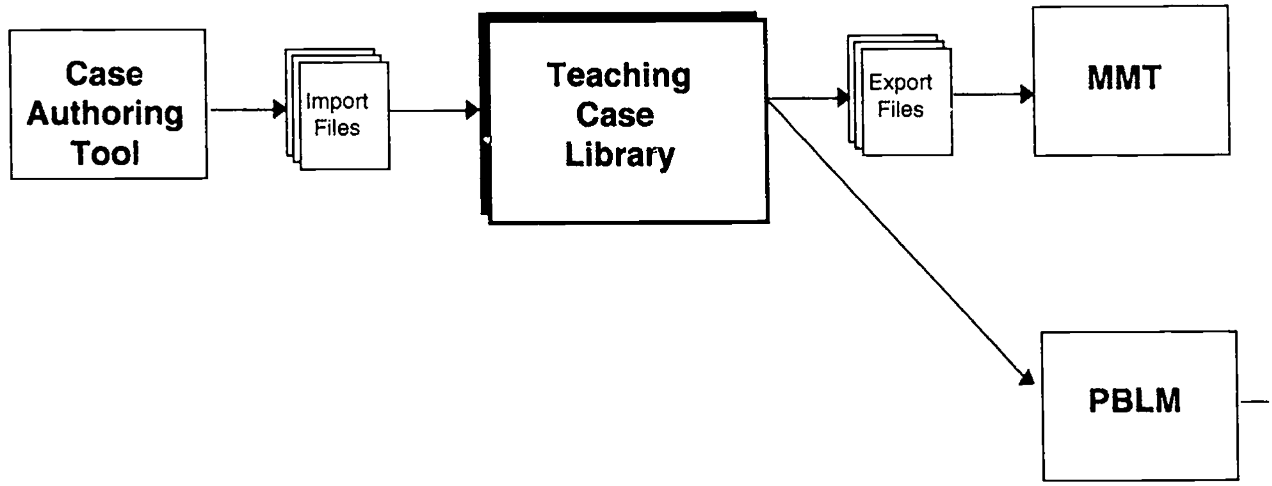

Figure 3: Data flow among the programs used to produce an MMT.

Automatic Generation of Documents

Considerable time and expertise is required to develop effective hypermedia documents. However, after the document has been developed and evaluated, it can be used as a prototype to create additional documents easily. The format remains the same for each subsequent document but the contents change without affecting usability. This strategy is ideal for production environments responsible for generating a large number of case documents that share the same format.

MMTs are implemented as a set of HyperCard stacks—each section of the case (e.g., interview, examination, tests) is implemented as an individual stack. Within each stack, data items (i.e., interview question, examination item, laboratory test) are presented on separate cards. An export file is produced by the TCL database management system for each section. For instance, there is an export file that contains data pertaining to the patient interview. The file contains some identifying information in a header record and then a large number of similarly structured records, each corresponding to a single data item. All information is stored as simple text that can be processed easily by other applications.

To produce an MMT, we start with a set of *Builders*— special stacks that expand and duplicate themselves. We developed a simple procedure that reads information from an export file and automatically builds a stack. Each Builder contains one or more prototype cards. A *prototype card* contains all of the fields and buttons to be used in the new stack. As the Builder reads each record in the export file, it duplicates a prototype card and fills the new card fields with data. This creates a collection of new cards that form the stack. This process is repeated with each of the export files to produce a set of stacks that constitute an MMT.

The building process can be quite sophisticated by copying buttons *only if they are needed*. For example, MMT uses videodisk technology. Cards that contain video information must have a "Play Video" button. Cards that do not have video information should not have a video button. We use a flag in the export file to indicate whether the Builder should include a particular button on the current card. This strategy can be extended to include optional images, sound, and video for each card based on flags in the intermediate file. Cards can take on different appearances depending on their content.

Conclusions

Automatic generation of teaching documents is part of a deliberate strategy to isolate the development of case content from the production of the presentation format. Previously these processes were combined, resulting in a great loss of flexibility. Using the procedure currently under development, new presentation formats can be easily implemented providing an environment that encourages experimentation. This strategy, though it lends itself particularly well to the production of materials for case-based instruction, could be useful in any setting with a high degree of structural similarity in the final product.

One potential application is a generic storybook. A prototype would be developed by experts that includes shared information and navigation buttons for a particular storybook style. Authors can then write original stories in a suitable format with a standard word processor. The resulting text document is used by a Builder to generate 'original' hypermedia documents. This strategy would allow grade school children to create their own sophisticated hypermedia documents without any programming or graphic design skills.

Automatic generation of multimedia documents is also useful for usability evaluation. Usability evaluation is an importat phase of software development (Hix and Hartson, 1993). Builders allows a developer to separate the look and feel of a hypermedia document from its content. Once the content has been standardized, user interface features such as appearance and navigation can be designed. This capability is ideal for usability evaluation experiments. Different versions of the same document can be created for an empirical evaluation. Document content is an independent variable and interface features are highly controlled dependent variables. For example, our original version of MMT uses a variety of buttons to navigate and make selections. We plan to develop an alternative interface that uses pull down menus instead of buttons. When we compare the two presentation formats for effects on learning, we will know that the document *content* is not a confounding factor. Given a properly controlled experiment, any observed differences will be due to the presentation format.

Acknowledgments

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paper

Worlds: A Constructionist Project for Second Grade Students

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Key words: constructionist, HyperCard, multimedia, elementary education

Abstract

This paper describes a project performed with second grade students that tested the feasibility of using HyperCard as a medium for constructionist learning. Students were introduced to HyperCard and allowed to use its features, including HyperTalk, a programming language, to develop imaginary worlds. Several of the resulting projects are described.

Background

The constructionist school of learning has sprung up from work done by Seymour Papert and his colleagues at the MIT

Media Lab [Harel & Papert, 1990]. It is characterized by three principle concepts, "learning-by-making", "holistic learning", and a freedom to choose learning styles. Several writers have suggested these characteristics make the constructionist approach especially appropriate for elementary aged children [Harel & Papert, 1990; Papert, 1993].

"Learning-by-making", for example, focuses students' learning on the creation of concrete objects. A student's project might involve writing logical programs that direct a computer to draw pictures, for example, but the outcome would be increased knowledge about math and logic. Intellectual development occurs as it becomes necessary for the advancement of the creation and the creative process provides the motivation and energy for learning. This is especially useful for children who tend to view their environment in very concrete ways [Papert 1980 Papert 1993].

"Holistic" learning also makes sense for children. In constructionism knowledge is not chopped into discrete subjects to be studied in 50 minute intervals, but is viewed as a vast sea of information and techniques that can be accessed as needed. A specific project provides a student with focus. Knowledge about all subject areas then evolves from the project. In a well designed project every branch of study, from math to art to social sciences will be naturally investigated as that knowledge is needed to complete the project. This also corresponds to how children naturally view the world [Papert 1993].

Finally, learning is traditionally forced into specific learning styles. For example, students may be encouraged to decompose problems into smaller easier-to-solve pieces or to use formal abstractions to obtain solutions. Constructionism allows children learn in different manners and no particular approach may work for any one child. Thus a student may design her project in any manner, through top-down planning, through an improvisional manner that evolves from the tools the students have available (called *bricolage* [Papert 1993]), or from any style in between. Students can use formal abstraction techniques or can create their project from a series of prototypes. Any approach that works for the student is encouraged.

This paper describes an experiment that uses constructionist principles for the education of second grade homeschooling children. The goal was to determine whether these principles could successfully be applied to children of this age group and to investigate which principles seemed especially appropriate.

The rest of this paper will describe this experiment by first examining some previous experiments and drawing some guidelines from them. Next the Ithaca experiment will be described and some example projects will be examined. Finally, the paper will discuss some future directions and summarize the results.

Implementations

Constructionism has spawned several experiments, both large and small. Some of the more famous experiments include the Brookline Logo Project [Papert, et. al. 1979], Project Mindstorm and Project Headlight [Papert 1993 pp. 78 - 79 and pp. 50 - 51], and the Instructional Software Design Project (ISDP) (including Harel's Software Designer project, [Harel 1990]). These studies have focused on students of various skill levels but have, in general, concentrated on students in grades 4 and higher. Though the experiments vary greatly in their implementation, they share some characteristics that spring from the constructionist principles that underlie them.

The most obvious shared characteristic of the projects, for example, is they provide students with complete access to computers and make the computer project the center of curricular activities. Computer programs are never studied as separate subjects, but are instead used as tools for creating or exploring knowledge and art.

In addition to having complete access to computers, students are largely self directed. They work on projects independently, though they do exchange ideas with other students, and have long periods of undirected time which they can devote entirely to their project. Students determine the pace of learning and the particular direction that is taken to get to their goals. Indeed, even the goal itself is often self determined.

In summary, then, the principle characteristics of constructionist projects are:

1. Complete access to the necessary tools and resources, such as computers.
2. Projects as the principal source of curricular activity.
3. Self directed goals, designs and creations.
4. Long periods in which to develop creations.
5. Freedom to interact with other students.

The Ithaca Experiment

This section describes the *worlds* project, a constructionist experiment with Second grade homeschooling students. As detailed below, the experiment was based on constructionist principles and followed the characteristics of earlier projects. Students operated in a computer-rich environment, i.e., there was at least one computer per student.

The goal of the experiment was to use a card based development environment (*HyperCard* and the *HyperTalk* programming language) to allow students to develop real or imaginary worlds. In particular, each student was given the task of creating a "card world" that reflected a world they were interested in. For example, a student who liked knights and medieval Europe could choose to create a liege complete with a walled city and a castle. Students interested in space exploration could create our solar system with space shuttles and satellites. Those whose interests were closer to home could create a plan of their town with enlargements for each of the stores and offices in the town.

The project took a total of six weeks. The first two weeks were spent learning the basics of the HyperCard/HyperTalk language and developing a simple prototype world. Each student created a plan of their house in this phase, though the actual design of the house was left to the individual students. In general, the first card of the HyperCard stack was a floor plan of the house, with each succeeding card (or group of cards) detailing a specific room or section of the house. Buttons were placed on the floor plan and other cards to allow users to go from the floor plan to a particular room, from one room to another, to create special effects (e.g. opening a refrigerator door), or to go from a room back to the floor plan. Students used small amounts of programming to relate buttons to these actions.

In the second phase of the project, students designed and created a world based on some subject that they were currently studying. There was no instruction during this phase, although there was always an instructor in the lab to provide support. In general, student stacks began with a card that gave an overview of their world. Successive cards expanded particular aspects of their world and provided more details. Examples of particular projects are provided in the next section.

These projects are primarily visual. Students create pictures of their world in varying detail and connect these pictures together through buttons. Students added writing and sound to their pictures, but essential features of the world were portrayed visually. Students at this age are use to communicating visually so pictures are a natural medium for them.

Students had a variety of tools available for their projects. The Hypertext programming language was used to connect cards, allow repetitive display of cards, and provide selective choice of cards. Clip Art and the drawing tools native to HyperCard were used to create pictures and background images. Sound tools allowed students to orally annotate their pictures. Finally, buttons and fields, endemic to HyperCard, were extensively used to connect cards and create special effects.

This project had several distinguishing characteristics. First, although it focused on a very distinct technology, HyperCard, the technology was flexible enough to support a variety of projects. Students could, and did, choose to create worlds from a number of different academic areas.

Second, the *worlds* project is a separate approach to learning and not just a technique to be used with traditional instructionist learning. Though *worlds* can be used to reinforce ideas learned in more traditional manners, it was conceived as a more comprehensive approach to learning. That is, students are engaged in *creating* and, as a result, learning is achieved. It is the world and the students' desire to expand that world that drives the learning of both programming and other academic fields.

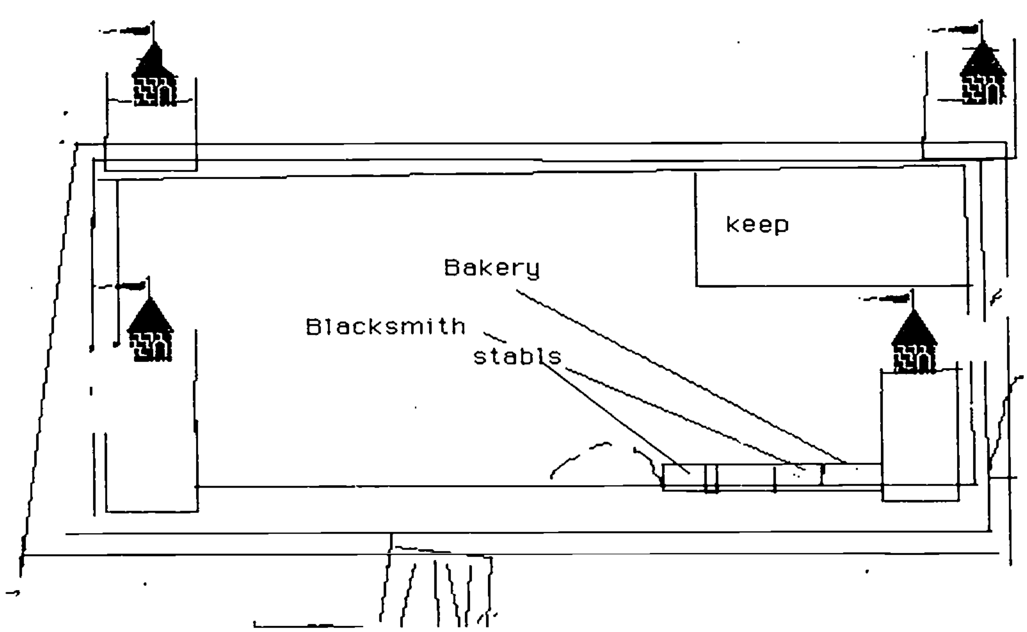
Third, the project was also constructionist in the design flexibility that it gave students. Students could, and did, approach their project from all ends of the design spectrum. Some students used a traditional top-down design, other students a more negotiational approach, and some used combinations.

Last, as in other constructionist projects, the goal of the project was not to provide specific knowledge to the students, but to let students learn what they needed to complete their project. Although there was initial instruction in the first two weeks of the project, the project was mostly self directed. Some of the knowledge learned w gained through experimentation, some through interaction with their peers, and some was provided, on request, by instructors.

Example Projects

Two examples highlight the success of the constructionist approach to this project, a stack created by a girl named Gwendolyn and one by a boy named Zachary. Gwendolyn's project was to illustrate medieval life by creating an example of a liege. The first card of the resulting stack is shown in figure 1. This card represents a typical city of the period. Each building on the card is actually a button that connects to a card (or cards) showing more detail.

Figure 1. First Card from Gwendolyn's Stack



Initially Gwendolyn's knowledge about medieval life drove the design. She took a top down design approach by first planning the layout of the liege and then making paper drawings of some of the cards. As the implementation developed, the design became less structured. Gwendolyn would create a card and then decide what should happen on the card. For example, she designed a card to represent stables and then decided what action individual horses would take when the user clicked on them.

Gwendolyn's implementations also drove her need for knowledge. For example, in the blacksmith shop she wanted a user to click on the tongs with the result that the tongs move to the table, pick up the horseshoe, take it to the furnace, and then place it back on the table. To create this effect, she had to learn how to make simple animations. The design drove her need for programming knowledge.

Similarly, when Gwendolyn wanted to create cards for the keep, she realized that she did not know what the inside of a keep looked like. She had to go to other resources (books on medieval life) to understand the design of the keep. Here her design drove her desire for knowledge about history.

Zachary approached his project, a water life world, with more structure. He initially designed his stack to have two sections, a fresh water life section and a sea life section. At every step of the implementation, he would complete the design of a section before he actually created that part of the stack.

From the beginning the project drove Zachary's interest in the related knowledge area, water life. After his initial design decision to create a partitioned stack, for example, Zachary realized that he didn't know which fish lived in fresh water and which lived in the sea.

Zachary also benefited from the free interaction in the class. When he saw other people using animation in their stacks, he immediately modified his design (again, he had to have a design before he began implementation) and set about learning the features of animation.

In general, Zachary was motivated by an interest in the computer. Although others focused on the project, learning to program only when it was needed in their design, Zachary was more driven to learn to program just to control the computer. This provided a nice balance in the classroom as Zachary was often the source of knowledge for programming techniques.

By the end of these project, both Zachary and Gwendolyn displayed a respectable grasp of a number of programming skills including simple conditional and repetition constructs. What is more interesting, however, is that both had also gained a fair amount of knowledge about different subjects (Medieval life and sea life) in the course of appropriating their programming skills.

Results

The project, though narrowly focused on homeschooled children, did successfully demonstrate that constructionist ideas can be applied even in early grades. Every student completed a stack reflecting her or his view of a world. Furthermore, learning was not restricted to a single field, but spanned mathematical/logical ideas (i.e. in the programming) as well historical, literate, and fantasy worlds. This knowledge was combined in a very natural way. Knowledge from each field was obtained as it was needed and from the most convenient source.

Though no formal testing mechanism was used either before or after the project, students did demonstrate greater mastery of programming and other fields at the completion of the project. Students were independently creating simple scripts in HyperTalk at the end of the project with a great fluency. They were also were able to orally articulate information about the academic area in which their world occurred in a sophisticated manner.

It is difficult to make generalizations about this project since the sample was so small. The project did demonstrate the feasibility of engaging younger students into computer centered projects and of integrating programming into other academic areas at this level. The key to this success is the flexibility of HyperCard. By providing a few preprogrammed buttons and access to clip art, even students that are unable to grasp sophisticated programming ideas can successfully create a world project. Thus students at all skill and ability levels will find success in the project.

In some sense, then, the *worlds* approach is better suited to younger students than other approaches such as logo or logo/Lego because of its emphasis on visual representation. The degree of logical sophistication to create successful worlds is quite low while visual representations can quickly and easily be created.

Future Directions

The most obvious extension to this experiment is to undertake larger and longer projects to test greater integration of *worlds* into a curriculum. The goal, of course, is to make a *worlds* project the centerpiece of a curriculum. Students would be challenged to create different worlds in areas where they have little of no knowledge. The creation of the worlds will drive the desire for more knowledge about the worlds.

Another direction for the *worlds* project would be to test it on older students. Some changes in emphasis might be made in this case, since *worlds* is currently very visually oriented to attract younger students. Older students might be encouraged to create, for example, a written description of their world on a separate stack that can run in parallel to their *worlds* stack.

Summary

This paper has described a project that was undertaken to determine whether younger students could use programming in a constructionist environment. The results seem to indicate that such an environment can be very successful, though larger projects are necessary to test this hypothesis.

In particular, it was found that Second grade students can successfully program in the HyperCard/HyperTalk environment to create stacks that mimic various worlds. It was observed that students will independently seek to learn about programming and other fields when motivated by a creative task.

Finally, the design styles observed in other constructionist experiments are also possessed by students at this level. The HyperCard environment proved nourishing to all of these styles.

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project

The Bridges Project: Building Connectivity

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Key words: restructuring, project-based learning, community, technology

Abstract

In its current round of restructuring, the Martha's Vineyard public school system is integrating curriculum, professional development, and technology to prepare its students for the 21st century. As our teachers use powerful technology to collaborate in the construction of their own community-based curriculum projects, they model exactly the kind of learning organization they are asking their students to join.

We will present examples of this emerging integrated model:

- A system-wide initiative in the area of marine education that links marine biology, nautical arts and science, maritime history, boat building, and tall ship sail training.
- A multimedia island history project that combines oral history and archival research and scholarship with new electronic publishing technologies.

The resulting products will make island history resources more accessible to local communities and the rest of the world.

As these projects gain momentum, the Island continues work on major school construction projects in all of its districts, with substantial attention going to the creation of a technology infrastructure that will support real world connectivity and information exchange.

project

Exploring the Environment: An Inquiry-Based Approach to Learning Earth Science over the Internet

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Key words: telecommunications, teacher training, earth science, technology infusion, hypermedia

Abstract

Introduction

As part of NASA's High Performance Computing and Communications (HPCC) program, the NASA Classroom of the Future Program is implementing a cooperative agreement to develop high school environmental earth science course modules accessible over the Internet. The modules will initially augment one semester of existing earth science courses, and will be beta-tested in classrooms across the country.

In addition to curricula using remote sensing databases, this project will focus on teacher preparation. To become knowledgeable citizens, our students need adequately prepared and equipped teachers. Teachers will be provided the skills, knowledge, and methods necessary to use the modules in teaching students about environmental earth science, to use technology as a teaching tool, and to become teacher-leaders.

Scientific researchers, using satellite and shuttle technology, remote imaging, and image processing, are focusing on global change. Instead of isolated problems, researchers are finding that problems are geographic. These problems include large areas of land and sea; climates; regional distributions of water, vegetation, soil and rocks; lines of physical communications; and trade, political, ethnic and language boundaries. The ability of remote sensing to look at entire areas facilitates discovery of the interconnectedness, diversity, and scale of global problems, stressing interactions of the Earth's subsystems in explaining Earth dynamics, evolution, and global change.

NASA and associated agencies hold terabytes of remote sensing data in databases that can be used effectively to support educational activities over the Internet. The purpose of this project is to develop high school environmental earth science course modules that capitalize on NASA's wealth of scientific, remote sensing information. These modules combine the disciplines of geology, biology, chemistry, physics, meteorology, and ecology, as well as economics, politics, and social considerations. Using the online inquiry tools built by this project, students will be able to: develop strategies for information gathering, recognize patterns and relationships, evaluate strengths and weaknesses of data, predict outcomes using extrapolation or interpolation, and design and conduct experiments after the formulation of problem statements.

Remote Sensing Databases

Remote sensing allows us to see Earth subsystem interrelation on a grand scale. It is ideal for the study of change and the wider relations between many components of the environment. It lends credibility to textbooks. In the past, it was difficult for humans to realize the global impact of their actions. The interconnectedness of Earth systems, however, means that human-induced changes are seized upon and magnified by nature, to be passed through the chain of natural events to have far-reaching, and sometimes, unexpected effects. Unfortunately, it is too easy to find examples of human impact on the environment. Noted environmental impacts include: the destruction of ozone in the upper atmosphere; the removal of protective grasses from savannah lands and steppes through plowing and overgrazing; and the loss of fertile soil, oxygen generation, and vapor transpiration through deforestation in tropical rain forests.

The examples cited above highlight the interconnectedness of the Earth's subsystems and suggest that had remote sensing been available, perhaps some of these problems could have been averted. The environmental Earth science course modules planned for this effort, however, will have a far wider orientation than humanmade environmental disasters. Students will be expected to synthesize and evaluate such matters as: the cause and effect relationships of degradational and tectonic forces with respect to the dynamic Earth and its surface; the relationship of atmospheric heat transfer to meteorological processes; and the relationship between Earth processes and natural disasters. Students should also be able to make and support insightful and informed recommendations to alleviate environmental problems.

Workshops and Support Materials

The "Exploring the Environment" modules will be disseminated through workshops for teachers. In addition to work-

shops, in the second and third year of this project, we will place necessary information for using NASA remote sensing databases in the course modules, references to articles about exemplary teaching, information about other Internet resources, and ideas about implementing evolving science teaching standards and methodology online.

During each year of this project, teachers will be brought to the NASA Classroom of the Future to participate in a week of instruction. The workshop's purpose is to prepare teachers to use the Internet and the "Exploring the Environment" modules in their earth science courses and to learn methodology appropriate to new technology and current standards. In addition, and perhaps most importantly, we want teachers to serve as teacher-leaders in the growing integration of instructional technologies, such as NASA's remote sensing databases, with inquiry-based science learning in the classroom.

The Exploring the Environment homepage is located at URL: http://cotf.edu/ETE/etehome. The project was developed using Netscape.

project

Computing across the Curriculum in the Middle School

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Key words: middle school, computer applications, integrated curriculum

Abstract

Session Objectives

To demonstrate how students can use their computer skills across the curriculum.

Project Content

Once students learn computer applications in the middle school, do they know how to apply these skills in all their other subjects? After a brief summary of a middle school computer applications program (word processing, drawing/painting, database, spreadsheets, desktop publishing, and telecommunications), project examples that demonstrate how students may use their new skills in all their other subjects (math, science, English, history, health, foreign languages, and others). This demonstration will also include how students may use these skills in extra-curricular activities such as the yearbook, newspaper, and sports.

Project Examples

Project examples will be shown of how students can use the following items in their various classes, such as English, social studies, math, science, physical education and health, art, reading, foreign languages, and computer education.

Word Processing:

- Reports–with and without footnotes
- Title Page
- Bibliography
- Outlines
- Book Reports and Reviews
- Class Notes
- Letters and Envelopes

Drawing and Painting:

- Announcements
- Advertisements
- Illustrations
- Diagrams

Databases:

- Lists
- Collections
- Searches

Spreadsheets:
- Calculations
- Charts
- Investment Portfolio

Desktop Publishing:
- Posters
- Newsletters
- Signs
- Cards
- Certificates/Awards

Importance

It is important that students realize that the computer is a tool and that it should be used in all subject areas–not just in a computer class. Articulation and coordination with all teachers are important in fulfilling the curriculum goals of all subjects.

Extra-Curricular Activities

It is extremely beneficial to showcase the student's ability to use the computer whenever possible. This can be accomplished when students use the computer to produce their own school newspaper and yearbook. Students involved in sports can also use the computer to log the statistics of all the games and/or events. Some suggested activities are as follows:

Word Processing:
- Newspaper Articles
- Letters Requesting Information
- Forms for Submission
- Deadline Outline
- Yearbook Articles/Headlines/Captions

Drawing and Painting:
- Announcements
- Advertisements
- Illustrations
- Cartoons

Databases:
- Yearbook Sales
- Yearbook Advertisements
- Labels for Advertisers
- Labels for Yearbooks
- Past Records of Sports Statistics

Spreadsheets:
- Record of Deposits and Expenditures
- Fund-Raising Activities
- Sports Statistics

Desktop Publishing:
- Posters
- Signs
- School Newspaper
- School Yearbook Final Layout

society session

The Current State of Developing On-line Communities

An ISTE SIGTE Session

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Key words: electronic networks, computer-mediated communication, computer conferencing, electronic communities, telecommunications, collaborative work, teleapprenticeships

More and more interactions between people are occurring "on-line", in electronically mediated discussions through email or electronic conferencing mechanisms. These interactions and the relationships that develop from and through them take many different shapes. It is the goal of this panel to describe some of the specific characteristics of these on-line interactions and some of the larger issues that surround these developing on-line communities.

Three major issues can be identified for this discussion:

- What technologies are used for this purpose?
- What kinds of things foster the development of on-line collaborations?
- What purposes can be achieved through on-line collaborations?

Each of the panelists will address these questions through descriptions of activities occurring at their own institutions and then follow up with comments regarding selected issues associated with these emerging on-line communities. Finally they will seek to identify common threads across their efforts that link these different approaches to developing on-line communities.

Michael Waugh will describe the Teaching Teleapprenticeship Project at the University of Illinois. The Teaching Teleapprenticeship project is working to develop an electronic educational network in which all who are interested in the education process can freely interact and share ideas. The project is specifically focusing on enhancing teacher education, but the emerging educational community can be of benefit to all participants. The project which has been supported by the National Science Foundation implements a wide variety of types of apprenticeship experiences with the courses which constitute the teacher education curricula. In this way, the students will experience multiple ways in which his technology can be used to support learning.

Marianne Handler will discuss the issues associated with attempting to develop a statewide, electronic network-based community of teacher educators using an email reflector mechanism. The goal of this effort is to provide an environment in which teacher education faculty can have a discussion "space" where they can establish and maintain an ongoing conversation around the issues associated with integrating technology into preservice teacher education courses. Handler will describe what has been done so far and identify problems and solution strategies associated with this effort.

Peter Skillen will describe another effort to develop a specialized on-line community based upon one school district's telecommunication system (NYNET), the National Network for Learning and ThinkingLand, which is a collaborative journal writing environment. Using this example, Skillen will discuss what 'intentional learning' techniques are necessary beyond the mere existence of the technology. When one develops a culture of computer-using educators whether face-to-face or via telecommunications, the ability to increase one's expertise is related to the initiative of the individual and to the collaboration among individuals. This is a distinct shift in the way knowledge is shared.

society session

Model Building and Simulation in Support of the New State Curriculum Frameworks

A SCS Session

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Key words: model building, simulation, standards

Across the country State Departments of Education are developing new K-12 Curriculum Frameworks. These are generally based on the National Standards in each discipline area that have emerged over the past 10 years. In most instances model building and simulation are not mentioned specifically. However, when educators try to concretize these guidelines, modeling and simulation can play a major and pivotal role in accomplishing the new goals. This panel will explore the ways modeling and simulation can bring new curricula strategies to physics, chemistry, mathematics and elementary education. Very specific examples of such uses of modeling will be given in the context of the new Massachusetts Curriculum Frameworks.

Key Ideas of the Massachusetts Common Core of Learning:

- Apply mathematical skills to interpret information and solve problems.
- Use computers and other technologies to obtain, organize and communicate information and to solve problems.
- Make careful observations and ask pertinent questions.
- Seek, select, organize and present information from a variety of sources.
- Analyze, interpret and evaluate information.
- Make reasoned inferences and construct logical arguments.
- Develop, test and evaluate possible solutions.
- Investigate and demonstrate methods of scientific inquiry and experimentation.
- Develop curricula from an interdisciplinary perspective.

classroom demonstration

The School Play and Virtual Reality: Computer-aided Lessons in Theatrical Set Design

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Key words: virtual reality, theater, design, HyperCard, art

Virtual Reality and Theatrical Set Design

For many students the school play is a high point of the year; aspiring artists get to see their ideas take on form in a life-sized, "virtually real" environment. Working with actors and technicians, young set designers can see their concepts brought to life through cooperation and careful planning.

Working on a school play is often a first-time experience for young designers; trying to envision a completed stage set from paper drawings can prove extremely difficult. The computer can help in the design process, enabling students to "see" their set designs in a virtual environment that allows for modifications before nails hit wood or paint hits canvas.

Denise Whitaker, art teacher and A. Howard Brown, English teacher at George Washington Middle School in Ridgewood, New Jersey, have supervised their school's annual theatrical performance for the past 5 years. Drawing on their experiences with traditional set design activities and their interest in computers as learning tools, they have developed computer-assisted activities for their school's aspiring theatrical designers. The computer activities are elements of a total theater crafts curriculum that includes model building, set construction, painting, and working in teams to complete a large, complex task: a performance before a live audience.

The first activity is a *HyperCard* stack, "HyperStage," which teaches the vocabulary of stagecraft and provides an empty stage that students may use to create and print out rough sketches of their ideas. "HyperStage" serves as a primer for the correct names of the parts of a proscenium stage and the concepts of stage directions ("stage right," "center stage," ...etc.). During stage crew meetings, students have "HyperStage" available to them as a resource for their own learning and as a means to communicate their ideas to younger or less experienced peers.

The second activity is the development of a "virtually real" stage set using *Virtus Walkthrough*. The proposed set is "constructed" on a virtual stage that has the same dimensions as the school's actual stage (the virtual set replaces the more traditional scale model). Student designers may then test the "sightlines" by viewing the set from a number of different angles that correspond to the audience's point of view. The designers also "walk" through the set as if they were the actors, checking to be sure that they have left enough space for performers to make easy entrances and exits. Once the designers come to agreement on the final set design, the virtually real set is presented on a large-screen monitor to the entire production staff so that everyone is aware of what the finished set will look like. Cast and crew members may ask questions or express concerns about the set's design and are given a "walking" tour through the virtual set. Once everyone in the production has seen the set design and the final adjustments are made, the designers turn their virtual model over to the construction team to use as a blueprint for building the actual set.

The two activities, "HyperStage" and the creation of a virtually real model of the set help students visualize and articulate their design ideas more clearly. Within the larger activity of putting on the school play, the computer is used as a tool that clarifies vision and communicates thought in a new and exciting way.

classroom demonstration

Curriculum Navigator for Art: Elementary School

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Key words: interactive, hypermedia, curriculum planning

Abstract

Empowering Art Teachers to be Creative Together

The Curriculum Navigator for Art: Elementary School has been created to use HyperCard's interactive qualities to empower teachers to maximize their planning efforts by dividing the work load. By using a simple, but comprehensive, interactive planning template to organize and store program goals, teaching units, and lesson plans, The Curriculum Navigator for Art: Elementary School makes it easy for classroom teachers and art specialists to share their most successful teaching units and lesson plans with each other. It has been designed to allow teachers to accomplish two major goals: (1) To create a multifaceted, sequential, cumulative, and articulated art program that subscribes to the latest educational theory and practice in art education, and (2) To provide endless opportunities to extend these planning efforts to fit the changing needs of the students in their schools and school district.

The Curriculum Navigator for Art: Elementary School stores curriculum information electronically in a format that can be easily adapted to meet the changing needs of students and their teachers. Teams of elementary school art and classroom teachers can use the planning format provided by the Curriculum Navigator to structure, sequence, store, and share information. If desired, other Curriculum Navigators specifically designed for middle school and secondary school art programs can be linked to The Curriculum Navigator for Art: Elementary School to create a unified K–12 district-wide art program. Ultimately, Curriculum Navigators will exist for other academic areas and each will allow curriculum planners to merge information from one navigator to another to achieve a truly integrated curriculum.

Grade Level Profiles

Provide the user with a "grade level overview." It consists of goals, themes, concepts, cultures, media, art discipline skills, and evaluation techniques for that grade level. The Curriculum Navigator for Art: Elementary School comes with information already installed in each of these areas in each grade level. This information is aligned with current theory and practice in art education, and convergent with national standards and state curriculum frameworks that are already in place in over thirty states. In addition, the information contained in the Curriculum Navigator also conforms with the tenets of the multifaceted approach to teaching art known as discipline-based art education.

Even though the information presented in the Grade Level Profiles for 1st–6th grades is generally sound, the greatest advantage provided by The Curriculum Navigator for Art: Elementary School is that all of the information that comes embedded in it can be edited, moved from one grade level to another, or even replaced with new information based on the specific educational needs identified by the curriculum writing team using it as a planning instrument.

Unit Plans

Once the Grade Level Profiles have been edited, teachers can begin to enter unit plans into the navigator. Each year in the Elementary School art program can be divided into a number of teaching units. Units can be thematically organized, culturally organized, or even designed around visual concepts and visual problem solving. The number of teaching units in any given year is, of course, left up to individual teachers.

As teachers, we all know that there are many things that children learn in art that are uniquely related to engaging in the creative process. The Curriculum Navigator's unit-planning template allows art and classroom teachers to *retain art production as the cornerstone of the art program while seamlessly integrating such crucial art disciplines as art criticism, art history, and aesthetics into the overall unit.*

Lesson Plans

Lesson planning often follows directly from unit planning. However, some teachers like to develop a series of lessons before they attend to completing the overall structure of the teaching unit. The Curriculum Navigator allows teachers to plan in the way that is most natural for them.

Great lessons in art feature "delicious ideas" for students to ponder as they seek to articulate their ideas and feelings visually and verbally. Great lessons in art also emphasize visual and verbal problem solving to encourage higher order thinking in students.

Sharing Information

One of the most powerful special features in the Curriculum Navigator for Art: Elementary School involves information sharing or merging. The merge feature allows teachers to share information with each other with just a few clicks of the mouse. The merge feature allows teachers to "import" information from other grade levels and append this information to the grade level they are working in. For example, if a teacher is editing the themes for grade 5, they can import themes from another grade level to make sure that they are not repeating a theme that has been covered or will be covered later. An even more powerful use of the merge feature, however, involves importing units and lessons from other teachers. By sharing individually created Navigator units and lessons, teachers can use the merge feature to add the units and lessons created by any number of other teachers to their personal Navigator.

System Requirements

The Curriculum Navigator can be browsed on any Macintosh that has the HyperCard Player installed. (HyperCard Player comes with most Macintoshes.) To use all of The Curriculum Navigator for Art: Elementary School functions, users must have *HyperCard* 2.0 or higher, three megabytes of random access memory (RAM), and one megabyte of storage space on their hard drive.

classroom demonstration
Connections

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Key words: middle school, elementary school, interdisciplinary, at-risk, fine arts, inclusion

Middle school is a unique time when transition from child to teen presents diverse challenges and communication is crucial. This is a time of testing self-concepts, and exploring both relationships and talents. Providing these students with an opportunity to express their individuality in an appropriate, positive, and non-threatening framework is important, but one must also recognize each student as a member of a diverse community that stretches beyond middle school confines.

Connections exist in many ways: within the academic framework, exploring multidisciplinary themes in multi-media presentations; within our middle school population, combining talents of students, from gifted to inclusion, to make a significant contribution; within the community, linking middle school and elementary schools. This web of connections is mutually beneficial. Middle school students, working cooperatively with teacher consultants, develop products to share with an audience. Elementary school students, in turn, react and respond in a variety of ways. Middle school students are affirmed when their efforts are well-received and valued, while the elementary students fill in a 'cultural gap,' both affectively and intellectually, as they sharpen their critical thinking skills, emphasizing the writing process.

Communication is not limited to the written or spoken word, but includes original music and graphics, crafts, and food which enhance themes developed in elementary classrooms. Focusing on a theme, student teams in an eighth grade music class create presentations that must include creative writing, graphics, and original music, applying concepts such as timbre and instrumentation. Technology is introduced and employed throughout this experience. Some of the themes which we've explored have included 'FableVision,' 'Boston,' and 'Our Town.' Inclusion students provide crafts and foods as part of their life-skills program, and some of our students who might be deemed 'at-risk' complement the connection by sustaining an informational link (using a variety of applications) for fourth graders about what to expect when they become middle-schoolers. The fourth grade classes, in turn, have visited, interviewed our creative author-artist-composers, and reviewed their work. This connection has expanded experiences in the writing process.

'Connections' addresses the following objectives: (1) significant opportunities for implementing technology in an interdisciplinary matrix, (2) an opportunity for interdisciplinary integration culminating in a product, (3) a shared and reciprocal learning experience that is an appropriate outlet for creative energy and self-expression, and (4) an awareness of the diverse talents and contributions of all our population.

classroom demonstration
Government Online: Educational Attractions along the Information Superhighway

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Key words: resources, on-line, government, federal

Abstract

In an information-rich world, it's important to provide useful and timely materials and resources to the educational community and others concerned about education. Whether it's the verbatim text of a recent law, current grant opportunities, speeches and testimony of the Secretary of Education, brochures for teachers, parents, and communities, or classroom resources, the Department of Education is committed to providing access to public information, and in particular, providing access online. This demonstration will show participants how to obtain education-related information from the Internet.

Among the wealth of available information, there are documents, data, and resources provided by the federal government of particular interest to the education community. This presentation will show participants where to find education-related information on government World Wide Web, Gopher, and FTP sites, government-funded locations, and other sites that provide resources for teachers and students.

We will begin at the White House Web site, an interactive handbook that provides virtual tours of the White House, indexes all White House publications, and allows users to link to all online resources made available by government agencies, such as the Department of Education.

We will travel next to the Department of Education's Online library. This is a rich collection of education-related information, including funding opportunities, legislation, speeches, calendars, survey results, research findings, and full-text publications, such as A Teacher's Guide to the U.S. Department of Education, A Researcher's Guide to the U.S. Department of Education, Goals 2000, and School-to-Work documents. We will demonstrate what resources are available through the Department's World Wide Web, Gopher and FTP services and how easy it is for you to find them online. On average, 10,000 visitors enter the virtual front door of the Department's Online Library every week.

In addition to the materials available at the Department of Education, funding from the Department has developed resources around the country. We will tour such sites as AskERIC, which contains teacher-created lesson plans, and where anyone can ask any education-related question via email and receive a response within 48 hours. AskERIC's popularity is enormous; it has answered 70% more questions in 1995 than it did in 1994. We will also visit a related service, the National Parent Information Network, which is the largest Internet resource for parents, providing high quality information devoted to child development, child care, education and parenting.

The Educational Resources Information Center (ERIC) runs a nation-wide network of 16 clearinghouses and adjunct sites that develop, maintain, and make available the world's largest education-related database. In addition to AskERIC, several other ERIC clearinghouses run Internet Web sites. We will also tour the Eisenhower National Clearinghouse for Mathematics and Science, which provides products and services to educators free of charge. Among these are the ENC Digital Curriculum Laboratory that assists teachers in finding or creating high quality instructional resources, and a catalog of curriculum resources for K-12 mathematics and science education.

Another set of locations sponsored by the Department of Education are the Regional Educational Laboratory Network sites. Almost every one of the ten labs maintains information that is available online. Some of the labs have Web pages; the others have gopher sites. We begin our tour with the Regional Educational Laboratory map and will travel to several Labs around the United States.

Then we will tour web sites of other Federal Agencies, such as NASA's education resources, the U.S. Geological Survey, and the National Science Foundation. All of these provide information that is useful for educators.

As time permits, we will travel to National Research and Development Centers around the country, such as the National Center for Research on Teacher Learning, the Learning and Development Center, and the National Center on Adult Literacy. In addition, we will visit selected State Web sites. Finally, we will show how to find examples of student and teacher Web sites around the country.

classroom demonstration
Math Pen Pals: Communication through Numbers

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Key words: telecommunications, math, weather, multileveled, interdisciplinary, graphing, special needs

Background

My sixth grade learning disabilities class expressed disappointment when they thought they couldn't participate in keypal exchanges. Since the class focus was not written language, students presumed they couldn't communicate with others by Email. But, through further discussion, we discovered math **does** help us communicate. We could grow to better understand our global neighbors and their environments by exchanging and studying numbers.

Therefore, we designed Math Pen Pals: Communication Through Numbers. This on-going project encouraged students to contrast and compare numbers, while learning more about their electronic community.

Introductory Activities

Math Pen Pals is a *KIDLINK* project. All students ranged in age from 10 to 15 and their teachers subscribed to the *KIDPROJ* list. Math Pen Pals represented over 50 schools in several countries and many sites within the United States.

Upon registering for the project, participating schools submitted the following information:

- population and latitude/longitude of their town/city
- closest major city
- exact beginning and ending times of school day

This information was organized and distributed to participants. Ensuing activities included ranking and rounding population figures; locating sites on maps, which helped to tie-in geography and map skills; and determining and ranking the length of school days. Students E-mailed letters to question accuracy of information (e.g., one school's data placed it in the ocean) and teachers posted class problem-solving strategies. One teacher reported her class tried to subtract school-day times with a calculator! Several students posted ASCII graphs that visually represented the numerical data gathered, i.e., school days and population.

Weather Activities

Each week, classes submitted their daily high and low temperatures, as well as precipitation recorded for the previous week. Students studied the weather to learn more about the different climates representing their Math Pen Pals. Teachers introduced and reinforced graphing and comparing/contrasting activities. Schools also downloaded satellite images from Internet sites to supplement their curriculum.

Several severe storms were tracked, including Hurricane Gordon and winter northeasters. In addition, students learned the relationship between elevation and temperature as a school in Arizona was, surprisingly, one of the first to report snowfall.

Survey Activities

The most popular survey activity required students to predict and determine the following information regarding M and M candies:

1. Total number in a 47.9 grams (1.69 oz) package.
2. Number per individual color.
3. Price of one M and M package if bought at various stores including: candy vending machine, supermarket, gas station, department store, or drug store.

Resulting classroom activities included: ranking information, creating ASCII graphs, determining averages and range of data, designing word problems with ratio, percentages, and fractions, and comparing/contrasting predictions vs. actual amounts. And of course, the classes enjoyed eating their M and M's.

Activities

Sites as far north as above the Arctic Circle and as far south as Antarctica submitted their sunrise and sunset times for the winter/summer solstice on December 21, 1994. The collected data was organized in a database allowing students to clearly see latitude's effect on length of daylight (from zero hours to 24 hours). The activity also provided curriculum tie-ins to social studies, science, and language arts classes as participants exchanged E-mail, for example, to learn more about a day with no sunrise or sunset. Thanks to a creative meteorologist online from Florida, students also created ASCII graphs that compared length of daylight and the shape of the earth's shadow (where it was dark).

Other activities included designing personal thermometers, pricing large take-out tomato and cheese pizzas, collecting spring/fall equinox sunrise and sunset times, and creating a file of activities honoring the 100th school day.

Internet Resources

Math Pen Pals became an Internet resource site for teachers as many shared pointers including:

- Geoserver-telnet martini.eecs.umich.edu 3000
- Weather Machine-gopher wx.atmos.uiuc.edu 70
- Macintosh Shareware-gopher gopher.archive.umich.edu

Summary

Math Pen Pals is an on-going telecommunications project that helped students to increase skills in E-mail communication, identifying locations through latitude/longitude, relating weather to location, contrasting/comparing/analyzing data, graphing, and identifying "Math in the Real World" examples. Participants in Math Pen Pals enjoyed the flexibility, variety, and multidisciplinary approach of each activity.

For more information: gopher kids.ccit.duq.edu

6. KIDLINK in the Classrooms/
6. KIDPROJ Activities: Current Activities/
12. Math Pen Pals Project/

invited session

Newton's Fractals

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Key words: mathematics, fractals, Newton's method, graphics

Abstract

Newton's method for finding roots of equations as simple as a third degree polynomial, when examined on the complex plane, produces an extremely rich and surprising source of fractals. These visual images in turn provide us with a greater insight into Newton's method than was possible before the advent of computer graphics.

mixed session

Multigrade LEGO™-Logo Project Builds for the Future

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Key words: Lego™, Logo, curriculum, gender

Abstract

Introduction

At the University of Chicago Laboratory Schools an extensive multigrade *Lego™-Logo* project provides students with fascinating challenges in the worlds of science, math, and technology. This project is unusual in that throughout the lower grades, kindergarten through fifth, *Lego™-Logo* serves as a tool within the framework of the entire curriculum rather than as a special area study.

This project integrates math, science, and technological principles in real-world settings through the use of Lego™ building pieces. When the Lego™ models of real-world applications become more advanced, students program their operation on the computer, using the Logo language as their first introduction to programming.

The "constructivist" theories of Jean Piaget assert that knowledge is not simply transmitted from teacher to student, but actively constructed by the mind of the learner. Children don't get ideas; they make them. Our use of Lego™ and Logo supports this theory as our learners are particularly likely to make new ideas when they are actively engaged in making some type of external, personally meaningful artifact.

Curriculum Goals

Problem solving and cooperative learning are integral aspects of this project as each teacher finds different ways to tie other skills into the *Lego™-Logo* curriculum. Sample curriculum ideas for science, social studies, writing, reading and other language arts, geography, math, art, foreign language, physical movement, and music are discussed . Some of teachers involved in this project strive to create a parallel integration of all subject areas.

When the Logo programming language is used, the focus is on the analytical thinking processes that Logo encourages as it is also integrated into the other disciplines. Both Lego™ and Lego™ combined with Logo provide opportunities for students to analyze situations, formulate solutions, and proceed in a step-by-step way to the desired conclusion. Using Logo on the computer to control machines built from Lego™ provides further motivation for analytic thinking and problem solving.

Results

There have been few negative results from the *Lego™-Logo* project, the major one being that students in the younger grades have experienced trouble in manipulating the smaller Lego™ pieces. Those grades have begun to introduce the larger Duplo™ pieces in place of Lego™, with good results.

The benefits from the *Lego™-Logo* project are many. Children get a chance to experience first hand the scientific process in a real-world setting. They learn to work together to reach a specific goal. Self-confidence is increased.

Gender differences seem to decrease as students work with the *Lego™-Logo* project. Teachers have noticed, as early as the second grade, that at the beginning of Lego™ use girls typically find Lego™ hard to use, while boys begin with the attitude of engaging in a familiar and easy activity. After several weeks this reverses itself. Girls who had no previous Lego™ experience get very involved and enjoy it. Boys who had played with Lego™ at home begin to see that this is a challenging activity, and remark that this is "a different way of playing with Lego™" than at home. This, too, evens out after several more Lego™ sessions, to the point where there is no noticeable difference between boys and girls.

For students with specialized needs *Lego™-Logo* is an excellent tool. Since Lego™ is not viewed by children as work, students with individual learning difficulties are willing to put more effort into getting results. Increased attention span has been observed in children who have difficulties in paying attention to tasks; in particular, the immediate visual and tactile feedback from Lego™ is beneficial for children with ADHD. Also, manipulation of Lego™ and Duplo pieces is good practice for children with visual motor problems.

For the very bright student *Lego™-Logo* is limitless. Once a goal is achieved, the child can–and does–immediately set a new goal. Every project is open-ended, providing stimulation at all levels.

A unique aspect of this multigrade project is that the students carry the skills learned at one grade level into the next, applying those skills in the same medium but in new contexts as they approach new, more challenging problems.

mixed session

PowerPages: Touro College's "One Campus" Library Solution

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Key words: research, CD-ROM, jukebox, library

The Touro College Wide Area Network (WAN), known as the "One Campus Project," is an initiative to use technology to connect all Touro's many campuses throughout the New York metropolitan area. A crucial component of the "One Campus Project" is the connection of all the college's libraries. Because of the physical dispersion of its many extension sites, Touro's library resources are often difficult for many students to access.

To enhance the research capabilities of the college, the Academic Computing department is implementing the PowerPages system by UMI. PowerPages is an article delivery system that provides access to a comprehensive selection of periodicals from the last three years. These periodicals are stored in CD-ROM jukeboxes which are accessible through the WAN. Selected article images can then be re-routed to any connected remote library for a print-out. Additionally, the images can be directed to any user-selectable fax machine.

PowerPages provides the entire Touro community with very powerful research tools all day, every day. It eliminates the enormous amounts of time and frustration associated with traditional document research methods. PowerPages improves the college's productivity because it eliminates the expense of maintaining duplicate information at various library sites. This single information system serves the college's many locations and still has the capability to expand for Touro College's future needs.

For sites not yet connected to the WAN, Touro and UMI have devised a unique solution. Students will dial in to the PowerPages system from remote computers equipped with fax/modems. After searching the index they can request articles from the CD-ROM jukebox to be delivered via fax. This dial-in access will be available to students from their homes as well.

The project presentation will demonstrate this unique solution for improving the college libraries. It will also demonstrate the type of remote access available from students' home.

panel
Teachers and Technology: Reaching 'Em and Teaching 'Em

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Key words: staff development, multimedia, technology training, preservice teacher education, inservice teacher education, state initiatives

Abstract

The panel will describe and discuss a variety of approaches currently being used in Florida schools and school districts to support inservice and preservice teacher education in the area of educational technology. Included will be an overview of many training opportunities in Florida and how those initiatives are coordinated; a description of train the trainer workshops offered which emphasize not only advanced multimedia technologies, but model anchored instruction and generative, collaborative learning; a pilot program in peer coaching and mentoring of university education faculty by teachers; and several distance learning initiatives currently in place including a video news magazine and a telecourse which may be taken for personal enrichment, inservice points, or college credit.

The panel will also discuss the services Florida TechTeam, full-time staff who work with other teachers to support the integration of technology into school improvement initiatives; state co-development projects and how they provide professional development opportunities; the Florida Educational Technology Conference; recent legislation that includes financial support for technology and requires a commitment to teacher training; and other innovative approaches to teacher training in the area of technology for education.

panel
Gender Equity and Technology: A Spectrum of Strategies from K-Adult

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Key words: gender, equity, intervention, strategies, K-12, university, adult

Abstract

Development of Gender Role Attitudes, Grades K-8

Characteristics that differentiate girls from boys, development of gender roles, and factors that might be contributing to gender differences in computer uses in elementary schools will be addressed with a presentation and discussion of possible intervention strategies applicable for preservice and inservice teachers.

Teacher and Female Student Intervention in Grades 3-8

A federally-funded project, "Women in Mathematics for the Year 2000," is in its third year of operation in Wisconsin. The project involves teachers and female students using the *Lego™-Logo* program as a context to develop higher order thinking skills and to promote positive attitudes towards mathematics and technology. The initial focus of our project was on student and teacher interactions in a female-friendly computer environment. We will discuss both the model of the project and preliminary findings from follow-up interviews with teachers, students, and parents. Interesting "ripple-effects" from the project will be shared.

University Computer Science Courses

An alarming drop in the already-low number of women majors in the computer science program at the College of Staten Island/City University of New York, was found. Successful approaches used in improving the situation were mentoring programs, workshops, special seminars, and pairing the women with professors (female if possible) in socially-relevant research projects. The project and findings will be presented.

Women in Technology Careers

There has been a recognition of the increase in women leaving the computer industry. Several news groups and lists have highlighted this issue recently and repeatedly. Corporate downsizing coupled with juggling home and family responsibilities in a field that is constantly changing and frequently requires 24 hour on-call support can be extremely difficult. Options that Yale has provided to keep these individuals active in the field–what has worked and what has not, will be presented and shared.

panel

The Science Learning Network: Science Museums Mediating Telecomputing in K-8 Classrooms

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Key words: telecomputing, science, inquiry, museums, Internet, elementary education

Abstract

The Science Learning Network

The challenges of preparing teachers to use the technology that will link the classroom and the school to the information superhighway are vast. Even if teachers have or can anticipate having hardware and software access, they need to be convinced that the technology will be of instructional value to their students. They also need to be assured that they can learn how to manage the technology, both as independent professionals and in the classroom setting. Perhaps most challenging, teachers need to grapple with the model of teaching and learning implied by the online classroom–a model in which the teacher is facilitator of student exploration and inquiry learning, rather than the purveyor of a body of received knowledge.

The Science Learning Network (SLN), a partnership among six science museums and Unisys Corporation, has been established to create an online educational resource network. The primary audience for this project is K–8 classroom teachers, students, and science museum educators. With funding from the National Science Foundation's Networking Infrastructure for Education Program (NIE) and Unisys Corporation, the SLN will integrate the educational resources offered by science/technology centers with the power of telecomputing via the Internet to provide powerful new support for teacher development and science learning. By the end of the project in 1997, the SLN will develop and evaluate the following:

- Online Museum Alliance: A national consortium of six science museums and Unisys Corporation will pool their resources to create online assets and provide ongoing professional development in telecomputing for pre-collegiate SMT teachers.
- Online Demonstration Schools: A network of six K–8 schools, working in collaboration with alliance museums and Unisys volunteers that will serve as demonstration sites for online teaching and learning in SMT.
- Online Electronic Librarian: An organized collection of online science, math, and technology (SMT) resources and a software package featuring a variety of communication functions that will enable teachers to have meaningful Internet explorations.

The members of the SLN Alliance are:

- The Franklin Institute Science Museum (Philadelphia, Pennsylvania)
- The Exploratorium (San Francisco, California)
- The Miami Museum of Science (Miami, Florida)
- The Museum of Science (Boston, Massachusetts)
- The Oregon Museum of Science and Industry (Portland, Oregon)
- The Science Museum of Minnesota (St. Paul, Minnesota)
- Unisys Corporation

Mediating Telecomputing

Museums will work collaboratively to identify and compile databases that support the teaching and learning of science in grades K–8. Initially, museum project staff will serve as the interface between the Internet and users by providing suggestions as to which online resources are most appropriate for teachers' needs.

Museum staff will also work to stretch the walls of the museum by creating unique "online exhibits" that present the resources of the museum in new and exciting ways. "Ben Franklin: Glimpses of the Man," "The Heart: A Virtual Exploration," and "The Wind: Our Fierce Friend" are examples from The Franklin Institute's online exhibit collection (available at http://sln.fi.edu).

As the project evolves, the Alliance will develop an electronic librarian which will help users in their online explorations.

K-8 Teachers and Telecomputing

Each museum will form a partnership with a local school district to create a K–8 online demonstration school. Professional development efforts within the school will focus on facilitating inquiry and adopting telecomputing to promote active learning in SMT. These efforts will include technical training, system support, and mentoring for school-based teams of teachers and administrators. In the first year, teams will include 8-12 teachers, the principal, and the librarian. Remaining faculty and staff will join the team in years two and three. Over the three years, schools will transform their classrooms into online classrooms, and by the close of the project, each demonstration site will become an online school.

In each of the three summers of the SLN project (1995-97), museum staff will coordinate an intensive three-week summer institute. By the close of each institute, participants will develop proposals for an online classroom project for the coming school year. Each year, new applicants will be asked to show how resources for information collection, problem-solving, and interpersonal communications will support their integrated classroom goals for curriculum, instruction, and assessment in SMT. Project results will demonstrate student learning outcomes, supported by system record keeping, teacher documentation, video documentation coordinated by the museum alliance partners, and portfolios of student work. Applicants will be encouraged to involve parents and other supporters in the educational community.

Our Goal

If telecomputing is to have a significant impact on teaching and learning in elementary and middle school classrooms and schools, networking projects must address teachers as primary agents of change. Teachers need the ability and confidence to explore, refine, and field test the potential of telecomputing in the classroom, or it will remain peripheral. At the same time, teachers who are actively engaged in developing the online classroom with their students will be the most powerful force in ensuring the sustained growth of the online community in support of science, math, and technology (SMT) education.

panel

Technology Tools for Authentic Teaching, Learning, and Assessment

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Key words: assessment, restructuring, portfolio

Abstract

The school restructuring efforts of the 1980's and 1990's have focused on "whole-school" change. The many systems that make up a school all need to lead to the school's primary goal: helping students to learn to use their minds well.

This panel discussion focuses on how an appropriate use of technology can support an overall restructuring effort. In particular, we will examine tools that provide assistance for creating school environments that focus on "authentic" teaching, learning and assessment: that is, places where education focuses on a vision of what students truly need to know and be able to do, rather than on dictates of textbooks or standardized tests.

The participants are connected with several reform initiatives: the Coalition of Essential Schools, the Annenberg Institute for School Reform and the ATLAS Communities Project (which is a new American School Development Corporation design team and is a joint effort of the Coalition of Essential Schools, the Comer School Development Project, Project Zero at the Harvard Graduate School of Education, and the Education Development Center).

In each of the initiatives, the use of technology has been driven by the educational needs of the effort. Among our tools are:

The New York Assessment Collection.

New York State's statewide reform effort, the New Compact for Learning, includes the development of a "data bank" of authentic assessment activities. Rather than enlisting state personnel to develop such activities, the data bank consists of assessments developed in new York schools. Thus, the collection is for schools and by schools. The elements of the Collection are being disseminated using hypermedia software; future versions may disseminate the work of schools via the World Wide Web.

The Digital Portfolio.

We will examine multimedia software that can help to organize and store portfolio information, but more importantly, can provide a way of tying student performance to a vision of what all students should be able to know and do. The Digital Portfolio could be used by many audiences including students, teachers, parents, state and district policy makers and college admissions and placement officers. What these different audiences would do with this information is the point of the current research.

Collaborative Environments.

The ATLAS project involves four research and development organizations and three test-bed school districts. We will examine the ways that collaboration among these organizations can be used in new forms of professional development. In addition, we will look at how schools can create collaborations with in a school and its immediate community.

project

MMT: A Hypermedia Case Presentation Document for Medical Education

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Key words: hypermedia, medical education, case-based instruction, *HyperCard*

Abstract

There is growing interest in methods of instruction which are based upon problem-solving cases drawn from real-world practice. The current project was undertaken to support a case-based instructional curriculum in medical education. Students work in small teams addressing a series of clinical cases and are given the circumstances that led the patient to seek medical attention. They must then "work up" the case by generating questions to ask the patient, selecting examination items, and requesting test and laboratory results. In the past this was done using a paper-based representation of the case, termed a PBLM. In the computer-based implementation of a teaching case, which we term an MMT, the case is presented as a hypermedia document.

MMTs are implemented as a set of *HyperCard* stacks–each section of the case is implemented as an individual stack. Sections correspond to typical components of a clinical encounter: patient interview, physical examination, and requested laboratory tests. Within each section, information (i.e., interview question response, examination description, laboratory test result) is presented on a card. In addition, MMT uses videodisk technology. An actor is hired to play the role of a patient. Careful attention is given to portraying the appropriate appearance and mannerisms of the patient. Responses to specific questions and physical examinations are recorded to videodisk for subsequent playback during an MMT session.

Data cards have page tabs near the bottom of the window enabling users to navigate among sections of the document. These tabs operate like radio buttons allowing the student to move from one section to another. In the Interview section, students ask the patient questions. MMT plays the role of a virtual patient by playing previously recorded responses to questions. In the Examination section, students describe a physical examination to be performed. MMT shows the appropriate examination being performed on the patient. Students interpret the examination results for themselves. In the Test section, students describe a laboratory test to be performed. MMT displays appropriate results for each test. By structuring the document in this way, the student is provided with a logical way of dividing the components of a clinical work-up, one that is consistent with clinical practice.

The means by which students request information is designed to support an authentic process of inquiry. For example, students enter a 'question' to elicit information from the virtual patient. The program compares the request against possible responses. If an appropriate response is found, then the information is displayed; otherwise, the student is prompted to try another request. This strategy has two instructionally important features: students must inquire all information and there is no queuing. Just as in a real clinical situation, students must determine their own questions without any help.

Learning is also facilitated by the way information, called a *resource*, is presented. A "Text" resource displays a textual response to the question. A "Video" resource contains one or more video segments to be played on an attached monitor. A "Consult" resource displays a specialist's interpretation of a test result. The division of information into multiple resources was designed to facilitate group deliberation and to allow more opportunities for group discussion. For example, students might discuss the significance of a test result obtained from a Text resource before referring to the Consult resource.

Acknowledgments

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project

Utilizing Video to Foster Creativity and Higher Order Thinking Skills

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Key words: video, creativity, thinking skills, media, videodisc

Abstract

Background

As we enter the Information/Knowledge Age, it is evident that the sheer volume of information available will be overwhelming. One of the challenges that institutions like business, the military, and education face is how to effectively utilize this abundance of information. It appears that any organization that can creatively synthesize information and make it easily consumable and yet of high value, will have a major competitive edge.

In years to come, many people will be employed as "knowledge workers" and will earn their living by "adding value" to raw information. One of the tools that will enable people to effectively synthesize information and make it easily consumable is video. There is little doubt that video, coupled with other multimedia components like animation, sounds, music, and graphics, has the capability of effectively delivering information in a succinct fashion. It is also obvious, with the advent of digital recording and improved compression techniques, that from a purely technical point of view, virtually anybody will be able to shoot and edit video.

Beyond Simply "Using" Technology

With much of the increased computing power dedicated to making technology easier to use, schools need to look beyond just providing students with hands-on experiences. The next stage in our evolution must lead to developing the creative and critical thinking skills of future generations.

The Impact on Teaching and Learning

Given the abundance and relatively short "shelf life" of information, it appears that tomorrow's world will not be nearly as text-intensive as it has been. Large bodies of text can be time consuming to read and the production cycle for books tends to be rather long, even in today's fast paced publishing industry. Thus, schools will need to adjust to this change and also become less text-based. If video is going to be a major teaching and learning medium, our students will need skills that enable them to become effective consumers and producers of video. This brings up two major issues: what media-focused skills will our students need, and how do teachers effectively utilize video in the classroom?

Media Literacy

Given the tremendous exposure that people have today to various media, media literacy has become a basic skill for the information age. Media literacy is about the ability to understand how mass media work, how they produce meaning, how they are organized, and how to use them wisely (Lloyd-Kolkin, 1991). A useful purpose of media literacy education is offered by the Trent Think Tank, a symposium of media educators sponsored by the Canadian Association for Media Literacy:

"The goal of media literacy curriculum must be to develop a literate person who is able to read, analyze, evaluate and produce communications in a variety of media (print, TV, computers, the arts, etc.)"

Sample Activities

What follows are a series of sample activities that can be used in the classroom using a videodisc player at Level One. Some of the activities call for the use of barcodes, these can be generated using software available for all platforms. The student outcomes that are used are taken from the State of Florida's school improvement initiative; Blueprint 2000.

1. Outcome: locate data and determine the main idea or essential message.

Use the videodisc player to show a stimulating segment from a movie, documentary, or television special; then offer the student groups a choice of the following activities.

- Write a summary report on what they have just seen.
- Prepare an oral report
- Create a poster that "aesthetically represents" the segment
- Use animation software to demonstrate the "essential message"

2. Outcome: identify relevant details and facts.

Show a segment from a documentary dealing with an event of historical or scientific importance.

- Discuss the segments
- Have student list relevant details and facts described in segment
- As a group, brainstorm possible connections to other events

3. Outcome: independently complete a task which requires the use or application of information, concepts, or ideas.

Select a segment from a movie that shows a conflict between characters. This segment should not be too long in length (5 minutes).

- Students will write an account of the incident from a particular character's point of view.
- Students meet in groups to present their interpretations and critique each others work.

4. Outcome: evaluate and make valid inferences from new, incomplete, or nonverbal information.

Select a short but dramatic segment (1-3 min.) from a videodisc version of a movie. Create a barcode for the segment that plays the video but not the audio. Have student groups create an account of what is taking place on the screen, this can take a number of different forms; a news report, a summary, the dialog, music score. As they are working on the activity, let them replay the segment as often as they need. A twist on this activity would be to make a barcode that plays the audio but not the video. Students would then "illustrate" the scene through art, dance, etc.

Conclusion

Shostak (1994) predicts that by the year 2025, smart machines will have caught up with just about every human capability. The primary attributes that employers will be seeking in employees are things like creativity, novel thinking, and the ability to understand multiple perspectives. Videodisc technology, with its capacity to access short segments of video, offers teachers and students an invaluable tool. The repurposing of video by both teachers and students provides a powerful medium for developing lessons and projects that will open up and expand the mind.

project

Totally Texas! A Hypermedia-based Integrated Curriculum Project

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Key words: interdisciplinary, curriculum, multimedia, hypertext, CD-ROM, videodisc

Abstract

The goal of this project is to develop a totally interdisciplinary and technology-integrated curriculum for grades 4 and 7 in Texas schools. Texas Education Agency (TEA) has identified these grades for emphasis of state-level topics in social studies and biological/ecological topics in science. Thus, these grades are ideal for development of curricula that involve students in authentic investigations and problem solving activities that bridge the traditional discipline boundaries.

In the curriculum materials being developed, hands-on nature of field-based local investigations enables students to more thoroughly describe and understand their natural, historical, and cultural environment; the capabilities of telecommunications and optical disk multimedia technologies enable students to widen the horizons of world as they share their findings with students in other regions of this diverse state through collaborative projects.

Unique features of this project include, but are not limited to, the following:

- Teacher-developed. Exemplary teachers across the state continually contribute new instructional units and activities based on existing resources, and new materials that they and their students have identified and/or constructed.
- Multimedia enriched. Although the curricula emphasize hands-on activity and field-based observation and data gathering, background information and instructional materials are delivered in the form of videodisc video and still frames, as well as formatted documents (word processor, spreadsheet, database, *QuickTime* movies and animations, PICT files, etc.) on CD-ROM. The structure of the delivery system provides teachers and students manipulative access to original files, enabling them to link, copy, edit, recombine, and repurpose the resources.
- Hypertext construction which allows teachers and students to select and make their own connections between more resources than can possibly be delivered or used in traditional curriculum constructions.
- User modifiable structure allows teachers to use the curriculum as delivered, to modify it as desired, or to construct their own curriculum using the units, activities, and resources provided.
- The use of formatted documents of *ClarisWorks*, *Inspiration*, and *GeoPoint BaseMap* enables high levels interaction.
- Extensive utilization of existing resources that are in the public domain or for which permission has been obtained for teachers and students to copy and adapt to their own constructions.
- Delivered in periodical installments. At regular intervals (two or more times during a year) new CD-ROMs and/or videodiscs will be delivered to provide updated and newly created curriculum materials linked to previous resources.

Although this is clearly a departure from traditional curriculum structure and delivery, teacher response to these unconventional concepts has been very positive. Traditionally, teachers, who know best how to teach, have enjoyed the fewest resources and the least opportunity to develop their own curricula. Teachers have expressed frustration at being encouraged, if not expected by state and local guidelines, to accept and adopt thematic/constructivist curriculum designs while being provided materials inappropriate for the desired paradigm. Teachers have apparently been eagerly awaiting curriculum designed according to the desired paradigm to help them move in the desired direction.

The project is intended to satisfy the needs of schools and teachers according to the following plan:

Phase 1: Demonstrate, test, and improve a system of collaborative curriculum development and interactive and "repurposable" materials delivery (1 year, in progress).

Phase 2: Production of supplementary materials as concepts are further refined (2 to 3 years).

Phase 3: Continued production of materials as state-approved alternatives to traditional textbooks in all disciplines for grades 4 and 7 in Texas schools (on-going).

At the time of this writing, collaborating schools include Holleman Elementary School, Waller; Southwood Elementary School, College Station; Anson Jones Elementary School, Bryan; Washington Junior High School, Conroe; and La Grange Middle School, La Grange. Within the few months following, additional schools are expected in Richardson (Dallas area, Spring Branch (Houston area), Odessa, Waco, Austin, San Antonio, Brownsville, El Paso, and Amarillo.

Teachers work in cooperative teams within their schools, as they collaborate with other teachers and content specialists via telecommunications and videoconferences. Content specialists in Texas A&M University and the University of Texas and cooperating agencies like the Institute of Texas Cultures (San Antonio), Texas Almánac (Dallas), Texas Parks & Wildlife Department (Austin), and Texas Farm Bureau (Waco) support the teachers with materials, technical advice, and other assistance. The Multimedia Development Laboratory in the College of Education at Texas A&M University assists in converting and repurposing existing materials into electronic formats.

This project will not focus on writing new material. Rather, the intent of this project is to gather, organize, and assemble existing materials that are already available from many organizations and agencies across the state such as:

- Photograph archives of the Institute of Texas Cultures
- A wide assortment of data from Texas Almanac
- Video, articles, and photographs from Texas Parks & Wildlife Department
- Video and curriculum guides from Texas Farm Bureau

project
Integrating Computers into a Study of the United States

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Key words: social studies, U.S., electronic mail, elementary school, databases

The Fifty Nifty States project is designed to provide a relevant, motivating, and current study of the United States. Students learn traditional information about the U.S., but they also acquire a deeper feeling and understanding of the similarities and differences around our country.

After a brief introduction to the study of the U.S. as a whole, individual students choose one state on which to become an "expert." The core of the experience involves the student corresponding with a person who lives in the state using e-mail. Through this relationship, the student gains a personal perspective. The student can also discuss information she is finding in other sources to get a better understanding. Student-designed surveys are sent out to the e-mail pals also. The surveys attempt to gather information not available in books or other traditional sources. One favorite part of the project is getting "Fascinating Facts" that aren't normally known to others about the state.

As students gather information from their e-mail pals and other sources, they enter it into a database that is accessible to all other students. In this way everyone has access to a fifty states database. Students can then analyze the information and find significant trends and relationships using spreadsheets and creating graphs. This gives all students the opportunity to become knowledgeable about the entire United States.

Finally, students share their information in several ways: a Fifty States Convention, a written product, and a Fifty States Artifact Museum. These methods give students the opportunity to use oral, written, and visual presentation skills in individual and cooperative settings. These approaches all make use of word processing and creativity.

Using this technologically rich approach to the study of the United States, students learn to use the computer as a tool. The skills learned in the unit are useful in many settings, and the knowledge acquired about our country is crucial to having concerned and involved citizens.

project

Teaching Programming in the Classroom: An Integrated Approach to Teach Logic Structures

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Key words: teaching programming, IF-THEN structure, logic control, integrated approach, creativity, higher-order thinking skills

Abstract

Logic control is one important structure in programming. The integrated approach in this presentation will use IF-THEN structure as an example to help teachers teach programming in the classroom. A lesson plan including objectives, teaching strategies and activities, evaluation, and follow-ups will be included in this presentation. It is hoped that this approach can be adapted by educators to teach not only logic controls in programming but also help students develop their creativity and higher order thinking skills.

Our current knowledge of hemispheric specialization in information processing has indicated that the right hemisphere is in charge of spatial gestalt synthesis and the left hemisphere handles the temporal linear analysis. Because successful programming depends upon the mastery of both holistic visualization and logistical sequencing skills or the ability to visualize the whole from the parts and the parts that will make up the whole, it is only reasonable that the best way to develop these equally necessary skills is to teach to both sides of the brain. The integrated approach using both left and right hemispheric specialization will emphasize the use of the following instructional strategies: visualization, graphic representation, metaphorical thinking, forced association, kinesthetic perception, identification fantasy, role playing, creative thinking and interpersonal communication skills.

project

Teaching CS1 Using the Closed Laboratory Approach: Perspectives from Two Schools

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Key words: computer science, undergraduate, curriculum, closed laboratory, CS1

Abstract

Introduction

As a discipline, computer science has seen many dramatic changes in its brief existence. Through new text books and an evolving curriculum, the content of undergraduate computer science education has generally kept pace with these changes. However, the way we teach computer science has not. Not only is this out of date–it is profoundly wrong. We have designed curricula and courses which focus on the individual's skill in writing short programs in a dead language, from scratch. This emphasizes the exact opposite of what is needed by the contemporary computing professional.

A New Undergraduate Curriculum

We believe a shift in the approach to teaching computer science will have a significant impact on the improvement of undergraduate computer science education. While lecture materials and course content can always be improved, we cannot expect to make quantum improvements solely in these areas. The concept of laboratories, by contrast, has largely been ignored as a method of teaching computer science.

At the University of Virginia, we have undertaken to develop a new undergraduate computer science curriculum. One of the cornerstones of this new curriculum is the use of closed laboratories in the first four courses.

In the new curriculum, through the use of closed laboratories, students will gain experience with many real-world practices. They will be exposed to real-world practices where programs are thousands or millions of lines long, are often extensively modified and maintained rather than merely constructed, are manipulated in a tool-rich environment, where work is almost always a team effort, and where the form of a solution has a profound impact on future cost and performance. Students have the opportunity to experiment with different ideas and approaches without grade penalty. They are encouraged to share their ideas and solutions with not only the instructor but with other students. They can experience disasters without the consequences of a "real" one.

Sharing Experiences

Another aspect of our new curriculum is our desire to make it available to any interested school. This is how UVA and Northwest Missouri University met. Three of the faculty members from Northwest came to UVA and spent a day meeting with various faculty members and previewing our CS1 course. They went away with a complete set of documents and software support for the course and a lot of work ahead of them.

The philosophy underlying the approach at Northwest is essentially the same as that at UVA. However, Northwest is primarily an undergraduate institution with small class size, enabling a different approach than that of UVA. The primary goal of the project at Northwest is to use closed laboratories to develop active learning environments, in the process promoting teamwork and development of lifelong learning skills. This is being done through the daily integration of lecture and laboratory sessions.

Project presentation

This presentation will detail the new curriculum philosophy, discuss the closed laboratory concept, and demonstrate an example of a closed laboratory session from both the UVA model and the Northwest model.

Our models are quite different. Our experiences at two quite different institutions have shown our approach to be quite flexible. We believe our approach can be successfully adapted to meet the needs of a wide variety of institutions. We want to encourage other schools to ask about what we have both done, how we did it, perhaps think about trying some of the materials and approaches we have developed.

Summary

Both UVA and Northwest believed a radical change was needed to bring our undergraduate computer science courses up-to-date. The idea of using a closed laboratory as a major component of an introductory computer science course required considerable effort in design and implementation. By sharing our resources and concentrating on our strengths, we each have a new CS1 course that is appropriate for our schools. In addition to demonstrating a part of our CS1 course, we hope this presentation will interest others in exploring a collaborative venture with us and with other schools.

project

Closed Laboratories and Alternatives for Introductory Computer Science Courses

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Key words: closed laboratories, supervised laboratories, computer science

The University of Nebraska at Omaha (UNO) Computer Science Department has recently been considering adopting the closed laboratory approach in teaching introductory computer science courses. This consideration is motivated by recommendations from ACM, IEEE, and an outside departmental review team.

The use of structured supervised (closed) laboratories in computer science courses is currently a topic of intense interest among computer science educators. The proponents of closed laboratories claim that such experiences allow students to explore conceptual material–gaining an understanding akin to that gained in a chemistry laboratory. In addition, they maintain that the laboratory experiences improve student understanding of the concepts taught in the lecture portion of the course and reduce student attrition. Many computer science educators believe that a laboratory component is essential. However there is little empirical evidence to support this belief. Some studies have shown an enhancement of problem-solving ability in students while others have shown little change in student achievement.

Faculty at UNO are interested in investigating the effects of laboratory instruction and demonstration on the student achievement in introductory computer science course. Of particular interest were the following questions:

1. Would the use of a closed laboratory on a weekly basis improve students' performance in introductory computer science courses?
2. Would the use of a closed laboratory on a weekly basis reduce student attrition in introductory computer science courses?
3. Would students in courses utilizing a closed laboratory perform significantly better than those who perform the same laboratory activities as a group in an interactive non-hands-on setting?

In order to answer these questions, a study was conducted involving three sections of Introduction to Computer Science II (CS-2)–the second course required of computer science majors. Students in these sections of the course (A, B, and C) had no prior knowledge of the study. All three sections received the same content and workload over the course of the semester. Students in section A were taught in the traditional manner–receiving two lectures (150 minutes) per week. Students in sections B and C received one lecture and one laboratory experience per week. All lectures in sections B and C were conducted by one faculty member, and all laboratory sessions were conducted by a second faculty member. The laboratory session for group B was conducted in a hands-on manner in a computer user room, with students working through the experiment at their own rate. The laboratory component for group C was held in a classroom, where the faculty member led the group through the laboratory manual experiments using a computer and a computer projection system. Each session was designed to be student-driven, with the faculty member acting as a facilitator.

It is important to determine the impact of both facilitated laboratory demonstration and individual laboratory work on student achievement. Therefore, we will compare the mean test scores of CS-2 students receiving this type instruction with those of students in the traditional lecture group.

Preliminary results indicate that student performance appears to be similar among all three groups. However, attrition was greater in the traditional lecture group. The final results of the study will be presented, along with a discussion of their implications for the use of closed laboratories in introductory computer science courses.

project
Reading, wRiting and Reuters: Reuters and Smithtown School District–Partners in Industry and Education

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Key words: computer integration, contextual learning, interdisciplinary, school/ industry partnerships

Abstract

In 1992, Smithtown, a large suburban school district on Long Island, and Reuters World Wide Information Services became partners in education and industry. Reuters is primarily a news and financial data retrieval service that supplies brokers and news networks with video and text news. Reuters prides itself on the speed and accuracy with which it delivers its online services from its major headquarters in Hong Kong, London, and New York. The initial goal of the partnership was to provide a functional environment for students, where real time financial and news information could be used to plan collaborative projects designed to hone students' intellectual skills, while teaching technological skills.

This presentation will demonstrate the capabilities of Reuter Terminal and show how the data is applicable to interdisciplinary projects. Among the features of The Reuters Terminal is the News 2000 with a four-second delay on world news, and Equities 2000 which displays online transactions as securities are being traded on the world financial exchanges. Reuters Instrument Codes (RIC) provide easy access to over twenty-four hundred news articles as well as stock quotes. Among the unique features of the Reuters Terminal is the Dynamic Data Exchange, which allows the user to run computer application software for analysis and display in real time.

In Smithtown High School, the Reuters Terminal (RT) is the centerpiece of an interdisciplinary multimedia computer laboratory adjacent to the school library. The interdisciplinary laboratory has several data collection stations and is equipped with application work stations that enable learners to sort, respond to, and display data.

The facility was designed with three goals in mind:

1. To use the laboratory as a training and exploratory center where teachers and students learn by focusing on the completion of a task.
2. To encourage tasks that demonstrate the learner's intellectual pursuits and conclusions.
3. To use computer resources to facilitate the integration of the curriculum.

Observations on the teachers' and students' perspectives of computer integration in the curriculum will be shared, interdisciplinary projects will be on display, and ideas on staff computer training will be presented.

classroom demonstration

Distance Education and the Computer-assisted Lifelong Learning Network

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Key words: computer, distance, independent, electronic

Abstract

Thomas Edison State College is a four-year New Jersey State College that awards baccalaureate and associate degrees to adult learners who complete a challenging course of study. The Computer Assisted Lifelong Learning (CALL) Network is Thomas Edison State College's computer facility for providing electronic access to many of the College's programs and services. This classroom demonstration will provide an overview of how the College utilizes computer and telecommunications technology to assist students in earning their degree by delivering courses online and providing online administrative support.

Thomas Edison State College is a unique institution of higher education, providing associate and baccalaureate degrees through a variety of non-residential methods including distance and independent learning courses, online computer courses, college equivalency examinations, prior assessment of college-level learning, and transfer credit. Thomas Edison was founded exclusively to serve the adult learner. Since 1972, the College has developed a comprehensive set of programs, policies, and support services that recognize adult lifestyles and conform to the natural rhythms of the adult learning process. Students complete their course of study from their homes or within their daily routine; there is no campus and all programs and services are time and location Independent.

The Computer Assisted Lifelong Learning (CALL) Network is Thomas Edison State College's computer facility for

providing 24 hour a day access to many of the College's services. Developed specifically for the benefit of Thomas Edison State College students, the CALL Network provides a variety of online services to assist students in achieving their higher education goals, including: information packages, application for admission to the College, the Online Computer Classroom, access to student records, electronic mail exchange with other users/College staff, discussion groups, and access to the Internet. The College also offers the CALL-PC personal computer lending program as a service to students who may otherwise be barred from access to higher education opportunities.

The central CALL service is the Online Computer Classroom that provides an excellent teaching/learning forum that allows students to participate in distance learning opportunities electronically. The program design is straightforward. Students register for the course of their choice, then utilize a personal computer and modem to access the CALL Network where they can participate in the electronic classroom. Classes are designed to accommodate asynchronous participation by students, who "call" into their classes at their convenience to participate in topical discussions with the faculty and other students. The computer connection is also used to privately transmit course assignments between faculty and students via electronic mail. Finally, students receive individualized guidance and instruction from the faculty mentor conducting the class, and have the option to form study groups with other students, undertake collaborative learning projects, and meet and exchange information with other students in an electronic student union.

The Online Computer Classroom strives to achieve specific educational goals and objectives that substantially contribute to the practical use of emerging technologies in delivering college-level courses across disciplines including:

- To encourage pedagogical innovation such as cooperative learning across time and space boundaries
- To provide access to distance and independent learning activities to students regardless of their geographical location
- To expand access to higher education to students who for personal and/or professional reasons choose to pursue learning at a distance
- To overcome the isolation of traditional independent or correspondence study
- To utilize current computer technology available to deliver credit programs
- To provide leadership in advancing the use of technology in distance and independent learning.

The proposed demonstration will provide an online demonstration of CALL and the Online Computer Classroom and will include examples of how the CALL Network addresses distance education administrative and communication needs for each of the services highlighted above.

NOTES

Author and Key Word Index