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ABSTRACT

The National Educational Computing Conference (NECC) is the largest conference of its kind in the world. This document is the Proceedings from the 23rd annual National Educational Computing Conference (NECC) held in San Antonio, June 17-19, 2002. Included are: general information; schedule of events; evaluation form; and the program. Information on the following is provided: events for special groups; tours registration exhibits; media; housing and travel; sponsorship; and future NECCs. Presentations from experienced educators include practical advice and examples for using technology in all subjects at the K-12 level and for staff development and teacher preparation, and visions for improving future education for all students. The sessions are organized into five major themes: Framework; Technology Capacity; Human Capacity; Learning Environment; and Equity and Accountability. Sessions consist of the following categories: Keynotes (one each morning during the three conference days, plus a luncheon keynote on Wednesday); Concurrent Sessions (highlighting successful programs, projects, ideas, and concepts of educators from all levels); Spotlight Sessions (featuring recognized leaders in the educational technology field); Research Papers (peer-juried original research papers on the general theme of using technologies to enhance education, in two formats: Lecture/Discussion and Roundtable); Posters (featuring both hard media and electronic displays where participants engage in one-on-one or small-group discussions); Web Posters (Posters including the enhancement of Internet connectivity); Make & Take (hands-on activities in collaborative groups); PT3 Grantees Showcase (selected as the most innovative, replicable, and sustainable of the PT3 projects from those that applied); Corporate CEO Spotlights (featuring CEOs from the NECC Corporate Sponsors); and Student Showcase (featuring students and teachers demonstrating technology use in their classrooms). (AEF)

NECC 2002: National Educational Computing Conference Proceedings (23rd, San Antonio, Texas, June 17-19, 2002)

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JUNE 17–19, 2002

Henry B. Gonzalez Convention Center
San Antonio, Texas

SPONSORED BY

National Educational Computing Association (NECA), Inc.

IN COOPERATION WITH

Texas Computer Education Association (TCEA)

Texas Center for Educational Technology (TCET)

SouthCentral Regional Technology in Education Consortium (SCRTEC)

Texas Education Agency (TEA)

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Join Us For A NEXUS in TEXAS!

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Meet us at the 23rd annual National Educational Computing Conference (NECC) to be held in San Antonio, from June 17–19, 2002. More than 10,000 educators from across the globe will converge in the Henry B. Gonzalez Convention Center to explore the opportunities and innovations of education in the 21st century.

Cathleen Norris
NECA President
University of North Texas

Inspiring speakers, stimulating workshops, a network of educational professionals, and more than 22 years of conference experience guarantee that your time at NECC 2002 will be well spent (not to mention that you will be a guest of one of the world's most gracious and lively cities). Strengthen the role of technology in education by sharpening your skills, learning new ones, sharing with colleagues, and becoming involved.

Learn about and further define the elements that make up your nexus of technology and education! The NECC 2002 organizers and the City of San Antonio look forward to welcoming you in June.

What does "Nexus" mean?

Well, it sounds high tech, and we are! Nexus means a synergy, a coming together, a connection, link, center, or focus. If there is one thing we have learned about harnessing the power of technology to improve students' learning, it is that it takes more than hardware and software. We must bring together shared vision, access, professional development, technical assistance, content standards and curriculum resources, student-centered teaching, assessment, and community support and support policies.

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Schedule of Events

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FRIDAY, JUNE 14, 2002

8:30 am–4:30 pm	ISTE's Assessment & Technology Forum*
5:30–7:30 pm	Registration—Convention Center
7–9 pm	ISTE Affiliates' Reception

SATURDAY, JUNE 15, 2002

7 am–6 pm	Registration
7:30 am–5:30 pm	ISTE Affiliates' Meeting
8:30–11:30 am	Morning Workshops*
9 am–4 pm	Full-Day Workshops*
1:30–4:30 pm	Afternoon Workshops*

SUNDAY, JUNE 16, 2002

7 am–7 pm	Registration
8:30–11:30 am	Morning Workshops*
9 am–4 pm	Full-Day Workshops*
1:30–4:30 pm	Afternoon Workshops*
2–6 pm	SIG Teacher Educators (SIGTE) Forum
4–5:15 pm	International Attendees' Reception
5:45–6:45 pm	Newcomers' Session
7-9 pm	Opening Reception

MONDAY, JUNE 17, 2002

7 am–6 pm	Registration
7:15–8:15 am	Newcomers' Session
8 am–4:30 pm	Kids' Camp: SeaWorld Amazing Animals*
8:30–9:45 am	Keynote: Lily Tomlin Sponsored in part by Texas Instruments
8:30–11:30 am	Morning Workshops*
9:45 am–5:30 pm	Exhibit Hall Open
9:45–10:15 am	Continental Breakfast
10 am–12 noon	Poster/Web Poster Sessions
10 am–12 noon	Make & Take Sessions*

* Preregistration and additional payment are required

** Preregistration is required

Take a tour through NECC!

See also

Events for Special Groups

10 am–12 noon	Student Showcase Sponsored by Adobe Systems, Inc.
11 am–12 noon	Concurrent Session 1
12:30–1:30 pm	Concurrent Session 2
1:30–3:30 pm	Poster/Web Poster Sessions
1:30–3:30 pm	Make & Take Sessions*
1:30–3:30 pm	Student Showcase Sponsored by Adobe Systems, Inc.
1:30–4:30 pm	Afternoon Workshops*
2–3 pm	Concurrent Session 3
3–3:30 pm	Afternoon Refreshment Break
3:30–4:30 pm	Concurrent Session 4
3:30–4:45 pm	ISTE HyperSIG Meeting
5–6 pm	Birds-of-a-Feather Roundtables
6:30–10 pm	Monday Night Extravaganza: Far West Rodeo*

* Preregistration and additional payment are required

** Preregistration is required

TUESDAY, JUNE 18, 2002

7–8:30 am	5K Fun Run/Walk** Sponsored by Visions
7 am–5:45 pm	Registration
7:15–8:15 am	Newcomers' Session
8 am–4:30 pm	Kids' Camp: SeaWorld Amazing Animals*
8:30–9:45 am	Keynote: Hall Davidson
8:30–11:30 am	Morning Workshops*
9:30 am–5 pm	Exhibit Hall Open
10–10:30 am	Coffee Break
10 am–12 noon	Poster/Web Poster Sessions
10 am–12 noon	Make & Take Sessions*
10 am–12 noon	Student Showcase Sponsored by Adobe Systems, Inc.
10 am–12 noon	PT3 Grantees' Showcase Exhibit
10:30–11:30 am	Concurrent Session 5
10:30–11:45 am	ISTE SIGTC Meeting
12 noon–1 pm	Concurrent Session 6
noon–1:15 pm	ISTE SIGCS Meeting

* Preregistration and additional payment are required

** Preregistration is required

1:30–2:30 pm	Concurrent Session 7
1:30–2:45 pm	ISTE SIGTel Meeting
1:30–3:30 pm	Poster/Web Poster Sessions
1:30–3:30 pm	Make & Take Sessions*
1:30–3:30 pm	Student Showcase Sponsored by Adobe Systems, Inc.
1:30–3:30 pm	PT3 Grantees' Showcase Exhibit
1:30–4:30 pm	Afternoon Workshops*
2–4:30 pm	NECC Administrators' Forum Sponsored by Chancery
2:30–3 pm	Refreshment Break
3–4 pm	Concurrent Session 8
3–4:15 pm	ISTE SIGTE Meeting
4:30–5:30 pm	Concurrent Session 9
5:45–6:45 pm	Birds-of-a-Feather Roundtables
6:30–9 pm	Tuesday Predance Mini-Mall
9–11:30 pm	Dance & Conference Social Sponsored by Hewlett-Packard

WEDNESDAY, JUNE 19, 2002

7:30 am–3 pm	Registration
8 am–5 pm	TCET PT3 Symposium*
8 am–2 pm	SETDA Business Meetings
8 am–4:30 pm	Kids' Camp: SeaWorld Amazing Animals*
8:30–9:45 am	Keynote: Friendship Through Education
9:30 am–2:30 pm	Exhibit Hall Open
10–10:30 am	Coffee Break
10 am 12 noon	Posters/Web Poster Sessions
10 am–12 noon	Make & Take Sessions*
10 am–12 noon	Student Showcase Sponsored by Adobe Systems, Inc.
10:30–11:30 am	Concurrent Session 10
10:30–11:45 am	ISTE SETSIG Meeting
11:45 am–1:15 pm	Luncheon* & Keynote: Toody Byrd Sponsored by Think.com & Sun Microsystems
12 noon–1 pm	Concurrent Session 11

1:30–2:30 pm	Concurrent Session 12
3–4 pm	Concurrent Session 13
4:15–5:30 pm	Closing Session/ISTE Membership Meeting

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ISTE Assessment & Technology Forum top | next

Join forum chair Dr. Helen Barrett for this first annual pre-NECC focus on Assessment and Technology.

More Information

Dr. Barrett brings her experience as assistant professor and coordinator of educational technology at the University Alaska Anchorage School of Education and project co-director for the International Society for Technology in Education's (ISTE) Community & Assessment PT3 grant to this exciting activity designed to:

- raise awareness of various stakeholders on options available for using technology to support authentic assessment, and
- begin a national conversation on the use of technology for supporting authentic assessment and electronic portfolios and the broader use of technology as a tool to assess learning in general.

Attendees will have the opportunity to critique existing electronic portfolios, hear the experts analyze several e-portfolios, and explore key issues involved in developing an authentic assessment.

This forum will be enhanced by also attending one of three NECC workshops:

- Design and Develop NETS-Based Electronic Portfolios Using Common Software Tools

- Assess Technology-Using Teachers: NETS for Teachers, Performance Standards, and Portfolios
- Digital Portfolios for Students, Teachers, and Schools

Forum Housing: A special block of rooms has been reserved for forum registrants. If you plan to attend this preNECC event, be sure to confirm your housing before the early cutoff date of April 1, 2002.

Preregistration and payment ($160) for this forum are required. Enrollment in the forum and the workshops is limited.

Questions about ISTE's Assessment & Technology Forum can be addressed to Chris Traver at ISTE.

Friday, June 14, 8:30 am—4:30 pm, Hyatt Regency San Antonio

ISTE Affiliates' Meeting & Reception top | next | previous

Affiliate representatives will gather for two events at NECC this year. Interested organizations and current Affiliates are invited to attend a reception Friday night. Join us for dessert and to meet and network with fellow Affiliates. The following day, all Affiliates are invited to the annual working meeting covering such topics as: staffing a not-for-profit, membership services, legislative issues, and funding sources. For more information and to RSVP, contact Sarah Nichols, phone: 1.541.434.8900; fax: 1.541.302.3781; e-mail: snichols@iste.org

Friday, June 14, 7—9 pm, and Saturday, June 15, 7:30 am—5:30 pm, Hyatt Regency San Antonio

International Attendees' Reception top | next | previous

Hosted by ISTE, this event provides international attendees the opportunity to meet other international guests, share global perspectives on the integration of technology into the learning experience, and learn how to make the most of the NECC experience. Light refreshments will be served; admission is complimentary.

Sunday, June 16, 4 5:15 pm, Henry B. Gonzalez Convention Center, Room 210

Special for Newcomers top | next | previous

Your first time at NECC? Come to the Newcomers' Session. Gather insights about how to build your plan for a successful NECC by integrating workshops, concurrent sessions, special forums, the Exhibit Hall, e-mail stations, electronic scheduler, and more...all while networking with other NECC Newcomers.

Sunday, June 16, 5:45—6:45 pm, Henry B. Gonzalez Convention Center, Ballroom B; this session repeats on Monday and Tuesday from 7:15—8:15 am

Opening Reception top | next | previous

Get your conference week off to a terrific start at the Opening Reception! This fiesta-themed event promises something for everyone, including food, beverages, music, and featured entertainment:

- Carnaval de San Anto, whose dancers and drummers revel in the carnival rhythms of Caribbean and Bahian Samba, Reggae, and Cumbias
- Mariachi Aguila, a service-based mariachi troupe from the Fine Arts Department of Brackenridge High School, whose goal is to represent its families, community, and school in a manner that reflects their culture positively
- Southwest Mariachis, one of the most popular performing groups in the community, whose special blend of traditional and newer styles delights audiences wherever it performs
- Ferdi Serim and Friends will lift your spirits and get you dancing to Latin, African, and straight-ahead rhythms of joyous jazz!

Don't forget to pick up your attendee badge in the registration area at the convention center upon arrival, as it's required for admission. Shuttles will run continuously between conference hotels and the convention center.

Sunday, June 16, 7-9 pm, Henry B. Gonzalez Convention Center, Second Level: Park View and Tower View Lobbies

Kids' Camp: SeaWorld Amazing Animals top | next | previous

Bring your kids to NECC this year, and treat them to three days of learning activities at SeaWorld. Specially designed for the children of NECC 2002 participants, kids from 6—16 can enjoy a professionally executed educational experience that integrates animal interactions, learning, and fun.

Kids can register for one, two, or all three days (8 am—4:30 pm). Cost is $65/day per child, including lunch.

- Monday, June 17 Details
- Tuesday, June 18 Details
- Wednesday, June 19 Details

REGISTRATION CLOSED as of Monday, May 27th. No onsite registration will be available, due to the need to plan ahead for instructors, meals, etc.

NECC Exhibit Hall top | next | previous

Be sure to visit the largest educational technology exhibit in the world, featuring 1,100+ booths and more than 400 companies. Refer to the Exhibit Guide in your registration bag for a complete listing of exhibitors and descriptions of each—or download it to your PDA via Bluefish. Or, use the Online Planner to map out your Exhibit Hall experience.

New Exhibitor Networking Game–Play the New Exhibitor Networking Game for

a chance to win a new Apple iMac computer! One very lucky individual will win a computer just for playing the New Exhibitor Networking Game. Don't miss the opportunity to have fun, get educated, and visit the newest exhibitors in the Exhibit Hall. See game card in your registration bag for all the details

Exhibit Hall Hours
Monday, June 17, 9:45 am—5:30 pm
Tuesday, June 18, 9:30 am—5 pm
Wednesday, June 19, 9:30 am—2:30 pm

Monday Continental Breakfast in the Exhibit Hall top | next | previous

Immediately following the opening keynote session, please join us in the Exhibit Hall for a complimentary continental breakfast. Take your first stroll through the largest national educational technology exhibit in the world.

Monday, June 17, 9:45—10:15 am, Henry B. Gonzalez Convention Center, Exhibit Halls A—C

Student Showcase Highlights Innovative Projects top | next | previous

Students will present creative projects that use technology to facilitate learning. Questions will be answered, and handouts will be provided. All levels and areas of education are represented. See great ideas successfully implemented!

For more details, go to the Session search page in the Program DB and choose Student Showcase as the category.

Sponsored by Adobe Systems, Inc.(Booth 2332)

Monday, June 17, and Tuesday, June 18, 10 am—12 noon, 1:30—3:30 pm; Wednesday, June 19, 10 am—12 noon; Henry B. Gonzalez Convention Center, Tower View Lobby

Corporate CEO Spotlights top | next | previous

Corporate CEO Spotlights are debuting this year as a new concurrent sessions strand. Throughout the daily program, CEOs or other leaders from our corporate sponsors will be featured in one-hour sessions intended to keep you informed about the vision and latest direction of some of the most committed companies in the field. More Details

Birds-of-a-Feather Roundtables top | next | previous

A nexus of like-minded populations gathering and networking on prearranged topics forms the basis for Birds-of-a-Feather sessions. Held in an intimate roundtable environment (10 seats per table), or meeting rooms, they are a perfect leadership opportunity for budding presenters and for

those wanting to build their own cadre.

Listings of prescheduled sessions and roundtables are here. Topics for roundtable format sessions can be submitted onsite in the Onsite Registration area. To be announced in the daily newsletter, sessions must be submitted by 2 pm on Sunday for Monday sessions and by 2 pm Monday for Tuesday sessions. Sign-up for Monday sessions closes at 4 pm Monday, and at 4:45 pm Tuesday for Tuesday sessions.

Monday, June 17, 5–6 pm, and Tuesday, June 18, 5:45–6:45 pm, Henry B. Gonzalez Convention Center, Ballroom A and additional meeting rooms as noted in the final program.

Monday Night Extravaganza at the Far West Rodeo top | next | previous

Better break in your boots! NECC attendees wanting to kick up their heels in true honky-tonk style won't want to miss this rollicking event, held offsite at the Far West Rodeo grounds, a 15-minute motor coach ride from the convention center. The all-indoor, air-conditioned arena features a live rodeo arena, complete with bull-riding, barrel racing, and rodeo clowns. Three dance floors, line-dancing lessons, a live band, and a mechanical bull are also featured.

Video screens throughout the facility simulcast the rodeo so participants don't miss any action. We invite all participants to get into the spirit and come wearing their best "cowboy" duds—line dancing follows the 45-minute rodeo. Registration is limited to 2,500 participants, so register early. Just $30 per person includes admission, buffet barbecue dinner, two complimentary drink tickets, and transportation to and from the conference hotels. Plenty of close-in complimentary parking is available for those driving to this event.

Monday, June 17, 6:30—10 pm; buses depart hotels and convention center beginning at 6:00 pm. (Note new times; supercedes text in Advance Program.)

Tuesday 5K Fun Run/Walk top | next | previous

Start your morning off right with this traditional NECC event. Each runner/walker will receive refreshments and a commemorative T-shirt following the event. Sign up onsite at the Information Booth located in the Advance Registration Lobby at the Henry B. Gonzalez Convention Center. Free to all NECC 2002 attendees and badged conference guests, but space is limited to 200 and sign-up will be on a first-come basis.

Sponsored by Visions Technology in Education(Booth 2108)

Tuesday, June 18, 7—8:30 am. Meet at the Marriott River Center lobby (across the street from the Convention Center) at 6:30 am.

Free Hands-on Labs top | next | previous

The following labs are free, due to the generosity of our Sponsors:

- **Hands-on with Adobe Web Software**

Wednesday, June 19, 8 am–12 noon, Room 202
Get introduced to the ease with which dynamic HTML can be added to Web pages without programming using GoLive. Add animation, remote rollovers, popup menus, and more from within the program. Also learn to use Adobe LiveMotion to create Flash animations for use in Web pages. Create text and objects, work with layers, create rollovers and remote rollovers, and explore animations.

- **Bring Your Lessons To Life with Think.com and Sun**
  Wednesday, June 19, 9 am–12 noon, Room 203
  Join a guided hands-on tour of Think.com's free Web-hosted and protected collaborative environment for K–12 schools, and learn about free teacher-created productivity resources for StarOffice from Sun Microsystems.

PT3 Grantees' Showcase top | next | previous

Focus on teacher education at the brand-new PT3 Grantees' Showcase and Showcase Exhibit. The Showcase Exhibit will feature 23 grants selected from among the 310 national grants to colleges and universities in the United States that were designated in 2000 and 2001 by the U.S. Department of Education as having the most innovative, replicable, and sustainable information technology projects in the country. Join us Tuesday, June 18, in the Tower View Lobby from 10 am–noon and 1:30–3:30 pm. The top four of these grants will be featured in the PT3 Grantees' Showcase Sessions, Wednesday, June 19, during the daily concurrent session timeslots. More Details

Exhibit: Tuesday, June 18, 10 am–noon and 1:30–3:30 pm. Henry B. Gonzalez Convention Center, Tower View Lobby.

Showcase: Wednesday, June 19, during the daily concurrent session timeslots.

Second Annual NECC Administrators' Forum top | next | previous

Don't Be Left Behind: Finding & Applying for Federal Funding for Education Technology
Chancery is proud to host the annual NECC Administrators' Forum for superintendents, district technology managers, and other school administrators. This exclusive briefing will provide a forum for education thought leaders and decision-makers to come together and exchange insights on the most current technology-related issues in K-12 schools & districts.

This limited-seating two-and-a-half hour session brings together leaders and authorities in education funding to provide administrators with:

- A better understanding of new legislation and how it affects technology funding
- Ideas on how to better apply the new legislation to secure additional funding
- Suggestions on how to use technology to prove eligibility for increased funding

Learn where the funding can be found with:

- John P. Bailey, Director, Office of Educational Technology, U. S. Department of Education
- Judy Rimato, Director of Technology, Klein Independent School District, Texas

Registration for this event is by RSVP on a first-come basis, limited to the first 400 participants. Check the option when you register online, or add it to your existing registration by either

reaccessing your registration online, by e-mailing registration@neccsite.org, or by calling toll-free 1.800.280.6218.

You can get additional details about the forum at www.chancery.com/necc. Sponsored by Chancery Student Management Solutions (Booth 2606)

Tuesday, June 18, 2–4:30 pm, Marriott Rivercenter, Salon K, followed by a hosted cocktail reception, 4:30–6 pm.

Tuesday Predance Mini-Mall top | next | previous

The Mini-Mall is your chance to purchase software, hardware, and materials from participating exhibitors. Sack-sitting will be available for those attending the dance. While you shop, listen to the sounds of the Southwest Jazz Ensemble I performing a variety of music from traditional '40s and '50s Big Band swing to current fusion jazz, under the direction of Richard Flores. Admission is free to all attendees and badged conference guests.

Tuesday, June 18, 6:30—9 pm, Henry B. Gonzalez Convention Center, Ballroom C Lobby (overlooking the Park View and Tower View Lobbies)

Tuesday Dance/Social top | next | previous

Dance to the music of *Rotel & The Hot Tomatoes,* an eight-piece band fronted by three dynamic women. These women will knock you out with their hairdos (everything is bigger in Texas!) and costumes while performing the best tunes of the '50s, '60s, and '70s. Attendees will receive tickets good for one hosted drink of their choice (including beer, wine, and margaritas) and are invited to indulge their late-night sweet tooth at our dessert buffet with gourmet coffees. Continuous transportation between conference hotels and the convention center will be provided. Admission is complimentary for all attendees, exhibitors, and badged conference guests.

Tuesday, June 18, 9–11:30 pm, Henry B. Gonzalez Convention Center, Ballroom C

TCET Teaching & Learning Symposium: Preparing Educators to Use Technology top | next | previous

The Symposium, funded as a part of a PT3 initiative granted to the Texas Center for Educational Technology (TCET), is a forum to discuss teaching, learning, and technology. This year's Symposium features a variety of technology-related strands with a deliberate focus on the Federal PT3 initiative through a series of conversations between key participants. Important issues will include:

- Technology mentoring
- Technology academies and institutes
- Faculty development issues
- Collaborative strategies
- Curriculum development issues

Please address questions directly to the TCET Symposium coordinator, Debi Burson.

Wednesday, June 19–Thursday, June 20, 8 am–5 pm. Cost for both days is $70 with NECC full or one-day Registration; $125 without NECC registration. Sessions will be held at the Henry B. Gonzalez Convention Center and the St. Anthony Hotel.

Take me to Registration now!

Wednesday Conference Luncheon with Toody Byrd top | next | previous

Join us for a heartwarming presentation by a Texas treasure—Toody Byrd. She will remind us about what students need the most and that "laughing first is a pretty good thing to learn to do when you're working with kids...or teachers...or principals...or spouses." Enjoy old-time Texas fiddle music provided by Regina Mathews and the Jurassic Cowboys. Luncheon attendees are offered their choice of sweet soy salmon, Asian barbecue chicken, and an angel hair pasta vegetarian selection. Coffee, tea, iced tea, and your choice of dessert are included. Ticket price, including meal, is $30 per person. Please check the appropriate place on your registration form.

Sponsored by Think.com(Booth 1010) & Sun Microsystems(Booth 1518)

Wednesday, June 19, 11:45 am—1:15 pm, Henry B. Gonzalez Convention Center, Ballroom C

Closing Session Giveaways, ISTE Membership Meeting, & NECC 2003 Preview top | previous

The NECC Closing Session features the annual ISTE Membership Meeting, closing giveaways, and the preview of NECC 2003: Visions and Reflections. A grand drawing of special prizes including an iMac (New Exhibitor Networking Game); a complete school-wide Bluefish beaming system, server, and training hardware; an HP Compaq iPaq; educational software; and an airfare/ registration package for NECC 2003. Guest registrants are not eligible for prizes. Your registration badge is your drawing ticket; you must be present and have photo ID to win.

> The ISTE Membership Meeting: Presented by co-presidents of the "new" ISTE Board, Cheryl Williams and Cathleen Norris, and CEO Don Knezek, the annual ISTE Membership meeting is a special event this year. Extend your NECC 2002 experience beyond San Antonio with news and briefings on:
>
> - The "new" ISTE organizational merger with NECA
> - Exciting ISTE mission-driven programs and membership projects
> - Future directions and upcoming opportunities
> - Recognition of key contributors
> - Special Interest Group awards

Wednesday, June 19, 4:15–5:30 pm, Henry B. Gonzalez Convention Center, Hall D

Student and Educator Performances top | previous

Look for the following student and educator music groups during the conference:

- **Mariachi Aguila,** a service-based organization from the Fine Arts Department of Brackenridge High School, whose goal is to represent its families, community, and school in a manner that reflects their culture positively, will perform at the Opening Reception.
- **Southwest Mariachis** will treat us with a special blend of traditional and newer styles at the Opening Reception under the direction of Eddie Perales and his associate, Homer

Gutierez.

- **Prairie Creek Elementary Sign Choir** includes hearing and hearing-impaired students from the fifth and sixth grades. The choir builds a bridge between the hearing and hearing-impaired communities and raises awareness of the beauty of sign language for all. Their repertoire includes patriotic, inspirational, and fun selections. They will perform before the Monday General Session. *Sponsored by Julia Flaning and Janis Anderson, Deaf Education interpreters.*
- Not to be outdone by the students, educators Dave Thornburg, Lou Fournier, and Ferdi Serim, the **Bluesmen of the Silicon Delta**, who thrilled packed audiences at NECC 2001, are back to perform their latest songs about the angst of the high-tech world and the world of technology-using educators. Thrill to their latest hits including, "I've Been Control-Alt-Deleted from the Hard Drive of Your Heart!" They'll be performing in the Lila Cockrell Theater during Monday's Birds-of-a- Feather timeslot.
- **The Southwest High School Singers** will perform a blend of folk songs, American anthems, patriotic, and uniquely American music at the Tuesday afternoon refreshment break under the direction of Eddie Perales.
- **The Southwest Jazz Ensemble I** performs a variety of music from traditional '40s and '50s Big Band swing to current fusion jazz. Many players have been cited as outstanding soloists in competitions this year, and the band has won numerous first-place honors at jazz festivals. Directed by Richard Flores, they will perform at the Tuesday night predance Mini-Mall.

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WHAT YOUR REGISTRATION INCLUDES

- Participation in your choice of more than 400 Concurrent Sessions
- Birds-of-a-Feather Roundtables (Monday & Tuesday evenings)
- Poster & Web Poster Sessions
- Special Newcomers' Sessions
- Student Showcase
- Daily Keynote & Spotlight speakers
- Unlimited access to the largest ed tech exhibit in the world
- Opening Reception on Sunday evening
- Tuesday morning Fun Run/Walk
- Tuesday evening Dance & Mini-Mall
- Access to more than 200 Internet/e-mail stations located throughout the San Antonio Convention Center
- Complimentary shuttle transportation between conference hotels & San Antonio Convention Center (Friday–Wednesday)
- Eligibility for the NECC 2002 Closing Session giveaways (Wednesday)
- Two complimentary refreshment breaks per day, including Monday morning Continental Breakfast in the Exhibit Hall
- Access to the NECC 2002 commemorative Web site, containing presenter abstracts, research papers, Internet resources, & presenter handouts
- High-quality registration bag with embroidered conference logo

One-day registrants can enjoy all of the above, limited to the day of registration!

Past NECC attendees and NECC 2002 registrants will automatically be mailed our Advance Program (in Spring 2002). If you're not already on those lists and would like to receive our brochures, please send an e-mail with your address to info@neccsite.org.

Registration Costs

QUESTIONS?

For help or additional instructions, please call the registration office at 1.800.280.6218 (U.S. only), or 541.346.3537 (8 am–5 pm Pacific Time), or send e-mail to registration@neccsite.org.

Guest Rate
The $50 guest fee includes entrance into the Exhibit Hall (16 years old and older), Opening Reception, and Dance/Social. One guest per attendee.

Student Rate
A student rate is available to full-time students who show proof of enrollment at the time of registration. Please provide your student ID number and school name. No one younger than 16 will be admitted to the Exhibit Hall.

Retired Educator Rate
In support of retired educators, NECC is offering a discount rate.

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NECC Workshops

Search Workshops!

Enhance your conference experience! NECC workshops offer a chance to learn new skills, gain new knowledge, and explore topics in more depth than time allows during regular conference sessions. NECC workshops are offered both before and during the conference, June 15-18.

Workshop Registration	Workshop Skill Level
Workshop Times	Spotlight Workshops
Workshop Formats	V-NECC Workshops
Workshop Transportation	Texas Showcase Workshops
Workshop Platforms	

Workshop Registration top

Registration for workshops is on a first-come, first-served basis. Additional fees are required and are not included in the full conference registration fee. Workshop enrollment is limited due to equipment and presenter constraints. To help ensure that we are able to accommodate your request, it is recommended that you select second and third workshop choices on your registration form.

Half-day (3 hours) $80
Full-day (6 hours) $160*
Two-day (12 hours) $320*
* Includes boxed lunch

Workshop Times top

Morning Workshops
8:30-11:30 am

Afternoon Workshops
1:30-4:30 pm

Full-day Workshops
9 am-4 pm

Two-day Workshops
9 am-4 pm
Saturday & Sunday

iste

NECC 2002 Workshops are organized and operated by the International Society for Technology in Education (ISTE). ISTE is a membership organization that promotes appropriate uses of technology in K-12 and teacher education. For more information on how ISTE supports and connects teachers with technology resources, visit www.iste.org.

Workshop Formats top

Hands-on workshops are conducted in computer labs with no more than two participants to a computer unless otherwise specified.

Seminar/Demo workshops are presented in demonstration, panel discussion, or lecture format and may or may not include some hands-on activities.

Field Trip workshops take place at offsite destinations of particular topical or local interest and may or may not involve hands-on computer or non-computer activities.

Workshop Transportation top

Transportation is provided for all offsite workshops with the exception of the field trip to the Institute of Texan Cultures (ITC), which is located within walking distance of the convention center. Buses will depart from and return to the Lila Cockrell Theater entrance to the convention center.

All workshop transportation is by shuttle unless otherwise specified. For most participants, this means you do not need to catch a specific bus. Simply take the next available shuttle to your designated workshop location.

Workshop shuttles will commence approximately one hour before the workshop start times and will depart approximately every 5–10 minutes until the last shuttle. Estimated travel time to offsite workshops is 20–30 minutes, depending on traffic.

Parking at offsite workshop facilities is limited and is available on a first-come basis. There is also a charge for parking at the ITC. Therefore, participants are strongly urged to take the workshop shuttles.

IMPORTANT! NECC will not be responsible for providing alternate transportation for participants who miss their buses, or for workshops missed due to unavailability of parking.

Offsite workshop locations do not offer availability or easy access to food or beverages (including coffee). Participants are advised to plan accordingly. Box lunches are provided for full-day and two-day workshop participants.

For shuttle schedule details and a location key, be sure to read the Workshop Transportation section of the Confirmation Materials. (opens in new window)

Workshop Platforms top

PC workshops are geared toward Windows-based tools and applications. If hands-on, they are conducted in computer labs with Windows-based environments.

Macintosh workshops are geared toward Mac-based tools and applications. If hands-on, they are conducted in computer labs with Macintosh-based environments.

Either workshops are not platform specific. However, due to availability, they are typically conducted in computer labs with Windows-based environments.

None indicates workshop does not involve platform-based subject matter.

Workshop Skill Level top

Novice indicates that the workshop is designed for participants with limited or no experience with content; no prerequisite skills required.

Intermediate indicates that the workshop is designed for participants with some experience in content; may require prerequisite skills.

Advanced indicates that the workshop is designed for participants with significant experience in content who are looking to expand their knowledge; may require prerequisite skills.

All indicates that the workshop is designed for participants of all experience and skill levels.

Spotlight Workshops top

SPOTLIGHT WORKSHOP indicates presenter is a recognized leader in the educational technology field. Many of our spotlight workshop presenters are also presenting keynote or spotlight sessions in the main conference program.

V-NECC Workshops top

indicates a V-NECC workshop with a pre/post or distance component extending the conference over time and place.

Texas Showcase Workshops top

indicates a Texas Showcase workshop, which features local presenter(s) and/or topics of specific interest to Texas educators.

NECC 2002 Snapshot Survey

Welcome to the survey! The questions are broken up into seven sections. The first section asks about who you are and what your role is in education. Please give answers to each of the questions and then click FINISH at the bottom of the page.

Contact: Snapshot Survey Team
Technical Questions: benlevy@mac.com

Demographics

Position:

O Administrator O Teacher/Faculty O Student
O Tech Coordinator/Media Specialist O Staff O Other

Level:

O Preschool O Elementary O Secondary O District O State
O Federal O Community College O College/University O Industry O Self-Employed
O Other

Are you a member of an ISTE Affiliate organization or a Cooperating Professional Organization?

O Yes O No O Don't Know

If yes, which organization?

Your answer:

Publicity

How did you learn about NECC?

O Brochure O Web O E-mail O Other Conference O Colleague O Other

If you chose *other*, please describe how you learned about NECC.

Your answer:

Were you able to obtain sufficient information about the conference?

O Yes O No

Did you find the NECC Web site helpful and easy to use?

O Yes O No O Did not use

Registration

How did you register for NECC?

O Web O Fax O Phone O Mail O Onsite

Rate the NECC registration process:

O Very difficult O Difficult O Easy O Very easy

My conference registration was paid by:

O Myself O My school O My district O My employer O Other

If you chose *other*, please describe your answer.

Your answer:

If your decision to attend NECC is dependent upon funds from your school, when do you find out if you have funding to attend?

O 6 months prior O 12 months prior O 18 months prior O Other

If you chose *other*, please describe your answer.

Your answer:

Logistics & Facilities

The e-mail stations are a valuable component of the conference.

O Yes O No

Did you use the wireless network?

O Yes O No

Did you use the iBook loaner program?

O Yes O No

My PDA is Palm OS powered.

O Yes O No O Don't have a PDA

I used the Bluefish beaming stations.

O Yes O No O Don't have a PDA

Please enter any comment you may have about the Bluefish beaming stations.

Your answer:

I am interested in NECC continuing to provide PDA-based resources.

O Yes O No

Rate the NECC housing reservation process:

O Did not use O Poor O Fair O Good O Excellent

Rate the hotel-to-convention center shuttle service provided at NECC:

O Did not use O Poor O Fair O Good O Excellent

Did you have any safety concerns with respect to the conference?

O Yes O No

If yes, please describe.

Your answer:

Did you have any ADA-related concerns with respect to the conference?

O Yes O No

If yes, please describe.

Your answer:

Tours & Social Events

Rate the quality of the NECC social activities:

O Did not participate O Poor O Fair O Good O Excellent

Please indicate which of the following social activities you participated in:

☐ Opening Reception ☐ Monday Night: Far West Rodeo ☐ Tuesday Fun Run

☐ Tuesday Dance/Social ☐ Wednesday Luncheon

Rate the quality of Kids' Camp -- SeaWorld Amazing Animals:

O Did not participate O Poor O Fair O Good O Excellent

Rate the quality of the NECC tours:

O Did not participate O Poor O Fair O Good O Excellent

What was your main reason for registering for tours?

O Interested in activity O Entertaining spouse/child O Saturday-stay airfare O Other

If you chose *other*, please describe your answer.

Your answer: [ ]

Did you participate in any social activities not sponsored by NECC (e.g., exhibitor or association receptions)?

○ Yes ○ No

Exhibits

How many hours did you spend in the Exhibit Hall?

○ None ○ 1-2 hours ○ 3-4 hours ○ 4-5 hours ○ More than 5 hours

How would you rate the NECC Exhibit Hall?

○ Did not participate ○ Poor ○ Fair ○ Good ○ Excellent

Do you think the NECC Exhibit Hall should stay open evenings?

○ Yes ○ No

Conference Program

Rate the overall quality of the conference program (keynotes, spotlight, concurrent, poster, and paper sessions):

○ Poor ○ Fair ○ Good ○ Excellent

The sessions provided useful ideas and knowledge that are applicable to my job.
Please rate from 1 to 5, where 1 means "disagree" and 5 means "strongly agree."

○ 1 ○ 2 ○ 3 ○ 4 ○ 5

Was the Student Showcase a valuable component of the program?

○ Not valuable ○ Valuable ○ Very valuable

Did you find the Birds-of-a-Feather Roundtables useful?

○ Yes ○ No ○ Did not attend

The Corporate CEO Spotlights were valuable.
Please rate from 1 to 5, where 1 means "disagree" and 5 means "strongly agree."

○ 1 ○ 2 ○ 3 ○ 4 ○ 5 ○ N/A

Please indicate if you participated in any of the following

☐ Workshops ☐ Make & Take Sessions ☐ Misc. Symposia/Forums

Did they meet your expectations?

○ Yes ○ No

List the best presentations you attended at NECC 2002:

Your answer:

List any presentations that were not the quality you would expect at NECC:

Your answer:

What were the hottest topics for you at NECC this year?

Your answer:

What topics were missing or needed more coverage?

Your answer:

For any items rated poor, not valuable, or unsatisfactory in any way, please explain so that we can improve.

Your answer:

Any additional comments or suggestions?

Your answer:

Apple iBook Drawing

The following questions ask for your name and e-mail address. These are not required to complete the evaluation, but they must be submitted in order for your name to be entered into the post-conference drawing for a brand-new Apple iBook. NECC WILL NOT SHARE YOUR E-MAIL WITH ANY ENTITY.

Please enter your name.

Your answer:

Please enter your e-mail address.

Your answer: [ ]

We will add your e-mail to the NECC mailing list unless you click on the box requesting that we do not.

☐ Do not add me to the NECC e-mail list

Clear Answers | Finish

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Post-NECC Update

- Go to Presenter Handouts to view handouts submitted before and after NECC.
- Go to The Sound of Knowledge Web site to order CD-ROM audio recordings of selected sessions.

Welcome!

The NECC 2002 Program Committee has created a program that is a nexus of opportunities for discussion on harnessing the power of technology to improve students' learning. Expert reviewers from across the United States devoted hundreds of hours to selecting the best presentation proposals in order to bring you the broadest, most inspiring, and useful program possible.

The program focuses on the essential conditions necessary for technology to fulfill its promise in education—shared vision, access to hardware and software, professional development, technical assistance, content and technology standards and curriculum resources, student-centered teaching, assessment, and community support and support policies. The program content is tied to the NETS for students, teachers, and administrators.

Over the two preconference and three conference days, the NECC 2002 Program features:

- Keynotes (one each conference day plus a luncheon keynote*)
- Workshops (180+ over the conference days)
- Make & Take Sessions* (20 over the conference days)
- Concurrent Sessions (300+ over the conference days)
- Research Papers (50+ over the conference days)
- Posters & Web Poster Sessions (approx. 60 each over the conference days)
- Student Showcases (15+ over the conference days)
- PT3 Grantees' Showcase (Four sessions on one dedicated day)
- Corporate CEO Spotlights (10+ over the conference days)

* The luncheon, workshops, and Make & Takes require preregistration

Your Guide to the NECC Program

Take me to the Workshops!

Take me to the Sessions!

Take a tour through NECC!

Final Program

THANKS!
Special thanks to all the volunteer and staff experts who collaborated over the last 24 months to create the best possible program format and content.
-Program Committee

and purchase of an additional ticket.

Use the session and workshop search engines to read about all the offerings for each of these categories.

Use the Online Conference Planner to help you schedule your time at NECC.

V•NECC—Virtually Extending NECC New this year are some sessions that extend NECC over time and place. These sessions have a pre- and/or postconference component in which the presenters have invited you to take part through mailing lists, threaded discussions, action research projects and other collaborative projects, or online courses. If the topics are of interest, these components will help you get the most out of the session at the conference and possibly extend the conference experience for you.

National Educational Technology Standards (NETS) Each workshop and session in the Program Database lists its NETS classification. To learn more about NETS and NECC:

- Visit the NETS and TEKS page of this site, which details the NETS categories, including how they correlate to the Texas Technology Standards (TEKS) for students and teachers.)
- Read "NETS at NECC" by Dr. M.G. (Peggy Kelly)
- Visit the Web site of the International Society for Technology in Education (ISTE).

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- ISTE Assessment & Tech Forum
- ISTE Affiliates' Reception
- ISTE Affiliates' Meeting
- International Attendees' Reception
- Special for Newcomers
- NECC Administrators' Forum
- TCET Symposium
- Closing Session Giveaways, ISTE Membership Meeting, & NECC 2003 Preview

ISTE Meetings

Auxiliary Meetings

ISTE Assessment & Technology Forum top | next

More information

Join forum chair Dr. Helen Barrett for this first annual pre-NECC focus on Assessment and Technology.

Dr. Barrett brings her experience as assistant professor and coordinator of educational technology at the University Alaska Anchorage School of Education and project co-director for the International Society for Technology in Education's (ISTE) Community & Assessment PT3 grant to this exciting activity designed to:

- raise awareness of various stakeholders on options available for using technology to support authentic assessment, and
- begin a national conversation on the use of technology for supporting authentic assessment and electronic portfolios and the broader use of technology as a tool to assess learning in general.

Attendees will have the opportunity to critique existing electronic portfolios, hear the experts analyze several e-portfolios and explore key issues involved in developing an authentic assessment.

This forum will be enhanced by also attending one of three NECC workshops:

- Design and Develop NETS-Based Electronic Portfolios Using Common Software Tools
- Assess Technology-Using Teachers: NETS for Teachers, Performance Standards, and Portfolios
- Digital Portfolios for Students, Teachers, and Schools

Forum Housing: A special block of rooms has been reserved for forum registrants. If you plan to attend this preNECC event, be sure to confirm your housing before the early cutoff date of April 1, 2002.

Preregistration and payment ($160) for this forum are required. Enrollment in the forum and the workshops is limited.

Questions about ISTE's Assessment & Technology Forum can be addressed to

Chris Traver at ISTE.

Friday, June 14, 8:30 am—4:30 pm, Hyatt Regency San Antonio

ISTE Affiliates' Meeting & Reception top | next | previous

Affiliate representatives will gather for two events at NECC this year. Interested organizations and current Affiliates are invited to attend a reception Friday night. Join us for dessert and to meet and network with fellow Affiliates. The following day, all Affiliates are invited to the annual working meeting covering such topics as: staffing a not-for-profit, membership services, legislative issues, and funding sources. For more information and to RSVP, contact Sarah Nichols, phone: 1.541.434.8900; fax: 1.541.302.3781; e-mail: snichols@iste.org

Friday, June 14, 7—9 pm, and Saturday, June 15, 7:30 am—5 pm, Hyatt Regency San Antonio

International Attendees' Reception top | next | previous

Hosted by ISTE, this event provides international attendees the opportunity to meet other international guests, share global perspectives on the integration of technology into the learning experience, and learn how to make the most of the NECC experience. Light refreshments will be served; admission is complimentary.

Sunday, June 16, 4—5:15 pm, Henry B. Gonzalez Convention Center, Room 210

Special for Newcomers top | next | previous

Your first time at NECC? Come to the Newcomers' Session. Gather insights about how to build your plan for a successful NECC by integrating workshops, concurrent sessions, special forums, the Exhibit Hall, e-mail stations, electronic scheduler, and more...all while networking with other NECC Newcomers.

Sunday, June 16, 5:45—6:45 pm, Henry B. Gonzalez Convention Center, Ballroom B; this session repeats on Monday and Tuesday from 7:15—8:15 am

Second Annual NECC Administrators' Forum top | next | previous

Don't Be Left Behind: Finding & Applying for Federal Funding for Education Technology
Chancery is proud to host the annual NECC Administrators' Forum for superintendents, district technology managers, and other school administrators. This exclusive briefing will provide a forum for education

thought leaders and decision-makers to come together and exchange insights on the most current technology-related issues in K-12 schools & districts.

This limited-seating two-and-a-half hour session brings together leaders and authorities in education funding to provide administrators with:

- A better understanding of new legislation and how it affects technology funding
- Ideas on how to better apply the new legislation to secure additional funding
- Suggestions on how to use technology to prove eligibility for increased funding

Learn where the funding can be found with:

- John P. Bailey, Director, Office of Educational Technology, U.S. Department of Education
- Judy Rimato, Director of Technology, Klein Independent School District, Texas

Registration for this event is by RSVP on a first-come basis, limited to the first 400 participants. Check the option when you register online, or add it to your existing registration by either reaccessing your registration online, by e-mailing registration@neccsite.org, or by calling toll-free 1.800.280.6218.

You can get additional details about the forum at www.chancery.com/necc.
Sponsored by Chancery Student Management Solutions (Booth #2606)

Tuesday, June 18, 2–4:30 pm, Marriott Rivercenter, Salon K.
Reception to follow, 4:30–6 pm (appetizers and cocktails included).

TCET Teaching & Learning Symposium: Preparing Educators to Use Technology

top | next | previous

The Symposium, funded as a part of a PT3 initiative granted to the Texas Center for Educational Technology (TCET), is a forum to discuss teaching, learning, and technology. This year's Symposium features a variety of technology-related strands with a deliberate focus on the Federal PT3 initiative through a series of conversations between key participants. Important issues will include:

- Technology mentoring
- Technology academies and institutes
- Faculty development issues
- Collaborative strategies
- Curriculum development issues

Please address questions directly to the TCET Symposium coordinator, Debi Burson.

Wednesday, June 19–Thursday, June 20, 8 am–5 pm. Cost for both days is $70 with NECC full or one-day Registration; $125 without NECC registration. Sessions will be held at the Henry B. Gonzalez Convention Center and the St. Anthony Hotel.

Take me to Registration now!

Closing Session Giveaways, ISTE Membership Meeting, & NECC 2003 Preview top | previous

The NECC Closing Session features the annual ISTE Membership Meeting, closing giveaways, and the preview of NECC 2003: Visions and Reflections. A grand drawing of special prizes including an iMac (New Exhibitor Networking Game); a complete school-wide Bluefish beaming system, server, and training hardware; an HP Compaq iPaq; educational software; and an airfare/ registration package for NECC 2003. Guest registrants are not eligible for prizes. Your registration badge is your drawing ticket; you must be present and have photo ID to win.

The ISTE Membership Meeting: Presented by co-presidents of the "new" ISTE Board, Cheryl Williams and Cathleen Norris, and CEO Don Knezek, the annual ISTE Membership meeting is a special event this year. Extend your NECC 2002 experience beyond San Antonio with news and briefings on:

- The "new" ISTE organizational merger with NECA
- Exciting ISTE mission-driven programs and membership projects
- Future directions and upcoming opportunities
- Recognition of key contributors
- Special Interest Group awards

Wednesday, June 19, 4:15–5:30 pm, Henry B. Gonzalez Convention Center, Hall D

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NECC 2002 Tours

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The deadline for tour registration is May 15, 2002.

Tour enrollment will be assessed at this time, and participants who have registered for under-enrolled tours will be contacted immediately regarding substitution or refund options. Onsite registration will be limited and will be accommodated on a space-available basis.

All tours will depart from and return to the Henry B. Gonzalez Convention Center, Market Street side, except where noted in the Tour Details.

Please plan to arrive in the bus loading area 30 minutes before the scheduled tour departure time.

For more information on individual tours, including cost and transportation, see the Tour Details.

Go to Registration to sign up for tours for you and your family. Be sure to read through the Tour Cancellation Policy.

Saturday Tours

VIVA SAN ANTONIO!
8:30 am–12:30 pm

THE PRICE OF FREEDOM
1:30–4:30 pm

AN EVENING AT THE DIAMOND W LONGHORN RANCH
6–9:30 pm

Sunday Tours

THE PRICE OF FREEDOM
8:30–11:30 am

LYNDON BAINES JOHNSON NATIONAL HISTORICAL PARK AND FREDERICKSBURG
8:30 am–5 pm

A WHALE OF A DAY AT SEAWORLD OF TEXAS
9:30 am–5 pm

Bring the Whole Family!
We're excited that San Antonio can offer conference attendees a variety of sightseeing opportunities. You can choose from the offerings here, or check in with your hotel concierge about spur-of-the-moment options.

Questions?
Please call the registration office at 1.800.280.6218 (US only), or 541.346.3537 (8 am–5 pm Pacific Time), or send e-mail to registration@neccsite.org.

ARTS, FLOWERS, AND HISTORY
1-5 pm

Monday Tours

VIVA SAN ANTONIO!
8:30 am-12:30 pm

HITTIN' THE HILL COUNTRY -- CANCELED
8:30 am-4:30 pm

A ZOOBILATION DAY AT THE SAN ANTONIO ZOOLOGICAL GARDENS -- CANCELED
9 am-3 pm

STEP BACK IN TIME ON THE SAN ANTONIO RIVER
1:30-4 pm

Tuesday Tours

DAY IN THE TEXAS RHINELAND-- CANCELED
8:30 am-2:30 pm

HAVE A BALL AT THE OUTLET MALL! -- CANCELED

9 am-3 pm

FIESTA TEXAS-A SIX FLAGS THEME PARK EVENT
5:30-10 pm

RIVER BOAT DINNER ON THE PASEO DEL RIO
7-8:15 pm

Wednesday Tours

LET'S VISIT AUSTIN, THE CAPITAL OF THE LONE STAR STATE! -- CANCELED
8 am-5 pm

STEP BACK IN TIME ON THE SAN ANTONIO RIVER
9 am-11:30 am

ROUNDTRIP TRANSPORTATION TO SCHLITTERBAHN

WATER PARK -- CANCELED
9:30 am departure, 4:30 pm return

HOMES OF THE PAST-- CANCELED
1–4 pm

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Online Registration is now closed. Thank you for your interest in NECC 2002. Advance registration is now closed but you can still attend the conference!

Please plan to register onsite in the West Lobby of the Henry B. Gonzalez Convention Center. Follow the signs!

Onsite registration hours:

Friday, June 14, 2002	5:30 - 7:30 pm
Saturday, June 15, 2002	7 am - 6 pm
Sunday, June 16, 2002	7 am - 7 pm
Monday, June 17, 2002	7 am - 6 pm
Tuesday, June 18, 2002	7 am - 5:45 pm
Wednesday, June 19, 2002	7:30 am - 3 pm

If you have questions or need assistance, e-mail is preferred:

- registration@neccsite.org
- Telephone: **541.346.3537**
- Toll-free: **800.280.6218**
- Fax: **541.346.3545**
- US Mail:
  NECC 2002 Registration
  1277 University of Oregon
  Eugene, OR 97403-1277

Questions?

For help or additional instructions, please call the registration office at 1.800.280.6218 (U.S. and Canada only), or 541.346.3537 (8 am–5 pm Pacific Time), or send e-mail to registration@neccsite.org.

*NECC 2002 Committee Members have access to **conference reports**. This option is password controlled.*

Return to NECC 2002 Website

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Exhibitor Information

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WELCOME TO THE NECC 2002 EXHIBITS AREA

NECC 2002

Attendees! Visit the live Current Exhibitor Listing and Floorplan to start planning your tour of the hottest ed-tech conference in the world!

Exhibitors! Starting with the Welcome and What it's All About pages, here you'll find everything you need in order to reserve booth space at the largest and most comprehensive educational exhibit in the world! For additional Exhibitor-appropriate pages, please look left to the navigation bar.

Download a pdf of the NECC Exhibit Guide! (4.1 mg)

NECC 2002

Media Information

last modified; 6/3/02

Post-conference Update

Eugene, Ore. — The 23rd Annual National Educational Computing Conference (NECC), held in San Antonio from June 17-19, was attended by 10,875 educators from all over the U.S. and globe that included teachers, administrators, technology coordinators and teacher educators, as well as nearly 3,500 exhibitor personnel.

See our press release for more details.

Representatives of the local, regional, national, and international media are welcome to join us at NECC 2002. Please note that media services this year are changed from those at previous NECCs.

The Media Room/Lounge, located at the Henry B. Gonzales Convention Center in Room 102 A/B, will be open and staffed:

- Sunday, 5—7 pm
- Monday, 8 am—6 pm
- Tuesday, 8 am—6 pm
- Wednesday, 8 am—2 pm

The NECC 2002 Media Conference Stage will be located in the Exhibit Hall. Media briefings on the media conference stage will be booked in thirty-minute increments during the Exhibit Hall hours:

- Monday, 10 am—5:30 pm
- Tuesday, 9:30 am—5 pm
- Wednesday, 9:30 am—2:30 pm

A preliminary schedule for the media conference stage will be available here in June. Updates will be provided at the conference.

Online media Registration will be available through June 3. After that, please register onsite at the conference.

Conference Facts are available here.

NECC 2002 Media Kit

- Welcome to the media (Word document)
- News release (Word document)
- Fact sheet (Word document)
- Media conference stage schedule (Word document)
- Workshops by theme (Acrobat pdf)

Media Contact:

Pat Walsh
pwalsh@ulum.com
NECC 2002 Media Relations
541.434.7021

Other conference contacts

4

- Media survey (Word document)

NOTE: Exhibitors looking for information on media services at NECC can use their password to access the Exhibitor Section or consult their Exhibitor Manuals.

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HOUSING UPDATE (June 2002)
All new hotel reservations, changes/inquiries to existing reservations, and cancellations must now be made directly with the hotel.

Please thoroughly read our cancellation policy. All reservations canceled after April 1, 2002, will be assessed a cancellation fee.

Should you have any questions about this page, please contact Conferon, our housing bureau, toll-free at 888.858.9330 (or 330.425.9003 outside the United States).
Please note that the housing bureau has no further information about the Non-Conference Hotels.

Thank you and we look forward to record numbers in San Antonio!

Conference Hotels

Listed below are the official NECC hotels and their phone numbers. You may contact these hotels directly for reservations. Although the NECC block is full and the NECC special group rate will not be available, you **may** be able to obtain a reservation at the hotel's "current available rate." This rate will vary depending on the time and day that you call, and can also be affected by whether the hotel has a national toll-free reservation system. All numbers listed here are local San Antonio numbers.

Shuttle service will be provided to all these hotels, **except** for the Marriott Rivercenter, the Marriott Riverwalk, the Hilton Palacio Del Rio, and the La Quinta Convention Center, all of which are within an easy walking distance of the convention center.

You can download a map in PDF format that shows the locations of the following hotels. (You will need to download Adobe Reader if you don't already have it installed on your computer.)

Adams Mark Hotel	210.354.2800
AmeriSuites Riverwalk	210.227.6854
Emily Morgan Hotel	210.225.8486
Fairfield Inn by Marriott	210.299.1000
Four Points Sheraton Riverwalk	210.223.9461
Hampton Inn Downtown	210.225.8500
Hawthorn Suites Riverwalk	210.527.1900
Hilton Palacio Del Rio	210.222.1400
Holiday Inn Crockett Hotel	210.225.6500
Holiday Inn Express	210.354.1333
Holiday Inn Market Square	210.225.3211
Holiday Inn Riverwalk	210.224.2500
Homewood Suites Riverwalk	210.222.1515
Hyatt Regency San Antonio	210.222.1234
La Mansion del Rio	210.518.1000
La Quinta Convention Center	210.222.9181
La Quinta Market Square	210.271.0001
Marriott Courtyard	210.229.9449
Marriott Rivercenter	210.223.1000
Marriott Riverwalk	210.224.4555
Menger Hotel	210.223.4361
Plaza San Antonio, A Marriott Hotel	210.229.1000
Radisson Inn Market Square	210.224.7155
Residence Inn Alamo Plaza	210.212.5555
Residence Inn by Marriott Market Square	210.231.6000
Sheraton Gunter Hotel	210.227.3241
St. Anthony, A Wyndham Historic Hotel	210.227.4392
Westin Riverwalk	210.224.6500
Woodfield Suites	210.212.5400

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You may also want to contact the following hotels for reservations. Please be aware that these hotels are NOT part of the official NECC block. We are providing as much information as possible to help assist you in making a hotel reservation. Most of these hotels have access to the trolley line or bus line or may even be within walking distance of the convention center. **NECC will NOT be providing shuttle transportation between the convention center or evening events and these hotels. Tip: if one of these properties is close to an official conference hotel with shuttle service, attendees staying at non-conference hotels are welcome to hop a ride.**

Click here for a city map to view non-conference hotel locations (not all hotels are listed).

Hotel Name	Distance to Convention Center	Transportation
Suzanne Motel	1.25 mile	On trolley line/hotel shuttle
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210.229.9611		
Ranch Motel	2.5.3 miles	Not on trolley line
3101 Broadway St		
210.826.2304		
The Fairmont Hotel	2 blocks	
401 S Alamo		
210.224.8800		
Ramada Limited Downtown	1.5 miles	2 blocks from trolley line
1122 S Laredo St		
210.229.1133		
Super 8 Motel Downtown	1 mile	Not on trolley line
1614 N St Mary's St		
210.222.8833		
Comfort Suites Downtown	1.5 miles	3 blocks from trolley line
1002 S Laredo		
210.472.1002		

Days Inn.Riverwalk	3 blocks	Not on trolley line
902 E Houston St		
210.227.6233		
Travelodge.Alamo	15 minute walk	On trolley line
405 Broadway		
210.222.1000		
Microtel Inn & Suites	.5 mile	Not on trolley line
1025 S Frio St		
210.226.8666		
Days Inn Downtown	1.5 miles	On bus line
1500 Laredo St		
210.271.3334		
Rodeway Inn Downtown	5 min drive	On trolley line
900 N Main Ave		
210.223.2951		
San Antonio Riverwalk	3.5 blocks	On trolley line
Plaza Resort Hotel		
100 Villita St		
210.225.1234		
Villager Lodge	1.5 miles	Not on trolley line
1126 E Elmira St	2.5 blocks to bus stop	
210.222.9463		
Drury Inn & Suites	6 blocks	1 block from trolley line
Riverwalk		

201 N St Mary's St		
210.212.5200		
Red Roof Inn Downtown	3 blocks	On trolley line
1011 E Houston St		
210.229.9973		

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This year in particular, our sincere appreciation is due to these companies whose generosity and commitment to educational technology has made the extensive services and events presented to you possible. We hope that you will make a special effort to join us in thanking them for their support by attending the Corporate CEO Spotlight Sessions, by exploring their booths in the Exhibit Hall, and by visiting their Web sites often.

Tell me more about **Sponsorship Opportunities** for NECC 2002.

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What's in your bag?
Thanks to Dell Computer Corporation for helping to provide NECC with beautiful embroidered tote bag souvenirs for each attendee. Each bag contains the following goodies and resources.

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The first information posted here will be the NECC 2003 Call for Participation—be sure to return in May, 2002.

In the meantime, visit the sites below to learn more about the hosting cities for upcoming NECCs!

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Seattle, WA
June 30-July 2, 2003
(opens in a new window)

New Orleans, LA
June 21-June 23, 2004
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Philadelphia, PA
June 27-June 29, 2005
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San Diego, CA
July 5-July 7, 2006
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NECC 2002 Program

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Research Paper Search Results

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Middle School Technology Use—Design Impediments versus Classroom Needs

Ronald Abate, Cleveland State University

This study isolates several key factors that influence educational technology use in middle schools and identifies design-related constraints associated with current educational technologies.

Format: Research Paper (Lecture)

pdf **abate.pdf**

Effects of Online Learning on Struggling ESL College Writers

Reima Al-Jarf, King Saud University

Integration of online learning into traditional English as a second language (ESL) instruction helped significantly improve ESL college students' writing skills.

Format: Research Paper (Roundtable)

pdf **al-jarf.pdf**

Results of Separate and Integrated Technology Instruction in Preservice Training

Cindy Anderson, National-Louis University, with Arlene Borthwick
This presentation compares surveys of two MAT cohorts on perceived ability to integrate technology for instruction following training using an integrated approach versus a class.

Format: Research Paper (Roundtable)

pdf **anderson.pdf**

Using Multimedia Tools to Evaluate the JASON Multimedia Science Curriculum Impact on Student Learning

Harouna Ba, Center for Children and Technology/EDC, with Caroline Joyce, Steve Coan
This presentation reviews findings from one-year in-depth evaluation of the JASON multimedia science curriculum effects on student learning.

Format: Research Paper (Lecture)

pdf **ba.pdf**

Best Practices in Cyberspace: Motivating the Online Learner

Toni Bellon, North Georgia College & State University, with Richard Oates
This session explores the link between personality styles and preferences for various online course components. Discussion will include strategies for motivating the online learner.

Format: Research Paper (Roundtable)

pdf **bellon.pdf**

Classroom Teachers Working with Software Designers: The Wazzu Widgets Project

Abbie Brown, Washington State University, with Darcy Miller
Find out the results of a year-long project involving K-12 teachers working with software designers to create "learning objects"–small, computer-based tools (widgets) for difficult-to-learn concepts.

Format: Research Paper (Roundtable)

pdf brown.pdf

Interactive Learning Exhibits: Designs for Building Teacher and Student Capacity

Kimberly Burge, Department of Education, U.C. Irvine, with Sue Marshall, Rob Beck
UCI ILE: Preservice teachers employ computer-based technology in the conception, design, construction, and installation of interactive learning exhibits for authentic audiences while fulfilling ISTE NETS.

Format: Research Paper (Lecture)

pdf Burge.pdf

Intel Preservice Teach to the Future at the University of North Texas

Rhonda Christensen, University of North Texas, with Gerald Knezek
Data gathered from 100 preservice educators at the University of North Texas during 2001–2002 is used to compare Intel's curriculum to traditional technology integration format.

Format: Research Paper (Roundtable)

pdf Christensen.pdf

Research, Students with Disabilities, and Technology: Guidelines for Teacher Educators

Karen Clark, Indiana University South Bend

This research review on the effective use of technology with students with disabilities is presented to guide teacher educators as they redesign technology courses.

Format: Research Paper (Lecture)

pdf **Clark.pdf**

Digital Study Groups: Online Learning Communities in Middle School

Kevin Clark, George Mason University, with Todd Jamison

This presentation discuss the results of a research study where seventh-grade students participated in an online learning community.

Format: Research Paper (Roundtable)

Systems Analysis of Learning Theory through Causal Influence Diagramming

Ann Cunningham, Wake Forest University, with Loraine Stewart

This paper presents a study of the effects of causal influence diagramming on student understanding of complex systems in learning theory.

Format: Research Paper (Lecture)

pdf **Cunningham.pdf**

The Adventure of the Discussion Board

Donald Davis, Valley View High School, Moreno Valley, California

Learn to use threaded online discussions to challenge all students—especially those with limited English proficiency—to wrestle with important issues or concepts and offer reasoned responses.

Format: Research Paper (Roundtable)

pdf Davis.pdf

Adding Value to Essay-Question Assessments with Search Path Data

Sara Dexter, University of Minnesota , with Eric Riedel

Peek into your students' thinking behind their essay responses. IMMEX-powered cases supplement essays with data showing how students search for information relevant to essays.

Format: Research Paper (Lecture)

Online Professional Development: Building Administrators' Capacity for Technology Leadership

Peg Ertmer, Purdue University

Examine how an online professional development course facilitated changes in administrators' ideas about technology leadership, including their ideas about supporting teachers' integration efforts.

Format: Research Paper (Lecture)

pdf Ertmer.pdf

Faculty Technology Professional Development: A Pedagogical and Curricular Reform Model

Sherryl Browne Graves, City University of New York, with Mario Kelly

This paper presents the results of a technology professional development project with 16 faculty members engaged in the preparation of teacher candidates.

Format: Research Paper (Lecture)

pdf **BROWN_GRAVES.pdf**

Using Threaded Discussions as a Discourse Support

Gregory Gray, Irvine High School

Online threaded discussions, as discourse supports, facilitate deeper levels of student understanding. Applying discussion strategies online creates an underpinning to do intellectual work.

Format: Research Paper (Roundtable)

pdf **Gray.pdf**

Student Accountability Using Powerschool

Linda Hampton, Meade School District 46-1, with Donna Sigman, Cathie Anderson

Powerschool makes it possible for both students and parents alike to view the current grades, attendance, and comments at any time.

Format: Research Paper (Roundtable)

pdf **Hampton.pdf**

Environmental and Personal Factors Affecting K–12 Teacher Use of Technology

Rebekah Hanks, Jefferson Davis Parish School System, with Helen Atchinson, Kathy Mack

This study attempted to determine the descriptive profile and extent of technology use and examine the factors that effected teacher decisions to use instructional technology.

Format: Research Paper (Roundtable)

pdf **HANKS.pdf**

Total Operational Costs: Where Does Your Money Go?

George Harris, Northern Valley Regional High School

Learn to understand, interpret, and project technology costs. Where are you spending money? And is it effectively being used?

Format: Research Paper (Roundtable)

pdf **Harris.pdf**

From Integration to Infusion of Technology: An Impetus for School Reform

Flo Hill, Southeastern Louisiana University, with Jill Prokop, Kim Ishee

This session highlights the results of a five-year school improvement plan targeting infusion of technology for turning students on to learning and changing the way teachers teach.

Format: Research Paper (Roundtable)

Criteria for Evaluating Web-Based Hypertext

Hsi-chi Huang, Ohio University

This study focuses on teachers as designers using constructive hypertext and their perspectives on evaluating Web-based hypertext projects.

Format: Research Paper (Roundtable)

pdf Huang.PDF

Becoming a Constructivist Teacher: Challenges, Struggles, and Successes

Misook Ji, University of San Diego, with Diane McGrath

This research will address the issue about teachers' struggles as they try to become more constructivist in their teaching. The results will discuss coping strategies, pedagogical beliefs, and changes in teachers' adoption of constructivist teaching and learning.

Format: Research Paper (Roundtable)

Linking Multiple Databases: A Term Project Using Sentences DBMS

Ronald King, The University of Texas at Tyler, with Stephen Rainwater

This paper describes a methodology for use in teaching an introductory database management system course.

Format: Research Paper (Roundtable)

pdf King.PDF

Learning Geometry Dynamically: Teacher Structure or Facilitation?

S. Kim MacGregor, Louisiana State University, with W. Randall Thomas

This study examines the effects of the level of instructional scaffolding on students' use of The Geometer's Sketchpad and other software tools in a technology-integrated geometry curriculum.

Format: Research Paper (Lecture)

pdf MACGREGOR.pdf

IT and Middle School Girls' Attitudes: A Follow-Up Study

Dale Magoun, University of Louisiana at Monroe, with Virginia Eaton, Charlotte Owens

This study examines the changes in middle schools girls' attitudes about information technology (IT) as it relates to a summer camp at the University of Louisiana.

Format: Research Paper (Lecture)

pdf Magoun.pdf

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Be the Technology: Redefining Technology Integration in Classrooms

Steven Mills, University of Kansas, with Robert Tincher

This examination of technology use in classrooms has caused us to conclude that technology integration is not about the technology—it is about teaching and learning.

Format: Research Paper (Lecture)

pdf Mills.pdf

Modeling Collaborative Inquiry in Online Staff Development

Robert Myers, NASA Classroom of the Future, with Hilarie Davis, James Botti

This session examines the design, implementation, evaluation, and effects of collaborative inquiry in online professional development courses for K–12 teachers.

Format: Research Paper (Roundtable)

pdf MEYERS.pdf

Experience Counts: Comparing Inservice and Preservice Teachers' Technology-Integration Decisions

Joycelin Palacio-Cayetano, UCLA IMMEX Project, with Stephanie Schmier, Sara Dexter, Christine Greenhow, Ron Stevens

Learn how IMMEX simulations help develop and test teachers' conceptual knowledge and decision-making skills regarding technology integration. Presenters will share findings from eTIPs-designed case studies.

Format: Research Paper (Lecture)

pdf Palacio_Cayetano.pdf

The Joys and Sorrows of Teaching Computer Literacy Online

Brenda Parker, Middle Tennessee State University, with Judith Hankins

This paper addresses our joys and sorrows in the development and delivery of the first completely online course offered in our computer science department.

Format: Research Paper (Roundtable)

pdf Parker.pdf

Understanding Teachers' Purposes for Using the Internet with Their Students

David Pratt, University of California, Santa Barbara

Teachers have many different purposes for using the Web with their students. This paper contributes to understanding these differences by considering Bandura's self-efficacy theory.

Format: Research Paper (Roundtable)

pdf PRATT.pdf

Are Schools Ready to Integrate Web-Based Biology Instruction?

Betsy Price, Westminster College, with Alec Bodzin, Ward Cates

Based on a recent research study, this session presents recommendations for implementing a Web-based biology curriculum, including implications for facilities and classroom teaching practices.

Format: Research Paper (Roundtable)

pdf PRICE.pdf

Closing the Digital Divide: Central American Immigrant Perspectives on Technology

Davina Pruitt-Mentle, University of Maryland, College Park

This paper explores the experiences and perceptions of immigrants from Central America toward educational technology and describe and interpret the behaviors, attitudes, and beliefs of these immigrants toward technology use.

Format: Research Paper (Lecture)

pdf **Pruitt_Mentle.pdf**

Beyond the Big Picture: Disaggregating and Demystifying Data in Schools

Jason Ravitz, Buck Institute for Education

Learn key questions to ask to more quickly and accurately understand technology use and effects in your school(s). Don't be fooled by the big picture!

Format: Research Paper (Lecture)

Online Discourse: Encouraging Historical Thinking in the History Classroom

Sara Rhodes, Lincoln Middle School

Can technology support critical thinking in the history classroom? This paper investigates FileMaker as a means of improving participation, understanding, and achievement of all students.

Format: Research Paper (Roundtable)

pdf **Rhodes.pdf**

The Digital Divide and the Learning Needs of Hispanic Students

Margaret Riel, Pepperdine University, with Jennifer Schwarz
Hear about the plans, progress, and outcomes of two schools that worked to close the Digital Divide by increasing access and developing a technology learning community.

Format: Research Paper (Lecture)

pdf RIEL.pdf

A Study of AlphaSmarts in Three Classrooms

Michael Russell, Boston College, with Damian Bebell
This study examines the effects of a one-to-one ratio of students to AlphaSmarts on teaching and learning in three fourth-grade classrooms.

Format: Research Paper (Lecture)

pdf RUSSELL.pdf

Nexus: Express, Reflect, Connect, and Collaborate

Edith Slaton, Southeastern Louisiana University
E-mail journaling between preservice teachers and their university supervisors caused journal reflections to become problem-solving tools that improved teaching learning experiences.

Format: Research Paper (Roundtable)

Learning to Integrate Technology: Lessons Learned from a PT3 Implementation Project

Sharla Snider, Texas Woman's University, with Kelly Shapley, Tobye Nelson

LINKS is a three-year technology project—supported through the U.S. Department of Education's PT3 initiative—designed to integrate technologies into a teacher preparation program.

Format: Research Paper (Lecture)

pdf **Snider.pdf**

Preservice Teacher Training: Has It Delivered the Promise of Technology?

Harriette Spiegel, Florida State University

Learn about the results of a survey of preservice teachers point to a gap between the programs that train for technology use in the classroom and actual implementation.

Format: Research Paper (Roundtable)

pdf **SPEIGEL.pdf**

Multimedia Digital Video Portfolios as a Tool to Develop Teacher Candidates' Critical Reflection

Sheila Spurgeon, Northwestern Oklahoma State University, with James Bowen

This presentation showcases teacher candidates' multimedia portfolios as evidence that the process of digital video editing used to create the portfolios significantly improves the quality of the candidates' critical reflections.

Format: Research Paper (Lecture)

pdf **SPURGEON .pdf**

Papertian Constructionism and At-Risk Learners

Gary Stager, University of Melbourne Dept. of Science & Math Ed./Seymour Papert Institute

Since September 1999, the presenter has worked with Seymour Papert to develop a high-tech alternative learning environment inside the Maine Youth Center, the state facility for adjudicated teens. The experience of trying to reacquaint (or acquaint) these previously unsuccessful students with the learning process teaches us many lessons about how at-risk our entire educational system has become.

Format: Research Paper (Lecture)

Bringing Up Girls and Science (BUGS): Incorporating Technology into an Environmental Science Program

Tandra Tyler-Wood, University of North Texas, with Mark Mortensen, Jane Pemberton

Bringing Up Girls in Science (BUGS) is an NSF grant designed to provide technology enhanced educational experiences in an outdoor learning lab for elementary school girls.

Format: Research Paper (Lecture)

Authentic Assessment of Student Understanding in Near-Real Time!

Terry Vendlinski, UCLA / IMMEX Lab, with Ron Stevens

Presentation demonstrates how technology enables educators to (a) provide students with opportunities to apply concepts and (b) assess student understanding of those concepts in realistic settings.

Format: Research Paper (Roundtable)

pdf **Vendlinski .pdf**

Online Discourse: Expansive Possibilities in the History Classroom

Elizabeth Wellman, UCLA, with Jana Flores

Do online discourse tools support student historical thinking and understanding? Do they support teaching history as a discipline? What issues should we be thinking about?

Format: Research Paper (Lecture)

pdf **Wellman.pdf**

Analog and Digital Video Production Techniques in Media Literacy Education

Melda Yildiz, William Paterson University

Discuss dissertation research on analog and digital video production techniques in developing new media literacy skills among university students.

Format: Research Paper (Roundtable)

pdf **Yildiz.pdf**

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Middle School Technology Use—Design Impediments Versus Classroom Needs

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Abstract: This paper reports on the relationships among classroom teaching, learning activities and technology integration in the middle school classroom. The results are based on a comparison of three studies conducted across diverse middle school settings. The studies considered three primary questions; 1) Are specific learning activities identifiable across middle school classrooms? 2) Are the technologies available to the schools supportive of the classroom goals of teachers and students? and 3) What reasons influence the use of current technology in classroom learning activities? A learning activity-oriented viewpoint guided the research focus. Documented within the study are the typical learning activities and potential role for technology within the classroom learning environment of middle schools.

After two decades of educational computing in schools it is easy to overlook that many teachers' experiences with technology fall short of the successful and exciting experiences reported by researchers (Ambron and Hooper,1990). What is reported; the individual instances of success, innovative technologies, and grant funded development projects provide a stimulating look at what can occur when circumstances are optimal. Unfortunately teachers work in less than optimal conditions. The occupational world of classroom teachers is different from that of an educational technology researcher. Classroom teachers do not design the software, hardware or technologies they use. They have minimal control over instructional time, preparation time, or the content mandated by their district. In addition, classroom teachers have minimal daily assistance with technology.

For the average teacher the use of technology has not been an empowering experience. Consequently, the level of technology use in the classroom has remained relatively low. There is documented concern that the level of technology use needs to increase (Morrison, Lowther, and DeMeulle, 1999). From the standpoint of the students, the end users of the technology, or the teachers, the facilitators of learning, the focus on level of technology is misplaced The critical variable of interest in the classroom is student learning. Technology offers one tool for accomplishing this learning. Using technology as the primary variable ignores the goals of the teachers and the needs of the students. Quantity alone disregards the context of learning activities and discounts whether technology supports classroom instruction. Agreement with the position that the quantity of technology in schools needs to increase is dependent in part on assumptions regarding the design of the technologies provided teachers. A key assumption is that educational technologies were designed for use by teachers and students. This is not the case for most technology available in schools.

Two questions merit considerations; 1. Are the technologies available in schools supportive of the classroom goals of teachers and students? and 2. What reasons influence the use of technologies in classroom learning activities? These are complex questions but they may be considered in light of studies of how people work in technology intensive workplaces. Holtzblatt and Jones, (1993) have pointed out that well designed technologies that take into account the reality of what people do on the job can boost productivity, enhance job satisfaction, and give workers a clear sense of what needs to be accomplished in their workplace. The essential point is that technological tools that are

insensitive to the work being performed lead to the negative consequence of reduced productivity. The argument for teacher and student use of technology hinges in part on how well available technology represents and supports what teachers and students do. Software developed for the classroom includes tutorials, simulations, drill and practice software, and educational games. These applications deliver instruction by complementing or replacing teacher directed instruction. Underrepresented in the software designed for school use are software tools for increasing productivity. Existing tool/productivity software such as the word processors databases, spreadsheets, and graphics were designed for an industrial or business audience. Both the context and the content of classroom teaching are markedly different from that of industry.

Those of us who work in the field of educational technology recognize technology as an outstanding resource. It provides opportunities for learning, tools for productivity, and a medium for creativity. However, many teachers still perceive technology to be confusing, complex and cumbersome. Despite advances in usability, teachers report that productivity software is not intuitive and that the software fails to address the needs of their classroom situation. In the eyes of teachers, productivity software is essentially re-purposed for classroom use. Consequently, teachers are hesitant to implement technology that does not address their immediate goals. As an example, elementary teachers participating in an in-service technology workshop indicated a preference for using *The Writing Center*, a simple writing and publishing tool designed for classroom use over Microsoft Word despite the expanded feature set offered in Word and pressure by their

administrators to use the more powerful software (P. Comstock, personal communication, June 16, 1998).

Purpose of Study

This study is based on three pilot studies. The goal of the three pilot studies was to establish a baseline on what technologies are most useful for students, and what technologies fit appropriately and effortlessly into classroom learning. The studies considered the questions; 1) Are the technologies available in schools supportive of the classroom goals of teachers and students? and 2) What reasons influence the use of technologies in their learning activities? This study examined technology use from an activity-oriented view. This viewpoint guided the research focus through an examination of the following research questions:

(1) What technology tools do students frequently use in their classrooms?
(2) What technological tools do teachers model for students' use in the K-12 classrooms?
(3) What learning activities do students do in the classroom?
(4) Is there a statistically significant relationship between teachers' modeling of technological tools and the level their students' use of these tools?
(5) Do students' usage of the technological tools significantly vary by teachers characteristics such as merit rating, level of teaching experience, and technology skills?

Methods

Within the field of software design there exists an organizing structure for initiating an analysis of user needs (Kuhn, 1996). The structure is a design approach that employs an activity-oriented view assessed from the perspective of the user audience. This study

initiated an examination of technology use from an activity-oriented view. Middle school teachers and students were targeted as the user audience. Central to the goal of identifying learning activities was to understand the middle school teachers and the tasks they wish to achieve with their students. A secondary goal was to identify existing technology based tools that might serve the teachers and students with these learning activities. The process of determining typical learning activities and enhancing some of those activities with technology began by surveying teachers.

Survey 1. The phenomena of learning in a middle school setting occur across a wide range of conditions. Agreed upon descriptions of classroom activities are elusive. A survey was developed to obtain a baseline of learning activities that span the curriculum. The first survey was distributed to ten middle school principals representing urban and suburban school districts in Northeast Ohio. The principals were instructed to select two teachers to participate in the pilot study. Criteria were provided to the principals for teacher selection. The teacher was to have at least three years of teaching experience, the students of this teacher should consistently perform at or above expectation, and the teacher should also have a history that included parental requests to have students placed in his or her class. Expertise in technology was absent from the selection criteria. The selected teacher completed an anonymous survey composed of three sections and returned it to their principal.

The first section consisted of six questions that contributed background information on the respondent. Included in this section were questions on teaching experience, grade

level, subjects taught, technology expertise, student expertise in technology, and the type of technology available to the teacher.

The second section provided a list of nineteen possible learning activities along with a four-point scale indicating the anticipated frequency of the learning activity. Traditional and technology based methods for implementing the activity were included below each learning activity. The teachers were directed to rate all items that applied. The nineteen activities represented a range of learning activities including; writing, collecting data, organizing data, analyzing data, presenting information, discussions, reviewing instruction, and developing projects. Ideas for the learning activities were based on sample activities included in assignments submitted by teachers enrolled in an instructional development course during the past ten years.

The third section of the survey included eight questions pertaining to students' use of computer based tools. These statements were also scored using the four-point scale. In addition, the teachers were asked to select the reason(s) for the score. Twenty-four reasons were provided. The teachers were encouraged to select all reasons that applied or to choose "Other" and explain this choice. The respondents were informed that this was a pilot survey and that comments were welcomed.

Survey 2. The second survey included the three sections in Survey 1 plus a forth section on teacher modeling of technology. This survey was completed by twenty-nine teachers from a suburban middle school. Teachers who taught one or more of four content areas;

Language Arts, Social Studies, Mathematics, and Science completed a four-part forty-seven item survey. Field notes and follow-up interviews were conducted to expand on the preliminary understanding of classroom / technology interactions.

Survey 3. Thirty-one self-selected middle school teachers from urban, suburban, and rural school districts were recruited to complete a four-part forty-seven item survey and complete a post-survey interview.

Results

Dimensions of modeling, activities, and technology use. A list of learning activities presented to teachers as a sample to establish everyday instructional activities are presented in Table 1.

Factor analysis revealed two parallel dimensions of technological modeling and use. The first dimension was *productivity tools,* which included database, spreadsheets, graphics, and presentations. The second was the *common tools,* which consisted of word processing, internet, and e-mail. Similarly, learning activities were conceptualized into three dimensions based on the tools they utilized. The first dimension was the *traditional tools* which utilized tools such as paper and pencil, worksheets, photographic slides, index cards, etc. The second was *common tools* which utilized popular technological tools such as word processing, internet, and e-mail.

Table 1: List of learning activities

	Learning Tools		
Learning Activities	Traditional	Common	Productivity
Writing drafts of reports	Paper & pencil	Word processing	
Editing written materials	Paper & pencil	Word processing	
Presentation of final written products	Posted in class or school hallway		
Writing correspondence	Letters	e-mails	
Note taking and recording observations	Paper & pencil	Word processing	Database, Spreadsheet
Creating tables or charts	Paper & pencil	Word processing	Database, Spreadsheet
Drawing graphs or diagrams	Paper & pencil		Database, Spreadsheet
Drawing maps	Paper & pencil		Graphic programs
Collecting data	Books, magazines,Surveys, interviews, Lab experiments, etc		Internet
Creating materials for presentation	Paper & pencil – printed materials, Makers & transparencies, slides		Computer presentation programs
Delivering presentations	Oral presentations		Computer-based multimedia
Discussing topics/assignments	Face-to-face/class discussions		e-mail discussions, list server/newsgroup discussions
Organizing data on forms	Worksheet, index cards		Databases, spreadsheets
Analyzing data	Manual computation, calculators		Auto calculating/spreadsheets
Reporting data	Verbal explanation, written reports	Word processing	
Checking learning progress	Print-based tests & quizzes, papers & projects		
Practicing/reviewing instruction	Notebooks, worksheets		
Developing projects	Paper, pencil & art materials	Word Processing	Computer Presentation Programs
Reading	Textbooks, trade books, magazines, newspapers, handouts		
Taking tests & practice tests	Handwritten, open book		

The following are the Crombach alpha reliability coefficients for each of these dimensions associated with modeling, learning activities, and technology use:

Crombach alpha Reliability coefficients

Dimension	Modeling	Use	Activity
Productivity Tools	0.79	0.78	0.90
Common Tools	0.69	0.60	0.81
Traditional Tools	-	-	0.90

The frequency of learning activity implementation was based on a four point response scale: 1 Never, 2 Rarely, 3 Occasionally, and 4 Frequently. Average implementation of learning activities with traditional tools was 2.87. Average implementation of the common tools was 1.74 and productivity tools was 1.37.

The Pearson correlation analysis was used to assess the relationship between students' usage of computer technology and teachers' modeling of technological tools and students' participation in various learning activities. The results are presented in Table 2.

Table 2
Pearson correlation results for the relationship between students' usage of technological tools and teachers modeling of tools and students' learning activities.

		Students' technological usage	
		Common tools	Productivity tools
Teachers' modeling	Common tools	0.599**	0.422**
	Productivity tools	0.454**	0.635**
Students learning activities	Traditional tools	0.385**	0.240*
	Common tools	0.764**	0.526**
	Productivity tools	0.519**	0.730**

* $p < 0.05$ ** $p < 0.01$

The Pearson correlation analysis revealed significant positive relationships between teachers modeling common and productivity tools and their students' use of such tools. The strongest correlation was observed between teachers modeling productivity tools and their students' usage of the same productivity tools ($r = 0.635$, $p < 0.01$). Similarly, a strong positive correlation was revealed between students participation in learning

activities utilizing common tools and their usage of the same common tools ($r = 0.764$, $p < 0.01$) and between students participation in activities utilizing productivity tools and their usage of the same productivity tools ($r = 0.730$, $p < 0.01$). These findings suggests that, teachers modeling as well as students participation in learning activities using productivity and common tools translates to increased students using the same tools. A moderate but positive relationship was also observed between students' participation in traditional learning activities and their use of common tools ($r = 0.385$, $p < 0.01$) and productivity tools ($r = 0.240$, $p < 0.05$). This finding also suggests that, students' participation in the proposed learning activities that utilize traditional tools does relate positively with students' usage of both common and productive technology tools.

The question of whether the level of classroom learning activities, teacher modeling, and student usage of technology tools varied by teacher rating, years of experience, and level of technological skills was assessed using analysis of variance. Analysis of variance results for the differencces in level of classroom learning activities, teacher modeling, and student usage of technology tools between rated and non-rated teachers is presented in Table 3.

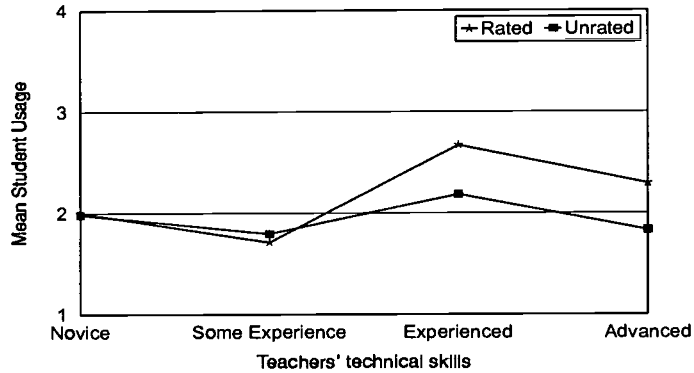
Analysis of variance revealed statistically significant difference between *rated* and *non-rated* teachers in the students' use of productivity tools ($F = 9.88$, $p < 0.01$). Table 3 also presents analysis of variance results for the differences in level of students' usage of technology tools, teachers' modeling technology tools, students' level of participation in classroom activities utilizing technology tools by teacher's level of experience with technology.

Table 3
Analysis of variance results for the differences in students' technology usage and participation in classroom learning activities between rated and non-rated teachers

	Rated		Non-rated			
Outcome	Mean	SD	Mean	SD	F-value	P-value
Students Technology usage						
Common tools	2.04	0.76	1.91	0.65	0.50	0.480
Productivity tools	1.93	1.05	1.41	0.46	9.88	0.002
Students' learning activities						
Traditional tools	2.94	0.48	2.85	0.64	0.34	0.560
Common tools	1.78	0.58	1.72	0.50	0.19	0.668
Productivity tools	1.49	0.53	1.34	0.42	1.50	0.224

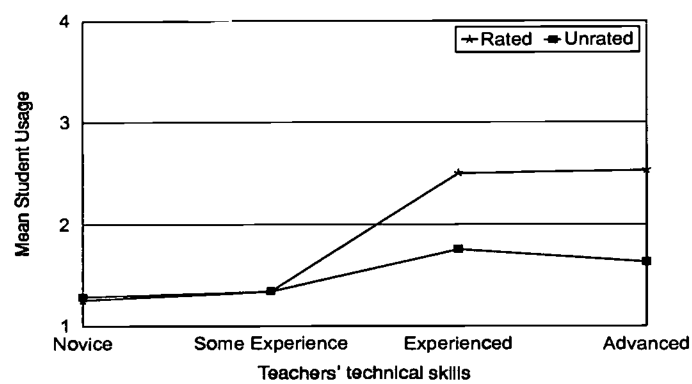
Teachers' perceived level of technological skills was a significant factor on students' technology usage of productivity tools ($F = 9.55$, $p < 0.001$), teachers' modeling of common ($F = 4.93$, $p < 0.01$) and productivity tools ($F = 4.44$, $p < 0.01$). In all these cases, the data seems to suggest that, the level of students' technology usage and teachers' level of modeling tends to increases with teachers' perceived level of technology skills (see also Figures 1 & 2). Teachers' perceived level of technological skills was a significant factor on students' participation on classroom learning activities when utilizing productivity tools ($F = 6.98$, $p < 0.001$) but not when utilizing either common tools ($F = 1.47$, $p > 0.05$) or traditional tools ($F = 0.84$, $p > 0.05$).

Figure 1: Student use of common tools



Participation in classroom learning activities utilizing productivity tools tended to be greater among teachers with more technology skills than those with less skills. However, teachers' years of teaching experience was not a significant factor on students' technology usage, teachers' modeling tools, or students' participation in classroom learning activities (see Table 4).

Figure 2: Student use of Productivity tools



Participation in classroom learning activities utilizing productivity tools tended to be greater among teachers with more technology skills than those with less skills. However,

teachers' years of teaching experience was not a significant factor on students' technology usage, teachers' modeling tools, or students' participation in classroom learning activities (see Table 4).

Conclusions

Eight categories of learning activities were considered in the study. The categories included 1) communication activities including written and multimedia forms of reporting, 2) data collection, 3) data organization, 4) data analysis, 5) practice and review, 6) discussion, 7) reading, and 8) evaluation. The individual items in the survey were not mutually exclusive. The frequency of traditional implementation for the nineteen items across all subjects was 2.87 suggesting occasional implementation of the activities. Level of implementation of individual items varied on the basis of content area. For example, writing drafts of papers was more prevalent in English Language Arts than Mathematics.

Table 4
Analysis of variance results for the differences in students' technology usage, teachers' modeling and student participation in classroom learning activities by teachers' technological skills

	Novice		Some Experience		Experienced		Advanced			
Outcome	Mean	SD	Mean	SD	Mean	SD	Mean	SD	F-value	P-value
Students Technology Usage										
Common tools	1.98	0.55	1.78	0.59	2.22	0.81	2.14	0.86	1.98	0.124
Productivity tools	1.28	0.33	1.34	0.43	1.81	0.59	2.23	1.12	9.55	0.000
Teachers' Modeling Tools										
Common tools	2.00	0.64	1.95	0.73	2.89	0.94	1.72	0.75	4.93	0.004
Productivity tools	1.29	0.48	1.39	0.48	2.02	0.85	1.33	0.58	4.44	0.007

Students' Learning Activities										
Traditional tools	2.87	0.69	2.84	0.58	3.11	0.37	2.75	0.72	0.84	0.475
Common tools	1.68	0.42	1.66	0.43	1.97	0.74	1.86	0.64	1.47	0.230
Productivity tools	1.20	0.29	1.31	0.35	1.59	0.61	1.65	0.57	4.18	0.008

The "occasional" score suggests that the sample learning activities represent a subset of baseline learning activities conducted in middle school classrooms. As such, one may conclude that the activities are useful for relating the level of technology use in middle school classrooms to the teaching and learning conducted in those classrooms. Specifically, the individual items may serve as point of reference for comparing levels of technology use within existing teaching practice. Participation in traditional learning activities correlated with an increase in student use of both common and productivity tools. The correlation hints at a connection between the identified learning activities and the potential application of technological tools to fulfill the learning goals of the activities.

Teachers in this study were more likely to engage their students in traditional (non-technology based) activities than in technology-based activities. This result was consistent with expectations and prior findings. More importantly teachers were more likely to engage students in common types of technology such as word processing, Internet, and email than in productivity tools. This result was true for all teachers regardless of their perceived technology acumen or teacher rating. The significant differences in tool selection suggest that teachers sense a distinction between common

and productivity tools. The nature of this distinction was not conclusively resolvable from the survey results. However, teachers in all three studies indicated 1) lack of teacher training, 2) too difficult, and 3) students lack skills as important reasons for students' non-use of computer based instructional tools in the classroom. Technology tools that most closely reflected the goals of the learning activity such as word processing and writing assignments or calculators for computation were cited as frequently used by students. The simpler the use and the more closely a technological tool mirrored the learning activity the more likely it was that students used the tools. Nevertheless, the results indicated that despite the fit of a tool to an activity, technological tools (common 1.94 and productivity 1.52) were used seldom at best in the classrooms. Individual activities might encourage frequent use of a specific tool but generalized technological tool use by students was lacking.

Teacher modeling of technological tool use was a strong predictor of student tool use. The positive correlation was intuitive. Teachers were more likely to model technological tools that their students need to complete learning activities. As expected, teachers modeled the use of common tools more often than productivity tools. This finding, coupled with the "lack of training" response commonly cited as a reason why students did not use computer tools in class suggests that teachers model the technological tools they are most comfortable using themselves.

The primary difference between rated and non-rated teachers related to the use of productivity tools. Students in the classes of rated teachers were more likely to use

productivity tools than students in the classes of non-rated teachers. This finding is intriguing. The criteria used to select the rated teachers lacked any reference to expertise in technology. The surveys were presented to school principals as surveys on learning activities not technology activities. Principals received copies of the surveys after the rated teachers were selected. It was not apparent from the data collected why rated teachers recognized a role for productivity tools in the learning activities listed. The number of years of teaching experience was not significant. This finding is somewhat counter intuitive as many educational technology practitioners assume that new graduates are more likely to implement technology than teachers who completed their teacher preparation programs less recently. Teachers' perception of their technology, however, was a positive factor in student use of technology and teacher modeling. The more knowledgeable a teacher was a tool the more likely they were to adopt it.

The current study avoided the limitation of level of technology use by tying specific learning activities to the use of technology. However the correlation results only hint at the reasons for use and non-use of the technologies listed in the study. The initial two questions remain unanswered. The data suggests that common and productivity technologies may be supportive of the classroom goals of teachers and students. However, the factors influencing the use of the technologies are not clear. Commonly recognized impediments such as lack of training, lack of student skills, difficulty of technology, and accessibility to technology were cited by study participants. Additional data is required to determine the factors that assist or impede technology use by middle school teachers. Further investigation is underway.

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Keywords middle school, learning activities, technology impediments

Effect of Online Learning on Struggling ESL College Writers

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Abstract

Two groups of freshman students participated in the experiment. They were enrolled in their first ESL writing course. Before instruction, both groups were pre-tested. They wrote an essay. T-test results showed significant differences between both groups in writing ability. The experimental group made too many errors and had many writing problems. Both groups covered the same in-class material, assignments and assessment. In addition, the experimental group used a Blackboard online course from home. Experimental students posted their threads, wrote short paragraphs and posted stories and poems. They located information in sites like "Yahoo Movies" and "webMD". They word-processed their paragraphs and checked their spelling. At the end of the course, both groups were post-tested. They wrote an essay. ANCOVA results showed significant differences between both groups. The experimental group made more gains as a result of web-based instruction. They became more proficient, made few errors and could communicate easily and fluently.

Descriptors: College writing, online learning, Second language learning, writing, web-based instruction, web-based learning.

Introduction:

Although the number of schools and classrooms using technology in general and distance learning in particular is increasing, many researchers are concerned about the effect educational technology has on student achievement since the effective use of technology requires significant investments in hardware, educational software, infrastructure, staff development, and technical support. Evidence that use of technology in instruction is useful, necessary, and cost-effective is also required. A review of the L1 and L2 writing research on technology and student achievement has shown three contradictory findings. Studies by Meem (1992), Batschelet and Woodson (1991), Cifuentes and Hughey (1998), Chambless and Chambless (1994), Hood (1994), Clark (1996), Grejda and Hannafin (1992), and Jannasch-Pennell, DiGangi, Yu, Andrews and Babb (1999) found that use of word-processing, use of a supplementary program that guides students through the writing process, computer conferencing, computer-based instruction, electronic mail, and World Wide Web page design had no significant differences on the writing quality nor attitudes towards writing between L1 elementary, middle school, secondary and college students who used technology and those who did not.

On the other hand, studies by Jones (1994), Davis and Mahoney (1999), Beyer (1992), Shaver (1986), and Allen and Thompson (1994) found that word processing, participation in a project using a personal computer in the classroom to teach the writing process, using the Writing-Aid and Author's Helper (WANDAH) computer writing system, and using a computer assisted collaborative writing by L1 elementary, middle, high school and college students increased the quantity of writing instruction and the amount of student writing more than those using traditional instruction. The quality of students' writing and their attitudes towards writing on the computer improved as well. Similarly, Pennington (1993), Sullivan and Pratt (1996), Braine (1997) and Liou

(1997) found that the writing skills of ESL students who used word-processing, a computer-mediated networked environment, and web-based materials improved significantly.

Surprisingly, in some ESL classroom settings, traditional instruction was found to be more effective. For example, Izzo (1966) found that technical essays produced by ESP college students in Japan using computer workstations were not as well organized and were significantly shorter than hand-written essays. Results of a study with college students in Taiwan found that face to face discussions that preceded writing activities in a traditional classroom were superior to computer-mediated discussions in producing written comments and explanations of their plans for writing more. Students in the face-to-face group could support and refute each other's arguments better (Huang, 1998).

Given those contradictory findings about the effect of technology on student achievement in the writing skill, it seems that the effect of technology on learning depends on the learning goals set, kinds of tasks and activities involved, kind of technology used, how long it is used, and how it is used. Therefore, the present study attempted to use a variety of instructional technologies consisting mainly of an online (web-based) course, some WWW resources, e-mail and word processing in ESL writing instruction from home, in combination with traditional writing instruction. The primary focus of this study was to find out whether the integration of technology in traditional ESL in-class writing instruction significantly improves the writing skills of less able ESL college learners. The current study tried to answer the following questions: Is there a significant difference between ESL freshman students exposed to a combination of traditional in-class writing instruction and web-based instruction and those exposed to traditional in-class writing instruction only in their writing achievement as measured by the posttest?

Participants:

A total of 113 ESL female freshmen students in two intact classes participated in the present study: 51 students enrolled in the fall 2000 class and 62 students enrolled in the spring 2001 class. The fall class constituted the control group and the spring class constituted the experimental group. The control group was exposed to traditional in-class writing instruction only, whereas the experimental group was exposed to a combination of traditional and online (web-based) writing instruction. Both groups were in their first semester of the translation program at the College of Languages and Translation (COLT), King Saud University, Riyadh, Saudi Arabia and were enrolled in the Writing I course that the author taught for four hours a week. Students in both groups were all Saudi, and were all native speakers of Arabic. Their median age was 18 years, and the range was 17-19. Students in both groups had 6 years of EFL instruction in grades 6-12 prior to their admission to COLT.

The pretest scores indicated that the experimental (online) and control (traditional) groups differed significantly in their writing ability before the writing instruction began ($T = 4.55$, $Df = 111$, $P<.01$). The control group outperformed the experimental group. It was a high-ability group whereas the experimental group was a low-ability group (see Table 1). The typical students in the control group got a score of 70% on the pretest compared to 55% for the experimental group, with more variations existing among students in the experimental group as revealed by their pretest standard deviation and score range.

Table (1)

Distribution of Pretest Scores of Experimental and Control Groups in Percentages

Group	Mean	Median	SD	SE	Range
Experimental	53.06	55	17.33	2.20	10-90

Control	67.45	70	15.98	2.24	30-90

A qualitative analysis of the pretest paragraphs revealed many writing problems that the experimental group had. Experimental students made too many spelling mistakes, did not use punctuation marks at all, could not capitalize words and had difficulty expressing, generating and organizing ideas. They had difficulty putting words together to make a sentence. Many wrote incomprehensible sentences. By contrast, the control group could construct sentences and express ideas. Their spelling ability and knowledge of punctuation marks and capitalization rules was much better.

Instruction:

The experimental and control groups were exposed to the same traditional in-class writing instruction. They studied the same writing textbook assigned by COLT which is "Interactions I: A Writing Process Skills Book, by Segal and Pavlik. The aim of the book is to develop the students' ability to write a cohesive paragraph that has a topic sentence and supporting details with minimal grammatical, spelling, punctuation and indentation errors. The book consists of 12 chapters. Each chapter has a theme and is divided into the following parts: Exploring ideas, building vocabulary, organizing ideas, developing cohesion and style, some grammatical points, writing the first draft, editing practice, writing the second draft and journal writing. In each chapter, tasks and skills are practiced one step at a time, before the students put them all together in their paragraph.

Each chapter was completed over one week, i.e. four class sessions, and the book was covered over 12 weeks. Each week, students in both groups completed all the skills, exercises and writing tasks in the chapter and wrote two one-paragraph essays per week. Students were always

required to do all the exercise and at least write part of their paragraph in class and rewrite their paragraphs when necessary.

Students in both groups were encouraged to write and not to worry about making mistakes. While doing the exercises and writing the paragraphs, students' work was monitored and individual help was provided. The students received communicative feedback focusing on meaning and only errors related to rules or skills under study were highlighted. Feedback was provided on the presence and location of errors but no correct forms were provided. Self-editing and peer-editing were encouraged. Extra credit was given for good paragraphs.

As to assessment, students in both groups were tested every other week. They were given a total of 6 quizzes. On quizzes 1, 3, and 5, the students wrote a paragraph and on quizzes 2, 4, and 6, they completed different tasks similar to those covered in class. Quizzes were always graded, returned to the students with comments on strengths and weaknesses. Words of encouragement were always given. Answers were always discussed in class.

Treatment:

In addition to the traditional in-class writing classroom instruction, the experimental group used an online (web-based) course with Blackboard Corporation that the author developed. The experimental group used their own PC's and the internet from home as it was inaccessible from campus due to wiring difficulties.

Prior to the web-based instruction, students' computer literacy skills were assessed by a questionnaire. A tutorial was given to students. Course components were explained and introduced one at a time. Instructions on how to use certain course components were also posted in the "Announcements" area. Sites were added in the "External Links" according to the specific writing skills and grammatical structures under study in the classroom.

Web-based instruction was initiated by the author posting a welcome note in the "Announcements", by starting a thread on the "Discussion Board" and by sending a group e-card. She continued to do so every now and then throughout the semester. The students responded by similar threads, e-cards and group messages. Then, they took the initiative to post their own threads on the "Discussion Board" on a theme they have studied in the book or any theme of their choice. They responded to the instructor's or another student's thread. They posted the stories and poems that they had read and liked to share with others. They felt free to e-mail each other or e-mail the instructor on any occasion like a student's birthday, religious and national holidays or whenever they needed help. Students checked the links posted in the "External Links". Many students wrote a paragraph about themselves in the "Student Homepage". Some used the "Send File to Instructor" facility to send their assignments to the instructor. They answered the quizzes posted in the "Assessment" area. Only six fill-in-the-blanks quizzes were posted and were used for practice not for course evaluation purposes. The students were also encouraged to use the online course "Resources" which included a weekly lesson and some writing links posted by Blackboard Corporation. Course components such as the "Virtual Chat", "Course Information", "Course Documents", and "Course Assignments" were not used.

In addition to the Blackboard online course, the experimental group located information related to the themes covered in the book from internet sites like "Yahoo Movies", "Yahoo Health", "webMD", and "Encarta". They were also encouraged to word-process the paragraphs they wrote in class and check their spelling at home using MS WORD. Typed paragraphs were posted in class, so that students could read each other's paragraphs.

Throughout the semester, the author served as a facilitator. She provided technical support on word-processing, using the different components of the online course, and responded to individual students' needs, comments and requests for certain sites. The author did not correct

anything that the students posted on the "Discussion Board" nor did she spell-check word-processed paragraphs. Students were given extra credit for using the online course, word-processing their paragraphs and locating information from internet resources. The online course was not assigned a portion of the final course grade. Using the online course was optional as 5 students had no internet access and hence were not part of the experiment.

Procedures:

Before instruction, the experimental and control groups were pre-tested. They took the same pretest that consisted of an essay. Test instructions specified the essay length and essay component related to the tasks and skills to be practiced in the book.

At the end of the experiment, the experimental group answered a post-treatment questionnaire that aimed at finding out how the students felt about the online instruction and whether they found it helpful.

At the end of the course, both groups were post-tested. They took the same posttest that was part of a three-hour final exam. The posttest consisted of an essay that the students had never seen nor practiced in class or in the online course. The essay topic was concrete and within the students' background knowledge. The test instructions specified the essay length and essay components that were taught and practiced during the course such topic sentence, types and number of supporting ideas, use of capitalization, punctuation, spelling, conjunctions and cohesive ties…etc. Moreover, the final exam contained a letter-writing task and four objective questions covering all the writing tasks practiced over the semester.

The pretest and post-test essays of both groups were holistically graded based on a general impression of content, organization, cohesion, word choice, language use and mechanics. All essays

were read once and a quality rating of high, above average, average, below average and low was given to each paper. Essays were then read for a second time and each was assigned a grade.

Test Validity and Reliability

The posttest is believed to have content validity as it aimed at assessing the students' ability to develop a cohesive paragraph that has a topic sentence and supporting details with minimal grammatical, spelling, punctuation and indentation errors. The topic was based on a novel situation and was not a reproduction of the material presented in the textbook or classroom. The essay components and writing tasks required in the posttest were comparable to those covered in the book and practiced in class. The test instructions were phrased clearly and the examinee's task was defined. The minimum and maximum essay length was specified (10-15 lines) and the number of supporting details was specified as well. 95% of the experimental and control students comprehended the essay topic and writing tasks and responded to the topic as instructed.

Concurrent validity of the posttest was also determined by establishing the relationship between the students' scores on the posttest and their writing course grade. The validity coefficient was .84 for the experimental group and .87 for the control group. Concurrent validity was also determined by establishing the relationship between the students' scores on the posttest and their scores on the last essay quiz that was administered 4 weeks prior to the administration of the posttest. The validity coefficient was .67 for the experimental and .70 for control groups.

To estimate inter-rater reliability, a 30% random sample of the pretest and posttest essays was selected and double-scored. A colleague who taught Writing I to freshman students before scored the pretest and posttest essay samples holistically. She followed the same scoring procedures utilized by the author. The marks given by both raters for each essay in the sample were correlated. Inter-rater correlation was 89% for each groups.

In addition to inter-rater reliability, examinee reliability was computed as it indicates how consistently examinees perform on the same set of tasks. Examinee reliability was calculated by correlating the students' scores on the posttest with their scores on another essay-type subtest that was administered at the same time as the post-test. The post-test was part of the final exam that consisted of several objective and essay-type questions. On another question, the students were asked to write a letter. Reliability of the posttest scores was computed using student scores on both subtests (essay and letter). The Kuder-Richardson formula 20 for essay tests was used. The examinee reliability coefficient was .77 for the experimental group and .88 for control groups.

Data Analysis:

All pretest and post-test raw scores were converted into percentages. The mean median, standard deviation, standard error and range were computed for the pretest and posttest scores of both groups. To find out whether there is a significant difference in ability between the experimental and control groups prior to instruction, a T-test was run using the pretest scores. Results are reported in the Participants section above.

Since difference in the writing ability existed between the experimental and control groups prior to the experiment, and the two groups were intact and unequal in size, Analysis of Covariance (ANCOVA) was run using the posttest scores as the response variable and the pretest scores as the covariate to correct for chance differences that existed when the subjects were assigned to treatment groups. This correction will result in the adjustment of group means for pre-existing differences caused by sampling error and reduction of the size of the error variance of the analysis.

Finally, to find out whether each group has made any progress (gain) as a result of the writing instruction, a within group paired T-test was computed for each group to find out whether there is a significant difference between the pretest and posttest mean scores of each group.

Results:

Table (2) shows that the typical ESL freshman student in the experimental group scored higher than the typical student in the control group (medians = 85% and 77% respectively) with less variations existing among students in the experimental group (SD=14.7) than the controls (SD=17.11).

Table (2)

Distribution of Post-test Raw Scores of the Experimental and Control Groups in Percentages

Group	Mean	Median	SD	SE	Range
Experimental	79.94	85	14.70	1.87	50-100
Control	74.75	77	17.11	2.41	30-100

Results of the paired T-test reported in Table (3) show a significant difference between the pre-test and post-test mean scores of the experimental group at the .01 level, suggesting that student achievement in the experimental group has significantly improved as a result of using a combination of web-based writing instruction and traditional in-class writing instruction (T=12.14, Df=61). Similarly, a significant difference between the pretest and post-test mean scores of the control group was found at the .01 level, suggesting that achievement in the control group has significantly improved as a result of the traditional in-class writing instruction (T=4.6, Df=50).

Table (3)

Results of the T-test for posttest and pretest mean scores of Experimental and control Groups

Group	T	Df	Mean difference	SD Difference	P
Experimental	12.14*	61	26.87	17.42	.01
control	4.6*	50	7.29	11.32	.01

However, T-test results alone do not show which group has made higher gains. After adjusting for initial group differences on the pretests, Analysis of Covariance (ANCOVA) on adjusted post-test means revealed significant differences between the experimental and control groups (F=29.84, P<.0001). The experimental group has made higher gains in writing achievement than the experimental group as a result of web-based instruction. The effect size, i.e. degree of superiority of the experimental treatment over the control treatment was .55.

Discussion:

The present study found that students in the experimental group who were taught using a combination of web-based writing instruction and traditional in-class writing instruction scored significantly higher than controls who were taught using traditional in-class writing instruction only. Use of web-based instruction as a supplement to traditional in-class writing instruction was significantly more effective than using traditional writing instruction alone. Web-based instruction seems to be an important factor in enhancing the writing quality of less able ESL students. It helped enhance their writing ability (achievement) and resulted in a significant improvement in their post-test (achievement test) scores.

Qualitative analysis of the posttest essays showed that members of the experimental group exhibited a great improvement in their writing ability. They became more competent, could write fluently and communicate easily. They could write long essays, long sentences and more compound and complex structures instead of short and simple sentences at the beginning of the semester.

There was a significant decrease in spelling, punctuation and capitalization errors. Only 10% of the students failed the course as opposed to 30% of the controls.

Furthermore, students' responses to the post-treatment questionnaire indicated that the online course had a positive effect on their attitude towards the writing process. It enhanced their self-esteem, motivation and sense of achievement and improvement. The students enjoyed writing and were motivated to write. Online learning encouraged writing and exchange of ideas. The amount of student writing increased in an environment secure for making mistakes. According to the usage statistics provided by Blackboard Corporation, the students made 4079 hits over a period of 10 weeks. Student-student and student-instructor interactions increased. Achievement was enhanced by the multiple skills practiced: writing, reading, spell checking and word-processing, and by the variety of innovative technologies utilized: the online course, WWW resources, e-mail and word-processing.

The effect of online instruction on the writing achievement of less able ESL freshman writers obtained in the present study is consistent with findings of other studies conducted with learning disabled or remedial writers in the L1 and L2 literature. Lewis (1998) conducted a study with learning disabled students in grades 4-12 who used word processing tools (spelling and grammar aids). She found that word processing had the most impact upon the writing accuracy of learning disabled students. Spell checks were found to be effective editing tools but grammar checks were not. Spell checks had a more positive effect on students' writing quality and accuracy than synthesized speech. In another study, Wresch (1993) found that use of a writing process software has improved disadvantaged college students' writing performance and pass rates. Furthermore, Spaulding and lake (1991) found that freshmen remedial writers who used a set of networked computers to assist them in their writing lessons interacted freely and comfortably with their teachers and peers and thus opportunities to learn and grow increased. Finally, Jacoby (1993)

found that secondary limited English proficient students who used a word processing program and were encouraged to use the computer independently acquired word processing skills and learned to use the computer for daily written assignments for regular classes.

The positive effect of web-based instruction on the attitudes of less able ESL students in the present study is also supported by findings of other studies. For example, Huang (1999) found that the EFL college students using internet-related assignments had positive attitudes towards use of the internet in writing instruction. In addition, Richards (1996) surveyed teachers, library media specialists and students in grades K-12 and found that the internet is a great motivational tool for students. Moreover, Shields (1991) used an 8-week practicum that aimed at improving use of Standard English and attitude towards writing of students in grades 6-8. Assessment of students' stories showed that they had improved their use of Standard English and the post treatment questionnaire indicated that students enjoyed writing the stories and felt more positive about the writing process.

Despite the positive attitudes that experimental students had towards writing as a result of their web-based writing experience, the author had always to prompt the students to use the course site by sending a group e-mail and by responding to and commenting on students' ideas. The minimum requirements of students' contributions in online course should be specified. A percentage of the course grade should be also assigned to using the online course in order for the students to take it more seriously.

Recommendations:

In the present study, web-based writing instruction was found to be a powerful tool for less able ESL freshman students. The benefits of introducing web-based learning in writing classrooms seem to be great for less able, less proficient and remedial students. Online instruction was found to

be effective in improving student-writing skills. Improvement was noted in the computer generated and handwritten assignments. Differences in length, neatness, mechanical correctness and style were observed. Results also showed that in learning environments where technology is unavailable to ESL students and instructors, use of technology from home and even as a supplement to traditional classroom techniques helps motivate and enhance less able ESL students' writing skills. Therefore, use of web-based writing instruction to improve the writing skills of poor ESL students at COLT is strongly recommended. It is also recommended that EFL instructors at COLT be trained to use the internet and online instruction in teaching ESL to students from home as it requires no equipment and connectivity from campus and no scheduling. In Addition, use of web-based instruction should be extended to students in other levels and to other ESL courses and skills taught at COLT such as speaking, listening, reading, spelling, grammar, vocabulary building and dictionary skills. It is also recommended that other researchers and instructors fully deliver whole writing courses and other ESL language courses online. The effect of fully delivered online language courses on less able ESL student achievement is still open for further investigation.

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Results of Separate and Integrated Technology Instruction in Preservice Training

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Abstract

Research into the best method for developing preservice teachers who integrate technology is mixed in its conclusions. The ISTE study in 1999 indicated that integrating technology training into teacher education classes was the strongest predictor of success. However, subsequent research identified the self-contained class in educational technology as an essential tool for developing technology-integrating preservice teachers. This study compared survey results of two elementary education cohorts, both part of the Master of Arts in Teaching program that is part of the National-Louis University Preparing Tomorrow's Teachers to Use Technology grant, on their skills necessary to be successful technology-integrating teachers. One cohort received their introductory educational technology course as a class integrated into an introductory special education class while the other cohort received their introductory educational technology class as a separate, stand-alone class. Results indicated several areas where greater gain scores between pretest and posttest were reported by the group receiving the stand-alone class.

Results of Separate and Integrated Technology Instruction in Preservice Training

Today's preservice teachers are empowering tomorrow's leaders. The future that they will lead will be characterized by technology growth and change. To be prepared to meet this change, today's students must be trained in the use of technology and to access and evaluate information technology. The public, in the form of parents, employers, communities, and the nation (ISTE, 2000), is asking schools to prepare their children to meet these changes. To accomplish this, schools have increased their investment in computers for the last several years, leading to a recently reported ratio of 5.7 students per computer (Market Data Retrieval 1999).

With this demand for technology-literate public school students, comes the demand for technology-literate teachers. The National Council for Accreditation of Teacher Education (NCATE, 1997) estimated the need for 2 million new teachers to be trained in the decade from 1997 to 2007. All of these teachers need to be prepared to help develop technology-literate students. Indeed, the National Council for Accreditation of Teacher Education (NCATE) is demanding that beginning teachers be technology-literate (NCATE, 1997) in order for teacher education institutions to remain certified by NCATE (ISTE, 2000).

To support teacher education programs in their efforts to infuse technology into their curriculum, NCATE worked with the International Society for Technology in Education (ISTE) to develop a list of standards in technology-literacy for beginning teachers. Research continues to explore the best method for teacher education institutions to meet these requirements and develop accomplished technology-integrating preservice teachers.

Research done by the ISTE (1999) looked at successful methods of technology instruction to train preservice teachers. They surveyed teacher education institutions and determined that the most predictive measure for developing technology-integrating teachers was to expose them to technology-integrating teacher educators during their training, as opposed to the common method for training technology in teacher education, a separate course in technology in education.

Halpin's findings (1999) were similar. Her research compared the growth and transfer of knowledge and skills learned in two different preservice instructional settings: (1) a stand-alone computer literacy course and (2) an integrated mathematics/science methods course where technology was used in support of instructional tasks, but students were not given specific instruction on technology applications. Results showed that participants whose technology instruction was integrated in their methods course reported more frequent use of technology for both teacher productivity and student projects during both on-campus courses and their first year of actual classroom teaching,

Using this research as a basis for redefining programs, several programs were developed or changed to provide technology training integrated within other methods courses. Two such programs, the field-based model for undergraduate teacher education experiences at Arizona State University (ASU) (Brush, Igoe, Brinkerhoff, Glazewski, Ku, and Smith, 2001) and the National-Louis Preparing Tomorrow's Teachers for Technology program (Anderson & Borthwick, 2002) were developed based on this research. The ASU program developed a program that integrated technology training into methods course with field-experience

components, so that students would be provided with the opportunity to experience technology activities relevant to tasks that teachers perform in the classroom.

The National-Louis PT3 program developed a model in which the Introduction to Technology in Education course was integrated within coursework over the first year of the elementary education Master of Arts in Education program. During the first term of this new program, an effort was made to integrate technology instruction into the Introduction to Special Education methods course. Using this course, the instructors co-planned the technology integrated class. As topics within the special education course were introduced and could be related to an objective from the Master Course Outline of the Introduction to Technology in Education course, both these skills were introduced at the same time. The instructors tried to ensure that the technology skill taught operated as the tool for the topic in the special education class. If this was not possible, the relationship of the technology skill to the special education topic was emphasized as the technology skill was taught. A copy of their integrated syllabus is found in Appendix B. A pre-post survey of students enrolled in this methods course reflected many gains by students in knowledge, skills, and self-assessment of future applications of educational technology (Anderson & Borthwick, 2002).

Despite these significant gains, the survey results of this integrated program failed to show significant gains in several technology skills identified as required skills on the master course outline for Introduction to Technology in Education (Anderson & Borthwick, 2002). For example, the surveys failed to identify a significant gain in knowledge of spreadsheets and databases. Given these results,

instructors looked to the literature that supports providing technology training as a separate course as they considered restructuring the program.

In a follow-up study to the ISTE (1999) study, Bielefeldt (2001) further investigated the methods used by teacher education institutions who described themselves as most successful at producing technology-using students to train their preservice teachers. Results revealed that a self-contained class in technology in education was "essential" in addition to technology integration in other education coursework (p. 9). Likewise, using pre-post course surveys, Willis and de Montes (2000) found evidence of improved technology skills following a self-contained educational technology class, although preservice students reported minimal use of technology during their student teaching experience. Thus, Willis and de Montes recommended that SCDEs consider one skills-based course and one course focusing on technology integration in the curriculum.

Other literature related to the design of technology coursework for preservice students includes studies of preservice teachers' attitudes toward computer use. Willis and de Montes (2000) found that students entered a technology course with a positive attititude about their ability to succeed in learning to use technology and no pre-post course difference in attitude was found. However, Abbott and Faris (2000) identified increased positive attitudes toward computer use following a literacy course where instruction and assignments that required the use of technology were coupled with supportive faculty. In a study of technology integrated within science and mathematics methods courses, Thomas and Cooper (2000) used both computer anxiety and computer use pre-post course surveys; they found significant differences in preservice student perceptions of

computers as tools for enhancing efficiency and communication and in computer anxiety (increased levels of comfort and confidence).

The literature also provides valuable insight into methods used for integration of technology in existing coursework. Campbell and Warburton (1999) described their development of interdisciplinary assignments and projects for students enrolled simultaneously in introductory courses in both information technology and language arts. Abbott and Faris (2000) also describe, in some detail, methods of technology integration in a literacy course, while Thomas and Cooper (2000) discuss integration in science and mathematics methods courses, concluding with general recommendations suitable for all methods instructors.

Based upon the literature evidence, the PT3 program was revised so that the Introduction to Technology in Education course was offered as a separate course. The course was offered during the first term of the elementary education program and again during the same term as the Introduction to Special Education was offered. This study is a report comparing survey results of both cohorts, the MAT students who received their Introduction to Technology in Education course as an integrated course and the MAT students who received a separate course.

Specific research questions addressed in this study include:

1. Will MAT teachers involved in a self-contained Introduction to Technology in Education class improve their knowledge and ability to operate microcomputers and their peripherals within the classroom more than MAT students who took the technology class as a class that was integrated into an Introduction to Special Education class?

2. Will MAT teachers involved in a self-contained Introduction to Technology in Education class improve their ability to evaluate software and to use technology effectively for instruction within the classroom more than MAT students who took the technology class as a class that was integrated into an Introduction to Special Education class?

3. Will MAT teachers involved in a self-contained Introduction to Technology in Education class improve their knowledge and ability to use technology as a teacher tool their more than MAT students who took the technology class as a class that was integrated into an Introduction to Special Education class?

4. Will MAT teachers involved in a self-contained Introduction to Technology in Education class feel better able to develop a technology plan than MAT students who took the technology class as a class that was integrated into an Introduction to Special Education class?

5. Will MAT teachers involved in a self-contained Introduction to Technology in Education class disseminate their knowledge and ability to operate microcomputers and their peripherals more than MAT students who took the technology class as a class that was integrated into an Introduction to Special Education class?

Each of these research questions was addressed through several questions on the survey instrument. The survey instrument is found in Appendix A. Researchers asked the students to rate their expertise on a 5-point scale. Students were asked to rate their expertise according to the following descriptors: no knowledge in this area, awareness but need to know more to utilize, limited skills in this area and desire more, basic knowledge to use the area, and competent in the

area. Researchers expected a greater gain score from pretest to posttest in the MAT group that took the self-contained introduction to educational technology class than the MAT group that took the introductory class as a class integrated within their introduction to special education class. A copy of the syllabi from each class is found in Appendices B and C.

The Subjects

The subjects of this study were members of two different elementary education cohorts of the Master of Arts in Teaching program in Milwaukee, Wisconsin. The Master of Arts in Teaching program is a part of the Preparing Tomorrow's Teachers for Technology (PT3) grant awarded to National-Louis University. The program is in its second year of the three-year cycle. The program is designed to provide an alternative certification program for adults who already have their Bachelor of Arts degrees and wish to join the teaching force. The program was further designed to provide a stronger technology emphasis than the traditional MAT program offered by National-Louis. To help accomplish this goal, these students were required to complete the Technology in Education (TIE) class at the 500 level, Introduction to Technology in Education. This course was offered to the first cohort, IC, in their first term of instruction as a class that was integrated within their introductory methods course in educating students with disabilities, SPE 500 or Introduction to Special Education. This cohort will be identified for this paper as IC. The second cohort, SAC, was offered Introduction to Technology in Education as a stand-alone course. They will be identified in this paper as SAC.

The first cohort group in this study included twelve members while the second cohort contained 15 members. Each cohort met one night per week when

classes were offered for six consecutive hours, from 4:30 in the afternoon until 10:30 at night, to accommodate the working adult. Each cohort member was given a Gateway laptop computer as a part of the PT3 program. In addition, their instruction occurred within the Macintosh computer lab at Manitoba Elementary School, an elementary school that is part of the Milwaukee Public School System, a partner in the PT3 grant.

Methodology

Each cohort involved in this study was provided instruction in educational technology during the first semester of their Master of Arts in Teaching program. The first cohort, IC, received their TIE 500 class as a class that was integrated within SPE 500, Introduction to Special Education. The second cohort, SAC, received their TIE 500 class as a separate class during the same term that they received their SPE 500 class. The integrated class was developed jointly by the instructors of the two courses. When the SPE 500 topic included something related to a skill from the objectives of the TIE 500 class, both topics were taught at the same time. A copy of the joint syllabus is found in Appendix C. The other cohort received two separate classes, beginning the evening with SPE 500 and ending the evening with TIE 500, each following the official syllabus of the respective course.

Pretest and posttest survey results were collected from each of the cohort students during the first and last nights of class to measure the effectiveness of this method. The survey instrument used was adapted from an instrument used by Blackhurst (1988) to measure technology skills in beginning teachers and subsequently modified by Anderson and Anderson (2001) and Anderson and Petch-Hogan (2001) for their research. Results of this survey for IC were reported

by Anderson and Borthwick (2002) and generally reflected significant gains in most areas of the survey. A copy of the survey instrument used is found in Appendix A.

The pretest was administered at the start of the ten-week term, while the posttest was administered following the completion of the experience. Analysis was done with SPSS 10 for Windows (SPSS, 1999) and use of a Microsoft (2001) Excel spreadsheet. Excel was used to list individual survey score results and calculate gain scores for each student on each item of the survey. Using the results or the gain scores of each MAT student, an independent samples t-test was run for each survey item using gain scores as the dependent variable. Significance level was set at .05. The first cohort (IC) had 12 students while the second cohort (SAC) had 15 students.

The Results

To address the first question (Will MAT teachers involved in a self-contained Introduction to Technology in Education class improve their knowledge and ability to operate microcomputers and their peripherals within the classroom more than MAT students who took the technology class as a class that was integrated into an introduction to special education class?), the survey instrument asked students to rate their ability to successfully operate a computer and acquire knowledge about technology. These computer skills include such skills as knowing best operating conditions, simple computer troubleshooting, and safety features of a computer, operating a variety of peripheral devices, and being able to perform several activities needed to successfully use the operating systems of a Windows and Macintosh computer. Knowledge skills were assessed with questions related to knowing about and maintaining knowledge about technology applications. Results

are reported in Tables 1, 3, and 5. Statistics for these survey results are found in Tables 2, 4, and 6 respectively.

Table 1

Knowledge of operation of microcomputers and peripherals

Skill	t	df	Mean Diff.	Std. Err Dif	Sig.	Sig
Operate a computer	-1.24	25	-2.5	.2	.113	
Operate a projection device	-1.45	25	-.58	.40	.08	
Hook up external devices	-1.45	25	-.58	.40	.079	
Install and set up software	-1.94	25	-.72	.37	.032	*
Explain safety features	-1.30	25	-.62	.47	.102	
Explain best operating conditions	-.682	25	-.35	.51	.251	
Use simple techniques for trouble-shooting	-1.47	25	-.68	.46	.076	
Perform routine maintenance	-1.13	25	-.47	.41	.135	
Operate CD-ROMs	-1.30	25	-.57	.44	.104	
Operate and maintain printers	-1.82	25	-.90	.49	.04	*
Operate and maintain scanners	-2.41	25	-.80	.33	.012	*
Operate and maintain digital cameras	-1.70	25	-.72	.42	.05	*

Note. An * in the s column denotes a significant value.

*$p < .05$

Table 2

Knowledge of operation of microcomputers and peripherals

	Number		Mean		Std. Dev.		St. Err. Mean	
Skill	IC	SAC	IC	SAC	IC	SAC	IC	SAC
Operate a computer	12	15	-.02	.17	.51	.52	.15	.14
Operate a projection device	12	15	.42	1.00	1.00	1.07	.29	.28
Hook up external devices	12	15	.42	1.00	1.00	1.07	.29	.28
Install and set up software	12	15	.42	1.13	.79	1.06	.23	.27
Explain safety features	12	15	.58	1.20	1.38	1.08	.40	.28
Explain best operating conditions	12	15	.92	1.27	1.38	1.28	.40	.33
Use simple techniques for trouble-shooting	12	15	.58	1.27	1.08	1.28	.31	.33
Perform routine maintenance	12	15	.67	1.13	1.15	.99	.33	.26
Operate CD-ROMs	12	15	.50	1.07	.52	1.44	.15	.37
Operate and maintain printers								
Operate and maintain scanners	12	15	.17	1.07	1.11	1.39	.32	.36
Operate and maintain digital cameras	12	15	.00	.80	.60	1.01	.17	.26

Table 3

Use of computer operating systems

Skill	t	df	Mean Diff.	Std. Err Dif	Sig.	Sig
Initialize disks	-.636	25	-.37	.58	.266	

Operate/navigate Mac system	-.286	25	-.15	.52	.389	
Operate/navigate Win system	-1.23	25	-.83	.68	.116	
Begin software in Macintosh	-2.54	20.7	-1.03	.41	.01	*
Begin software in Windows	-1.19	25	-.58	.49	.123	
Delete program in Macintosh	-1.43	25	-.77	.54	.083	
Change settings in Macintosh	-.925	25	-.38	.41	.182	
Find file in Macintosh	-1.20	25	-.50	.42	.121	
Make alias in Macintosh	-1.11	25	-.63	.57	.139	
Configure peripherals in Macintosh	-.974	25	-.47	.48	.170	
Delete program in Windows	-1.04	25	-.55	.53	.154	
Change settings in Windows	-1.22	25	-.57	.46	.117	
Find file in Windows	-1.30	25	-.62	.47	.102	
Make shortcut in Windows	-1.31	25	-.62	.47	.102	
Configure peripherals in Windows	-1.31	25	-.62	.47	.102	

Note. An * in the s column denotes a significant value.

*$p < .05$

Table 4

Use of computer operating systems

	Number		Mean		Std. Dev.		St. Err. Mean	
Skill	IC	SAC	IC	SAC	IC	SAC	IC	SAC
Initialize disks	12	15	1.17	1.53	1.53	1.46	.44	.38
Operate/navigate Mac system	12	15	1.58	1.73	1.16	1.49	.34	.38

Operate/navigate Win system	12	15	.83	1.67	1.59	1.88	.46	.48
Begin software in Macintosh	12	15	.33	1.37	.65	1.39	.19	.36
Begin software in Windows	12	15	1.08	1.67	1.38	1.18	.40	.30
Delete program in Macintosh	12	15	.50	1.27	1.57	1.22	.45	.32
Change settings in Macintosh	12	15	1.08	1.47	1.08	1.06	.31	.27
Find file in Macintosh	12	15	.83	1.33	1.11	1.05	.32	.27
Make alias in Macintosh	12	15	1.17	1.80	1.80	1.15	.52	.30
Configure peripherals in Macintosh	12	15	1.50	1.97	1.31	1.17	.38	.30
Delete program in Windows	12	15	1.25	1.80	1.29	1.42	.37	.37
Change settings in Windows	12	15	1.50	2.07	1.31	1.10	.38	.28
Find file in Windows	12	15	1.42	2.03	1.24	1.20	.36	.31
Make shortcut in Windows	12	15	1.42	2.03	1.24	1.20	.36	.31
Configure peripherals in Windows	12	15	1.42	2.03	1.24	1.20	.36	.31

Table 5

Acquire knowledge of the use of computers and related technology

Skill	t	df	Mean Diff.	Std. Err Dif	Sig.	Sig
Define terms and concepts related to technology applications	-.299	25	-.01	.33	.384	
Identify major issues associated with the use of computers	-2.78	25	-1.00	.36	.005	*
Identify ways that	-.186	25	-.02	.45	.427	

computers can be infused into the curriculum.					
Take steps to keep knowledge and skills in technology up to date.	-.213	25	.02	.39	.417
Identify sources of information about technology.	-3.91	25	-1.88	.48	.001

Note. An * in the s column denotes a significant value.

*p < .05

Table 6

Acquire knowledge of the use of computers and related technology

	Number		Mean		Std. Dev.		St. Err. Mean	
Skill	IC	SAC	IC	SAC	IC	SAC	IC	SAC
Define terms and concepts related to technology applications	12	15	.83	.93	.72	.96	.21	.25
Identify major issues associated with the use of computers	12	15	.17	1.17	.94	.92	.27	.24
Identify ways that computers can be infused into the curriculum.	12	15	1.42	1.50	1.08	1.21	.31	.31
Take steps to keep knowledge and skills in technology up to date.	12	15	1.25	1.33	1.14	.90	.33	.23
Identify sources of information about technology.	12	15	-.42	1.47	1.38	1.13	.40	.29

Table 1 results indicate that the self-contained cohort, SAC, identified a greater improvement in their ability to install software and to operate and maintain printers, scanners, and digital cameras. In Table 3, SAC reported a greater improvement in their ability to start using software on the Macintosh computer. Table 5 findings identify a greater improvement in SAC cohort's knowledge of major issues associated with the use of technology.

To address the second research question (Will MAT teachers involved in a self-contained Introduction to Technology in Education class improve their ability to evaluate software and use of technology effectively for instruction within the classroom more than MAT students who took the technology class as a class that was integrated into an introduction to special education class?) students were asked to rate their ability identify the purpose of a software program, evaluate the content to match the learner, evaluate the documentation, and use the teacher options. To address the second part of the question, use of the technology for instruction, students were asked to Results are found in Tables 7 and 9.

Table 7

Evaluation of software

Skill	t	df	Mean Diff.	Std. Err Dif	Sig.	Sig
Identify the purpose of the software program.	-2.56	25	-.90	.35	.009	*
Determine the characteristics of learners appropriate for the program.	-1.65	25	-.72	.43	.056	

Identify characteristics of software that meets instructional needs.	-1.23	25	-.67	.54	.115	
Evaluation of the content.	-3.00	25	-1.27	.42	.003	*
Match level of difficulty with learner.	-2.67	25	-1.23	.47	.007	*
Evaluate documentation.	-1.89	25	-.97	.51	.035	*
Determine teacher options.	-1.49	25	-.75	.50	.075	
Set up options for use	-4.11	25	-1.93	.47	.000	*

Note. An * in the s column denotes a significant value.

*p < .05

Table 8

Evaluation of software

	Number		Mean		Std. Dev.		St. Err. Mean	
Skill	IC	SAC	IC	SAC	IC	SAC	IC	SAC
Identify the purpose of the software program.	12	15	.50	1.40	.67	1.06	.19	.27
Determine the characteristics of learners appropriate for the program.	12	15	1.08	1.80	1.08	1.15	.31	.30
Identify characteristics of software that meets instructional needs.	12	15	1.33	2.00	1.23	1.51	.36	.39
Evaluation of the content.	12	15	.67	1.93	.78	1.28	.22	.33
Match level of difficulty with learner.	12	15	.83	2.07	1.11	1.28	.32	.33
Evaluate documentation.	12	15	1.17	2.13	1.27	1.36	.37	.35

Determine teacher options.	12	15	1.25	2.00	1.14	1.41	.33	.37
Set up options for use	12	15	.00	1.93	1.41	1.03	.41	.27

Table 9

Use of technology to facilitate instruction

Skill	t	df	Mean Diff.	Std. Err Dif	Sig.	Sig
Use technology for effective instructional practice.	-1.30	25	-.62	.47	.102	
Set up classroom for effective instructional practice.	-1.22	25	-.57	.46	.117	
Use tutorial programs. effectively.	-1.04	25	-.55	.53	.154	
Use drill and practice programs effectively.	-.974	25	-.47	.48	.170	
Use problem solving programs effectively.	-1.11	25	-.63	.57	.139	
Use tool software for students.	-1.20	25	-.50	.42	.121	
Use tool software for teachers.	-.925	25	-.38	.41	.182	
Use assistive technology appropriately	-1.43	25	-.77	.55	.083	
Evaluate the effectiveness of technology applications	-1.19	25	-.58	.49	.123	
Use the Internet for research	-2.54	20.71	-1.03	.44	.013	*
Use Internet online learning activities	-1.23	25	-.83	.60	.116	
Have students use multimedia for creating projects.	2.286	25	-.15	.52	.389	
Have students use Web pages to	-.636	25	-.37	.58	.265	

create projects.

Note. An * in the s column denotes a significant value.

*p < .05

Table 10

Use of technology to facilitate instruction

	Number		Mean		Std. Dev.		St. Err. Mean	
Skill	IC	SAC	IC	SAC	IC	SAC	IC	SAC
Use technology for effective instructional practice.	12	15	1.42	2.03	1.24	1.20	.36	.31
Set up classroom for effective instructional practice.	12	15	1.50	2.07	1.31	1.10	.38	.28
Use tutorial programs effectively.	12	15	1.25	1.80	1.29	1.42	.37	.37
Use drill and practice programs effectively.	12	15	1.50	1.97	1.31	1.17	.38	.30
Use problem solving programs effectively.	12	15	1.17	1.80	1.80	1.15	.52	.30
Use tool software for students.	12	15	.83	1.33	1.11	1.05	.32	.27
Use tool software for teachers.	12	15	1.08	1.47	1.08	1.06	.31	.27
Use assistive technology appropriately	12	15	.50	1.27	1.57	1.22	.45	.32
Evaluate the effectiveness of technology applications	12	15	1.08	1.67	1.38	1.18	.40	.30
Use the Internet for research	12	15	.33	1.37	.65	1.39	.19	.36
Use Internet online learning activities	12	15	.83	1.67	1.59	1.88	.46	.48
Have students use multimedia for creating projects.	12	15	1.58	1.73	1.16	1.49	.34	.38

Have students use Web pages to create projects.	12	15	1.17	1.53	1.53	1.46	.44	.38

Cohort SAC reported a greater increase in their ability to identify the purpose of a software program, their ability to evaluate content and documentation, their ability to match the level of difficulty with the learner and use the options of the program. Cohort SAC reported a greater increase in their ability to use the Internet for research to facilitate instruction than cohort IC.

To address the third research question (Will MAT teachers involved in a self-contained Introduction to Technology in Education class improve their knowledge and ability to use technology as a teacher tool their more than MAT students who took the technology class as a class that was integrated into an introduction to special education class?), students were asked to rate their ability to use word processors, databases, spreadsheets, utility programs, email, listservs, bulletin boards, IEP generators, portfolio software, and manage files. Results can be found in Table 11 with statistics in Table 12.

Table 11

Use of technology as a teacher tool

Skill	t	df	Mean Diff.	Std. Err Dif	Sig.	Sig
Use a word processor to develop materials.	-.883	25	-.55	.62	.192	
Use utility programs	-1.954	25	-.70	.36	.031	*
Use a database. effectively.	-4.23	25	-.1.85	.44	.000	*
Use a spreadsheet	-2.32	25	-.1.27	.55	.015	*
Use email programs effectively.	-2.63	25	-.1.05	.40	.008	*

Use the Internet for lesson plans.	-.644	25	-.33	.52	.263	
Use the Internet for researching information.	-7.01	25	-3.53	.50	.000	*
Use listservs	-.934	25	-.45	.48	.18	
Use bulletin boards	-.599	25	-.32	.53	.277	
Use IEP generators	-1.08	25	-.48	.45	.115	
Use word processor for IEPs, reports	-.719	25	-.38	.53	.240	
Use portfolio software	-2.40	25	-1.13	.47	.012	*
Conduct regular back-ups of data.	-4.36	25	-1.70	.39	.000	*
Transfer files between different computers/programs.	-4.76	25	-1.92	.40	.000	*

Note. An * in the s column denotes a significant value.

*p < .05

Table 12

Use of technology as a teacher tool

	Number		Mean		Std. Dev.		St. Err. Mean	
Skill	IC	SAC	IC	SAC	IC	SAC	IC	SAC
Use a word processor to develop materials.	12	15	.92	1.47	1.56	1.64	.45	.42
Use utility programs	12	15	.17	.87	.72	1.06	.21	.27
Use a database. effectively.	12	15	.02	1.93	.90	1.28	.26	.33
Use a spreadsheet	12	15	.67	1.93	1.67	1.16	.48	.30
Use email programs effectively.	12	15	.02	1.13	.67	1.25	.19	.32
Use the Internet for lesson plans.	12	15	1.67	2.00	1.30	1.36	.38	.35
Use the Internet for researching information.	12	15	-1.67	1.87	1.30	1.30	.38	.34

Use listservs	12	15	1.08	1.53	.90	1.46	.26	.38
Use bulletin boards	12	15	1.08	1.40	.90	1.64	.26	.42
Use IEP generators	12	15	1.25	1.73	1.06	1.22	.30	.32
Use word processor for IEPs, reports	12	15	1.42	1.80	1.00	1.61	.29	.42
Use portfolio software	12	15	.67	1.80	1.15	1.26	.33	.33
Conduct regular back-ups of data.	12	15	-.17	1.53	.72	1.19	.21	.31
Transfer files between different computers/programs.	12	15	.02	2.00	1.31	.76	.38	.20

Students from SAC reported they became more skilled using utility programs such as spell checkers, thesauruses, wizards, and mail merging. They reported a greater improvement than cohort 19 in their ability to use databases, spreadsheets, email, and the Internet for researching information. Cohort SAC also reported a greater increase in their ability to use portfolio software, do regular backups of data, and their ability to transfer files.

Responses to the fourth research question (Will MAT teachers involved in a self-contained Introduction to Technology in Education class feel better able to develop a technology plan than MAT students who took the technology class as a class that was integrated into an Introduction to Special Education class?) were addressed by asking the cohorts to rate their ability to identify goals for using technology in the classroom, identifying parts of the curriculum for technology, setting up the classroom for technology, ensuring equitable access and creating guidelines for its use. They were asked their ability to plan purchase of the

technology by asking their ability to set a budget, find funding sources, and writing a grant. The results are recorded in Table 13 with the statistics in Table 14.

Table 13

Developing a technology plan

Skill	t	df	Mean Diff.	Std. Err Dif	Sig.	Sig
Identify goals for using technology in education.	-1.25	25	-.47	.37	.111	
Identify parts of the curriculum that are appropriate for technology.	-.709	25	-.25	.35	.243	
Plan appropriate classroom changes for technology.	-1.85	25	-.60	.32	.039	*
Ensure equitable access to the computer.	-.344	25	-.13	.39	.347	
Create guidelines for technology use.	-1.26	25	-.52	.41	.109	*
Develop a budget for technology.	-2.31	25	-1.07	.46	.015	*
Determine possible funding sources for technology needs.	-2.69	25	-1.32	.49	.006	*
Write grants for technology	-.843	25	-.47	.55	.204	

Note. An * in the s column denotes a significant value

*p < .05

Table 14

Developing a technology plan

	Number		Mean		Std. Dev.		St. Err. Mean	
Skill	IC	SAC	IC	SAC	IC	SAC	IC	SAC

Identify goals for using technology in education.	12	15	1.33	1.80	.89	1.01	.26	.26
Identify parts of the curriculum that are appropriate for technology.	12	15	1.58	1.83	1.00	.84	.29	.22
Plan appropriate classroom changes for technology.	12	15	1.33	1.93	.89	.80	.26	.21
Ensure equitable access to the computer.	12	15	1.67	1.80	.89	1.08	.26	.28
Create guidelines for technology use.	12	15	1.42	1.93	1.08	1.03	.31	.27
Develop a budget for technology.	12	15	.67	1.73	.98	1.33	.28	.34
Determine possible funding sources for technology needs.	12	15	.42	1.73	1.16	1.33	.34	.34
Write grants for technology	12	15	.33	.80	1.56	1.32	.45	.34

*p < .05

Cohort SAC students reported a greater increase in their ability plan appropriate changes to the classroom to accommodate technology than cohort IC. They further reported a greater increase in their ability to create guidelines for technology use, their ability to develop a budget, and their skill at determining possible funding for technology.

Responses to the fifth research question (Will MAT teachers involved in a self-contained Introduction to Technology in Education class disseminate their knowledge and ability to operate microcomputers and their peripherals more than MAT students who took the technology class as a class that was integrated into an

Introduction to Special Education class?) were addressed by asking students if they maintain a file of information on technology, if they provide consultation to colleagues and parents, if they make presentations, and if they prepare written reports on technology. Responses are recorded in Table 15 with statistics recorded in table 16.

Table 15

Dissemination of technology information

Skill	t	df	Mean Diff.	Std. Err Dif	Sig.	Sig
Maintain a file of information on technology.	-2.17	25	-1.02	.47	.02	*
Provide consultation to colleagues on technology.	-1.87	25	--83	.44	.037	*
Provide consultation to parents on technology.	-1.31	25	-.62	.47	.105	
Make presentations on technology.	-2.68	25	-1.35	.50	.007	*
Prepare written reports/articles on technology.	-.789	25	-.50	.63	.219	

Note. An * in the s column denotes a significant value.

*p < .05

Table 16

Dissemination of technology information

	Number		Mean		Std. Dev.		St. Err. Mean	
Skill	IC	SAC	IC	SAC	IC	SAC	IC	SAC
Maintain a file of information	12	15	.58	1.60	1.31	1.12	.38	.29

on technology.								
Provide consultation to colleagues on technology.	12	15	.83	1.67	1.11	1.18	.32	.30
Provide consultation to parents on technology.	12	15	1.08	1.70	1.31	1.13	.38	.29
Make presentations on technology.	12	15	.42	1.77	1.38	1.24	.40	.32
Prepare written reports/articles on technology.	12	15	.83	1.33	1.11	1.95	.32	.50

According to the survey results, students in cohort SAC reported a greater increase in their ability to maintain a file of information on technology, their ability to provide consultation to colleagues, and their ability to make presentations about technology than students in cohort 19.

To summarize, survey results comparing the pretest to posttest responses of cohort IC to those of cohort SAC, both elementary education MAT groups, indicated several areas that SAC students, those who took the separate Introduction to Technology in Education course, reported a greater improvement from pretest to posttest. Cohort SAC reported a greater improvement than IC in their ability to set up and install software and operate printers, scanners and digital cameras. Cohort SAC reported a greater increase in their ability to begin a software program on a Macintosh computer and to identify major issues associated with the use of technology. Identifying the purpose of a software program, evaluating the content, matching the level of difficulty with the learner, evaluating the documentation, setting up options for using software, and using the Internet for research were reported as

greater areas of improvement by SAC than IC. Cohort SAC also indicated a greater improvement in their ability to use utility programs, use databases, use spreadsheets, use email, use the Internet to aid teaching, use portfolio software, make regular backups, and transfer files between different programs. Other areas of the surveys filled out by cohorts IC and SAC failed to show significant difference in the gain between pretest and posttest.

Discussion

Beginning teachers are required to master skills identified by the International Society for Technology in Education and recognized by the National Council for the Accreditation of Teacher Education (1997). To meet these technology standards, two elementary education cohorts were offered different methods of instruction. One, cohort IC, was taught the skills to meet these standards as a class, Introduction to Technology in Education, integrated within the Introduction to Special Education class (Appendix B) while the other cohort, WC 20, was offered a separate class (Appendix C). To determine which group reported a greater change in technology expertise, a survey instrument was administered, both as a pretest at the beginning of the term that they received the class Introduction to Technology in Education and at the conclusion of this term.

The first study question asked if cohort members involved in a self-contained Introduction to Technology in Education class would indicate that they improved their knowledge and ability to operate microcomputers and peripherals within the classroom more than the cohort that received their class integrated into the Introduction to Special Education class. This study suggested that this group improved their scores significantly in several areas: installing and setting up

software; operating and maintaining printers, scanners and digital cameras; and beginning software programs on the Macintosh computer. They failed to show significant gain scores in their ability to operate a computer; operate a projection device; hook up external devices; explain safety features of the computer and peripherals; explain best operating conditions for computers; use simple trouble-shooting techniques; perform routine maintenance; initialize disks; operate and navigate the Macintosh and Windows systems; begin software in Windows; delete programs, change settings, find files, make alias, and configure peripherals on the Macintosh; delete programs, change settings, find files, make shortcuts, and configuring peripherals in Windows.

Survey evidence would seem to indicate SAC demonstrated more areas of improvement during the term of instruction. An explanation for this might be found in the syllabi for the two courses. The syllabi for cohort WC19, the group with the integrated technology class, are found in Appendix B, both the integrated syllabi and the syllabi for the course itself. The syllabus for cohort SAC is found in Appendix C. Using the syllabi from the courses, the cohort with self-contained course was provided with a more in-depth introduction to the interface of the Windows computer (Night 1). The integrated nature of the technology class offered to the other cohort, IC, did not provide the time to teach such an in-depth introduction to the operation of their computers.

The syllabi also reveal that more time was available to SAC to explore technology in general. During night two, the subject, according to the syllabus for cohort SAC was best practice in methods of integrating technology into the curriculum. The syllabi for IC fails to indicate that this type of broad introduction to

the use of computers and technology in the classroom was provided. Topics were correlated with the Introduction to Special Education course, limiting the opportunity to provide IC with a complete introduction to general computer use on the Macintosh computers in the Manitoba lab or to provide sufficient instruction on the installation of software on their laptops. This might provide an explanation for the significance in gain scores for SAC on these survey items.

Instruction in peripheral devices such as scanners, printers, and digital cameras were also restricted for IC. While the syllabus for this group reflects multimedia and Web page design, along with portfolio instruction, the syllabi for SAC provides a more detailed project requirement that uses these skills, the Web page portfolio requirement. As part of this project, students in SAC were required to develop Web-based page portfolio pages that required the use of these skills in their project. The assignment was to provide some artifacts using scanned documents, an individual's digital image on the cover of the portfolio, and a printed version of the results to be turned into the instructor. These skills required the SAC student to perform them; the same was not asked of the IC student.

The second research question addressed the MAT students' ability to evaluate software and to use technology effectively for instruction. To measure this area, the survey asked the students to identify the purpose of a software program, determine characteristics of learners appropriate for software, identify characteristics of software that meet instructional needs, evaluate the content, match the level of difficulty with the learner, evaluate the documentation and teacher options, and be able to set up options for using the software. To measure students' ability to use technology for effectively for instruction, the survey asked students to rate their

ability to use technology for effective instructional practice; set up the classroom for effective instructional practice; use tutorial, drill and practice, and problem solving programs; use tool software for both teachers and students, use assistive technology, evaluate the effectiveness of technology, use the Internet for research, use the Internet for online learning activities, use multimedia, and Web pages to create projects. Results were significant for many areas related to the evaluation of software indicating that SAC felt better able to do this than IC as a result of instruction. An explanation for this might again be found in the syllabi for the course. Because the time allowed for the course was greater, more software packages were required to be evaluated by the cohort, SAC, helping them to feel better able to do this skill. At the same time, both cohorts were exposed to the use of a variety of technology that could be used to facilitate instruction: language arts software, multimedia, assistive technology, Web pages, and the Internet. This might explain the nonsignificant differences in gain scores for these areas identified . Each cohort was taught to the types of software, tutorials, drill and practice packages and problem-solving packages, when they each explored technology-integrated lessons on the Web, explaining the nonsignificant results of these areas.

At the same time, survey results indicate a significant difference in gain scores between the two cohorts in use of the Internet for research. This might again be explained by the contents of the syllabi. The Internet use by cohort 19 had a focused intent, evaluating Web sites and finding lessons on the Web. For cohort 22, the Internet was used in a broader sense: to explore online activities, facilitate instruction and learn WebCT. This might have made this group better prepared to use the Internet for research.

Students' responses to the third research question (Will MAT teachers involved in a self-contained Introduction to Technology in Education class improve their knowledge and ability to use technology as a teacher tool more than MAT students who took the technology class as a class that was integrated class into the Introduction to Special Education class?), reflected many areas where SAC felt that they had greater improvement than their ability to use software as a teacher tool than IC. Areas of significance include ability to use utility programs like spell checkers and thesauruses, ability to use a database, ability to use a spreadsheet, ability to use email, ability to use portfolio software, conduct regular backups and transfer files between computers.

The instruction in these areas that was received by cohort IC was much more focused than that of SAC. Looking at the two syllabi, the word processing instruction received by IC was related to finding lessons on the Web and generating other lessons of their own using a word processor. Thus, this group did not receive extensive instruction in using word processors, as the other group did. SAC received specific instruction in Microsoft Word and then used it as Web authoring software for their portfolios. Comparing the two syllabi for telecommunications activities, both SAC and IC received direct instruction in using the Web to find lesson plans, yet neither received direct instruction in the use of listservs, bulletin boards, or IEP generators. Further comparison of the respective syllabi reveals a portfolio project requirement for cohort SAC that IC did not have, explaining this significant gain score difference, SAC had more time to explore the operation of the computers including making backups and transferring files.

Results of the fourth research question (Will MAT teachers involved in a self-contained Introduction to Technology in Education class feel better able to develop a technology plan than MAT students who took the technology class as a class that was integrated into an introduction to special education class?) reflected several areas where SAC felt better prepared to develop a technology plan. This area is measured by students' s ability to identify goals for using technology, identify parts of the curriculum that are appropriate for technology, plan appropriate classroom changes for accommodating technology in the class, ensure equitable access to the computer, create guidelines for technology use, develop a budget for technology, determine possible funding sources, and write grants for technology. Students in SAC reported a greater gain in classroom changes, creating technology guidelines, developing budgets, and determining possible funding sources for technology needs.

An explanation of the results might be found in the syllabi of the two courses again. Cohort SAC had more opportunities to receive instruction in the skills necessary to develop a technology plan. They discussed best practices for the integration of technology into the classroom, so that they felt better able to make room changes for technology and create guidelines for using technology. SAC was asked to evaluate more software packages than IC. On the software evaluation for that SAC used, students were asked to find the price of the software, making SAC better aware of the prices of software. This is information that would be needed when developing a budget. While looking this information up for their larger assignment, SAC could very well have encountered more sources for funding technology purchases, providing an explanation for this significant area.

At the same time, nonsignificant areas might be explained by the syllabi also, While SAC had more software evaluations to do, the form to evaluate the software required the students to identify instructional goals that the software can be used for and identifying those curriculum areas where it can be best integrated and write a lesson description using the software. This might make the nonsignificant differences in gain scores, since both groups were required to do this. Finally, since neither group received specific instruction in writing grants for funding technology, neither group reported great gain in this area explaining the nonsignificant gain. Indeed, the mean gain scores (Table 14) were only .33 for IC and .80 for SAC.

Responses to the fifth research question (Will MAT teachers involved in a self-contained Introduction to Technology in Education class disseminate their knowledge and ability to operate microcomputers and their peripherals more than MAT students who took the class as a class that was integrated into an introduction to special education class) reported several areas of significance. This area was measured by asking students to rate themselves on maintaining a file of technology information, providing consultation to colleagues, providing consultation to parents, making presentations on technology, and preparing reports or articles on technology. Of these areas, SAC reported greater gain scores in maintaining a file of technology information, providing consultation to colleagues, and making presentations. An explanation for these results might be found by looking at several things. First of all, comparing the two syllabi of the groups indicates a greater emphasis on beginning an electronic portfolio for SAC, a file that provides information on technology. In addition, with more software packages to evaluate, SAC would have a larger file of information technology.

An explanation for the significant increase in providing consultation to colleagues for SAC might be that IC student roster included the technology coordinator for Manitoba Elementary School. She quickly came to the aid of students experiencing trouble in this cohort, so that it was unnecessary for others to provide assistance. Cohort SAC did not have this person, so that students had to help their colleagues having trouble significantly more than IC.

The syllabi provide a possible explanation for the significant gain score in making presentations on technology. Since SAC had more time available and not a pointed focus on their technology instruction, they were asked to demonstrate their software packages and portfolios to the class. This might be the explanation for their greater gain score in this area.

At the same time, neither group was required to provide technology consultation to parents nor to prepare written articles on technology. Mean differences for both groups in these two areas were only .62 and .50 respectively.

To summarize the findings of this research, surveys for two groups of cohort students, IC and SAC, were compared for gain scores in this study. The first cohort, IC, took their Introduction to Technology in Education course as a course that was integrated within the Introduction to Special Education. The latter cohort, SAC, took their two courses as separate courses. A variety of technology integration areas were measured using a survey instrument on which students rated their ability on a 5-point scale. Areas that were rated included students' ability to improve their technology knowledge and skills, their ability to evaluate software and use technology in the effectively with instruction, their ability to use technology as a teacher tool, their ability to develop a technology plan and their ability to disseminate

this technology knowledge. On several skills, the cohort that took the class in technology separately, SAC, reported a statistically significantly higher gain score than the cohort who took the technology class as an integrated class, IC. For most areas, these results could explained because the technology skills in the integrated technology class were correlated to the skills taught in the special education class. The separate class allowed more time for instruction and allowed more extensive instruction in technology integration.

Implications for Future Research

While noting the limitations caused by small sample size and the possibility that survey results reflect a student's desire to please his or her instructor, this research study offers several areas for future study. Future research might follow these cohort members into their classrooms and measure which students become the most successful at integrating technology. Future research might look at these technology-integrating skills at the end of the cohorts' training programs and see if the focus of technology throughout the Preparing Teacher for Tomorrow's Technology program causes the significant differences in gain scores to disappear. These cohorts in PT3 might be compared in these skills areas with the traditional MAT program at National-Louis University who do not receive a TIE 500 class to determine if their program provides a greater ability to integrate technology. Finally, in our comparison of integrated vs. stand-alone courses, the technology component was integrated into a special education methods course. Other literature discusses integration of technology instruction in a variety of methods courses including literacy (Abbott & Faris, 2000) and mathematics and science (Thomas & Cooper, 2000). It would seem that different software tools may be more relevant to some

courses than to others. It may be that survey results would be different if the Introduction to Technology course were integrated into different methods courses.

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Appendix A

Student Survey

Teacher Name ______________________________

Grade(s) ____

Personal Computer Type __________________________________

Directions for use:

N = No knowledge in this area.

A = Awareness only of this area; need to learn how to utilize

L = Limited skills; desire for more

B = Basic knowledge; skills to use or useable knowledge of area but not proficient

C = Competent in area

I. Knowledge of operation of microcomputers and peripherals:

Skill	Rating				
	N	A	L	B	C
Operate a computer					
Operate a projection device (LCD pad, projector, etc.)					
Hook up external devices					
Install and set up software					
Explain safety features about computers and peripherals					
Explain best operating conditions for computers					
Use simple techniques for trouble-shooting when software or hardware does not work.					
Perform routine maintenance of technology system					

Operate CD-ROMs
Operate and maintain printers
Operate and maintain scanners
Operate and maintain digital cameras

II. Use of computer operating systems:

Skill	Rating				
	N	A	L	B	C
Initialize disks					
Operate/navigate Macintosh system					
Operate/navigate Windows system					
Begin software program in Macintosh					
Begin software program in Windows					
Delete program in Macintosh					
Change settings in Macintosh					
Find file in Macintosh					
Make alias in Macintosh					
Configure peripherals in Macintosh					
Delete program in Windows					
Change settings in Windows					
Find file in Windows					
Make shortcut in Windows					
Configure peripherals in Windows					

III. Acquire knowledge of the use of computers and related technology:

Skill	Rating				
	N	A	L	B	C
Define terms and concepts related to technology applications					
Identify major issues associated with the use of technology					
Identify ways that computers can be infused into the curriculum.					
Take steps to keep knowledge and skills in technology up to date.					
Identify sources of information about technology					

IV. Evaluation of software:

Skill	Rating				
	N	A	L	B	C
Identify the purpose of the software program					
Determine the characteristics of learners appropriate for the program.					
Identify characteristics of software that meets instructional needs					
Evaluation of the content					
Match level of difficulty with learner					
Evaluate documentation					
Determine teacher options.					
Determine options for students with physical disabilities.					
Set up options for use (sound, scanning, etc.)					

VI. Use of technology to facilitate instruction:

Skill	Rating				
	N	A	L	B	C
Use technology for effective instructional practice					
Set up classroom for effective instructional practice, i.e. one on one use, large group use, effective placement, effective scheduling, etc.					
Use tutorial programs appropriately					
Use drill and practice programs suitably					
Use problem solving programs effectively					
Use tool software for students (word processing, spreadsheet, etc.)					
Use tool software for teachers (word processing, spreadsheet, gradebooks, etc.)					
Use assistive technology appropriately					
Evaluate the effectiveness of technology applications					
Use the Internet for research					
Use Internet online learning activities like Jason or Globalearn					
Have students use multimedia for creating projects (Hyperstudio, Linkway, Digital Chisel, etc.)					
Have students use Web pages to create projects					

VII. Use of technology as a teacher tool:

Skill	Rating				
	N	A	L	B	C
Use a word processor to develop materials					
Use spell checkers, thesaurus, wizards, mail merging and other utility programs					
Use a database for maintaining student rosters/records					
Use a spreadsheet for mathematical jobs such as grades					
Use email					
Use the Internet for lesson plans					
Use the Internet for researching information to aid teaching.					
Use listservs					
Use bulletin boards					
Use IEP generators					
Use word processor for IEPs, reports					
Use portfolio software					
Conduct regular back-ups of data					
Transfer files between different computers/programs					

VIII. Developing a technology plan:

Skill	Rating				
	N	A	L	B	C
Identify goals for using technology in education					
Identify parts of the curriculum that are appropriate for technology and how its use can be implemented.					
Plan appropriate classroom changes for accommodating technology					
Ensure equitable access to the computer					
Create guidelines for technology use					
Develop a budget for technology					
Determine possible funding sources for technology needs.					
Write grants for technology					

IX. Dissemination of technology information:

Skill	Rating				
	N	A	L	B	C
Maintain a file of information on technology					
Provide consultation to colleagues on technology					
Provide consultation to parents on technology					
Make presentations on technology					
Prepare written reports/articles on technology					

Appendix B

Integrated Syllabus for IC

Integrated Syllabi of Introduction to Special Education and Introduction to Technology in Education

SPE 500	TIE 500
Introduction to course	KP Studio Introductory activity
History of special education	Assignments with Living Books
Legal issues, IDEA, 504, ADA	Evaluating web sites, legal use of technology
Accessibility, advocacy, deaf-blind	Technology standards
Intelligence, learning, MR, gifted, TBI, autism	Finding lessons on the web
Accommodating diverse learners	Assistive technology
Supporting students' social/ emotional needs/EBD	Spreadsheets data analysis
Multiple disabilities, OHI	Multimedia
Community, family and collaboration, agencies, transition	Web pages and electronic portfolios

TIE 500 Syllabus for IC

TIE 500 Introduction to Technology in Education
Instructor: Dr. Cindy L. Anderson
Email: kcanders@voyager.net
Phone: 262-552-7178
Office Hours: Thursday, 3:30 to 4:40, Manitoba, online Monday 5:00 to 6:00, Wednesday 4:00 to 5:00

Program Mission: The mission of the Technology in Education program is to prepare educators to use technology in their schools and to provide instructional leadership and technical support to other educators who wish to integrate technology in teaching and learning.
Catalog Description: This survey course provides the educator with a broad base of knowledge about the use of computers in education. Students will have hands-on experience with word processing, databases, spreadsheets, graphics software, instructional software, and teacher utilities. Other topics include software evaluation, hardware selection, and telecommunications.
Required Textbook(s):
Morrison, G.R., Lowther, D.L., and DeMeulle, L. (1999). Integrating computer technology into the
classroom. Upper Saddle River: NJ: Merrill
ISTE (2000). National educational technology standards for students: Connecting curriculum and technology. Eugene, OR: Author.
Materials:
Two 3 and 1/2 inch "floppy" disks; these will be used for your work. Format these for IBM.
Prerequisite: none.
Objectives or Competencies:
The student will be able to:

4. Operate a computer and common peripherals.
5. Create a document on a word processor and print it out.
6. Use a multimedia program in an effective instructional fashion, complete with appropriate images, audio and video.
7. Effectively evaluate software.
8. Select appropriate software for instructional activity after evaluating several packages.
9. Use teacher tools to create instructional materials.
10. Use a graphics program.
11. Create entries, search, sort, and print reports with a database.
12. Use a spreadsheet to analyze and chart data and maintain student records.
13. Use telecommunications effectively in instruction.
14. List technology resources that are helpful for educators.
15. Define technology terminology appropriately.

Content and Sequence:

Night 1 – Technology Activity: KidPix Studio Deluxe (Multimedia Software)
Assignment: Read Chapters 1 and 2

Night 2 – Technology Activity: Instructional Software, specifically Storybook CD-ROMs
Assignment: Read Chapter 3

September 23 – Technology Activity: Internet, email, Creating a CDA lesson
Assignment: Chapter 12

September 28 – Technology Activity: Using and evaluating the Internet
Assignment: Chapters 4 and 6

October 5 – Technology Activity: Addressing Technology Standards and assistive technology
Assignment: Chapters 5 and 7

October 12 – Technology Activity: Accessing technology-integrated lessons on the Web and writing yours with a word processor. Types of software available for integration.
Assignment: Work on Projects

October 19 - No Technology Activity
Assignment: Chapters 8, 9

October 26 – Technology Activity:: Spreadsheets and databases
Assignment: Chapters 13 and 15

November 2 – Technology Activity: Online data activities and teacher utilities
Assignment: Chapters 10, 11, 14.

November 9 – Technology Activity: Multimedia
Assignment: Compile portfolio elements to present

November 16 – Technology Activity: Presentations
Assignment: Final Test

Projects for Class:

1. Evaluate 3 software packages with appropriate modified use for 3 different disabilities in the classroom. Results will be entered into a classroom database of evaluations. Include a word processed document that explains how to use the software in an appropriate instructional fashion and inappropriate instructional fashion. Your intended audience is a substitute teacher for your classroom. Be sure to include directions on how to use the technology that the software requires in an equitable fashion and how to use it for diverse students. When the database is finished, each student will use it to sort and print out a report of two other packages that you think that you might use in your classroom.

100 points
Standards Covered: 4, 5, 6, 7, 9, 11, 15, 16, 17, 18, 19, 24

2. Create a family technology handbook with a multimedia package that describes the operation of the computer and includes a policy and directions for searching the Internet, with tips for evaluating its resources. The handbook must include an original graphic. It is suggested that this be a depiction of the computer with common peripherals that are labeled. If this is not the choice, another original graphic must be depicted and a different method for identifying and labeling the parts of a computer with its peripherals must be used.

    100 points
    Standards Covered: 1, 10, 15, 16, 18, 19, 20, 21

3. Develop a thematic lesson plan that includes technology, assing areas from the list of minimal student standards, i.e. inquiry lesson with spreadsheet data collection and interpretation of the data. Begin the lesson with a CDA entry which provides a type of outline. Include a list of resources appropriate for a technology-using teacher. Include a rubric for scoring the lesson and a spreadsheet template for recording the grade of the lesson.

    100 points
    Standards Covered: 2, 3, 12, 13, 14, 15, 16, 18, 19, 22, 23

Feel free to work together in groups to complete these assignments. I would like individual products that reflect your individual classes and personalities, especially for the portfolios, but brainstorming and working together is encouraged.

Grading:

Test 1	100 points
Test 2	100 points
Project 1	100 points
Project 2	100 points
Project 3	100 points

NLU seeks to ensure that its programs are accessible to all persons. Students in need of special assistance or accommodation regarding any of the course requirements as outlined in this syllabus, the course objectives and/or course evaluation and assessment criteria, are advised to notify me immediately. We can meet to discuss a solution privately.

Appendix C

TIE 500 Syllabus for SAC

TIE 500 Introduction to Technology in Education
Instructor: Dr. Cindy L. Anderson
Email: clanderson@rr.wi.com
Home Phone: 262-552-7178
Office Phone: 414-272-2658
Office Hours: Thursday, 2:30 to 4:40, Manitoba, Tuesday, 2:30 to 4:30
Program Mission: The mission of the Technology in Education program is to prepare educators to use technology in their schools and to provide instructional leadership and technical support to other educators who wish to integrate technology in teaching and learning.
Catalog Description: This survey course provides the educator with a broad base of knowledge about the use of computers in education. Students will have hands-on experience with word processing, databases, spreadsheets, graphics software, instructional software, and teacher utilities. Other topics include software evaluation, hardware selection, and telecommunications.
Required Textbook(s):
Morrison, G.R., Lowther, D.L., and DeMeulle, L. (2000). Integrating computer technology into the
classroom. Upper Saddle River: NJ: Merrill
Materials:
Two 3 and 1/2 inch "floppy" disks; these will be used for your work. Format these for IBM.
Prerequisite: none.
Objectives or Competencies:
The student will be able to:

16. Operate a computer and common peripherals.
17. Create a document on a word processor and print it out.
18. Use a multimedia program in an effective instructional fashion, complete with appropriate images, audio and video.
19. Effectively evaluate software.
20. Select appropriate software for instructional activity after evaluating several packages.
21. Use teacher tools to create instructional materials.
22. Use a graphics program.
23. Create entries, search, sort, and print reports with a database.
24. Use a spreadsheet to analyze and chart data and maintain student records.
25. Use telecommunications effectively in instruction.
26. List technology resources that are helpful for educators.
27. Define technology terminology appropriately.

Content and Sequence:

When Scheduled: MPS Training – Technology Training: Internet, email, Creating a CDA lesson

Night 1 – Discussion Topic - Integrating the computer into the classroom - theories that might impact its integration : behaviorism, constructivism, cooperative learning, multiple intelligences.
Technology Activity: Learn Windows interface; Microsoft Word if time; if not, paint program of Appleworks - With partners, create an alphabet KPS or Appleworks Slide Show.
Assignment: Read Chapter(s) 1, 2

Night 2 - Discussion Topic - NTeQ Model for instructional planning and best practices in technology integration in the classroom; academic standards
Technology Activity: Explore laptops and software that comes with laptop; writing activities with the computer (add email if possible); writing software (Imagination Express, Hollywood High, Appleworks, Microsoft Word, Storybook Weaver Deluxe, etc.).
Assignment: Read Chapter(s) 3, 4, 5

Night 3 - Discussion Topic - Designing the lesson to include the various types of software, teacher facilitation, finding technology integrated lessons on the Web
Technology Activity - Inspiration; Using the Internet for research, Integrating the Internet in the classroom; WebCT design and posting
Assignment: Chapter(s) 6, 7

Night 4 – Discussion Topic - Managing the computer and using the tools of Web
Technology Activity: Building Web pages, build own Web page for PT3
Assignment: Chapter(s) 8, 9

Night 5 – Discussion Topic - Assistive Technology
Technology Activity: Multimedia (It addresses learning styles and writing also.)
Assignment: Chapter(s) 10
Night 6– Discussion Topic - Using spreadsheets
Technology Activity: The Graph Club and Appleworks Spreadsheet
Assignment: Chapter(s) 11

Night 7 - Discussion Topic - Using databases
Technology Activity - Appleworks database
Assignment: Chapter(s) 12, 13

Night 8 – Discussion Topic - Multimedia in the classroom
Technology Activity - Hyperstudio
Assignment: Chapter(s) 14

Night 9 – Discussion Topic - Integrating technology in the classroom
Technology Activity - Online activities and subject software
Assignment: Chapter(s) 15

Night 10 – Discussion - Thematic Units
Technology Activity - Portfolio
Assignment: Compile portfolio elements

Projects for Class:

1. Evaluate 5 software packages with appropriate modified use for 3 different disabilities in the classroom. Results will be entered into a classroom database of evaluations. Include a word processed document that explains how to use the software in an appropriate instructional fashion and inappropriate instructional fashion. Your intended audience is a substitute teacher for your classroom. Be sure to include directions on how to use the technology that the software requires in an equitable fashion and how to use it for diverse students. When the database is finished, each student will use it to sort and print out a report of two other packages that you think that you might use in your classroom.

   100 points
   Standards Covered: 4, 5, 6, 7, 9, 11, 15, 16, 17, 18, 19, 24

4. Create a Web page that will become the beginning of your portfolio. This Web page introduces you and describes your teaching interests. It links your artifacts acccording to the elementary education standards. Most artifacts will be projects from your classes that you will type on your laptop. These can be saved and become part of your portfolio. With this portfolio, you will need to take a digital picture of yourself to put in it. You will need to scan in documents that do not have a computer file for them. A printed version of portfolio will be turned into the instructor.

   100 points
   Standards Covered: 1, 10, 15, 16, 18, 19, 20, 21

5. Develop a thematic lesson plan that includes technology, addressing areas from the list of minimal student standards, i.e. inquiry lesson with spreadsheet data collection and interpretation of the data. Include a list of resources appropriate for a technology-using teacher. Include a rubric for scoring the lesson and a spreadsheet template for recording the grade of the lesson.

   100 points
   Standards Covered: 2, 3, 12, 13, 14, 15, 16, 18, 19, 22, 23

Feel free to work together in groups to complete these assignments. I would like individual products that reflect your individual classes and personalities, especially for the portfolios, but brainstorming and working together is encouraged.

Grading:

WebCT postings	100 points
Project 1	100 points

Project 2	100 points
Project 3	100 points

NLU seeks to ensure that its programs are accessible to all persons. Students in need of special assistance or accommodation regarding any of the course requirements as outlined in this syllabus, the course objectives and/or course evaluation and assessment criteria, are advised to notify me immediately. We can meet to discuss a solution privately.

THE JASON PROJECT'S MULTIMEDIA SCIENCE CURRICULUM IMPACT ON STUDENT LEARNING

A SUMMARY OF THE YEAR ONE EVALUATION REPORT

CENTER FOR CHILDREN & TECHNOLOGY

CCT REPORTS
MARCH 2002

THE JASON PROJECT'S MULTIMEDIA SCIENCE CURRICULUM IMPACT ON STUDENT LEARNING

A SUMMARY OF THE YEAR ONE EVALUATION REPORT

SPONSORED BY

THE JASON FOUNDATION FOR EDUCATION
US DEPARTMENT OF EDUCATION STAR SCHOOL PROGRAM

PREPARED BY

HAROUNA BA
WENDY MARTIN
ODALYS DIAZ

CENTER FOR CHILDREN & TECHNOLOGY

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THE JASON PROJECT

For the past thirteen years the JASON Project has offered students and teachers a unique opportunity to learn about how the earth and space systems support life, and technologies used to study the earth-space system. The project today reaches a diverse population of approximately 25,000 teachers and 1 million students around the country. Both populations are diverse in terms of ethnicity, community profile (geography and income), teaching experience, number of years in the JASON program, student achievement levels, as well as experience with technology and science.

The project's model for the delivery of science is inclusive of technology, focuses on scientists doing science in the context of a research expedition, relates science to other subject domains and provides for interactive learning. It brings educators and students together to construct their own knowledge base by putting science concepts and skills to work in a media-based anchor. Ultimately JASON's goal is to engage students in lifelong learning.

The JASON Project aspires to help teachers to increase student learning of content-specific information; and to engage students in complex, difficult tasks that lead to the development of scientific thinking and problem-solving skills. In doing so, it provides teachers with instructional tools that bring together academic standards, the rich research environment of a new curriculum topic each year, and student performance measures that support state standards and assessment initiatives.

JASON's multimedia curriculum model comprises a holistic collection of resources, include a print curriculum and prologue video, live exposition broadcasts and update video, and Team JASON Online:

A] The **print curriculum** mirrors researchers' work in the field or lab, and includes a video, which introduces and reinforces key curriculum topics and themes, as well as models fieldwork.

B] The **live expedition Tele-presence**, central to the JASON Multimedia Science Curriculum, helps students become a part of the research team, experience the expedition firsthand, and relate their work to that of the researchers. It is held annually at a specific location for a two-week period, and involves research and Argonaut teams (scientists, teachers, and students), technical and broadcast staffs, JASON partner sites, and the local community.

C] **Team JASON Online** (TJO) is a set of integrated online interactions (e.g., teacher-directed exercises, discussion groups, chat sessions, additional curriculum exercises, assessment tools, online journals, etc.) used by teachers, students, and scientists to articulate and share their understanding of science concepts, skills, vocabulary, and projects.

JASON's media-based research expedition provides an authentic, complex problem-solving environment to work in. The project's curriculum emphasizes the acquisition of thinking and problem-solving skills, as well as core science content appropriate for the middle grades. Students engage in hands-on research that requires them to pose hypotheses, then devise methods and procedures for solving problems. Student experiments are central to the JASON curriculum; they require a broad range of competencies, are often interdisciplinary in focus and require student initiative and creativity.

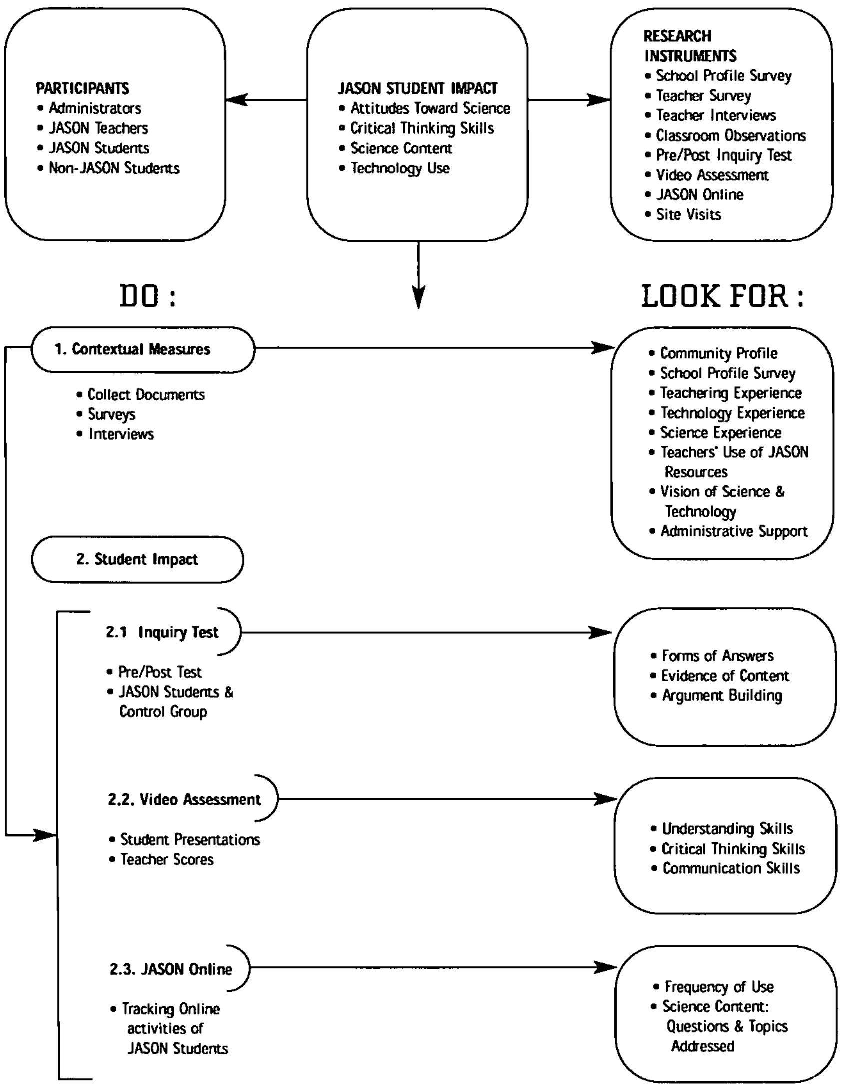
As is widely known, one of the biggest challenges facing teachers is state-mandated assessment. Many teachers face rapidly mounting pressures to demonstrate student competencies. Caught on the horns of an assessment dilemma, they are increasingly held accountable for preparing their students to do well on the standardized achievement tests, but expected at the same

time to teach their students to think critically, explore deep content, and use technology to create project work. Most teachers are reluctant to spend a great deal of time on test preparation recognizing that it impoverishes the curriculum, but feel they have little choice. A constructive response to this dilemma is multimedia projects that engage students in real science explorations and help teachers who have not yet become deeply familiar with inquiry-based pedagogical methods to learn along with their students how to manage and guide such projects. Such projects provide intellectual and material scaffolding for new teaching with new media in an educational climate that demands old accountability measures of teachers while also insisting that they integrate technology into new ways of teaching.

The Center for Children and Technology (CCT) proposed to study the impact of the JASON Project on a diverse population of students' science experiences and learning by undertaking a one-year comprehensive evaluation of student learning in the JASON multimedia environment. The major design components of CCT's study and its assessment techniques are illustrated in Figure 1.

This booklet has been adapted from CCT's *The JASON Project's Multi-media Science Curriculum Impact on Student Learning: Final Evaluation Report—Year One*, available online at www.edc.org/cct.

Figure 1 :
Major Components of the Jason Year One Study



JASON SCHOOLS AND TEACHER PROFILES

The first-year study showed that the JASON Project is used in diverse ways in diverse contexts, and that the variety of use significantly influences how teachers and students experience the JASON multimedia curriculum. The schools participating in the study differed along numerous dimensions, including type of community, ethnic makeup of students, socioeconomic status, number of students and teachers in the school, grade levels in the school, school achievement, and number of teachers and students involved in JASON.

CCT researchers worked with nine science teachers and 269 students from eight middle schools located around the country in Arkansas, California, Michigan, New York, Ohio, Pennsylvania, Texas and Wisconsin. The schools have the following characteristics: grades 6 to 8; low student/teacher ratio; average to above-average school achievement; and an average of 400 JASON students. Most of the schools serve mainly white low-to-middle-income students. However, one of our JASON classrooms consists of academically at-risk black students, and another classroom has mainly low-income Hispanic students. All nine of the participating teachers taught science. They are mainly white and female, and have an average teaching experience of 20 years, technology experience of eight years and JASON experience of five years. These teachers are not the only JASON teachers in their schools. There is an average of five JASON teachers per school participating in this study.

The diversity of the eight sites in the study extended beyond demographic and school characteristics. There was also significant variation at the classroom level, and the ways in which the JASON curriculum was used by students and teachers. In terms of classroom variation, one of the most important differences among the eight sites was the way in which class schedules

were organized. Two of the study schools—Philadelphia and Michigan—had very flexible schedules, which allowed the teachers to engage their students in extended labs and activities. The school in Wisconsin had some flexibility as well, but the teachers could have extended periods only a few times a year. All other schools had standard class periods of about 45-50 minutes, except for the school in Ohio, which had very short 35-minute class periods.

JASON IMPACT ON TEACHERS

JASON changes teaching practice.

- **Promotes the use of alternative assessments, such as presentations and portfolios**
- **Encourages project-based learning**
- **Increases collaboration among teachers**
- **Supports an interdisciplinary approach to learning**

A number of teachers mentioned that as a result of their participation in JASON, their teaching practices have changed in terms of collaboration, project-based learning and alternative assessment. Teachers noted that JASON lends itself to project-based learning. All of the teachers requested student to present projects as part of their JASON work. Some teachers asked that their students do more active group work. One teacher took the presentation idea one step further and required that all the students teach part of the JASON curriculum for about a week using a poster or display, or PowerPoint as part of their presentation.

Another significant change in teaching practice noted by both teachers and administrators was that a school's involvement with JASON often led to an increase in collaboration among teachers in and across grade levels. More often, JASON inspired collaboration among teachers who taught different

subjects within the same grade. Along with modeling teamwork and problem-solving, the study participants noted that collaboration among teachers enabled them to take an interdisciplinary approach to a single large topic. One principal observed that although her school theoretically encouraged collaboration among teachers, she realized that "You need something like a JASON to make it happen."

Some teachers mentioned using more varied methods to evaluate student performance. One teacher said that she uses "more alternate assessments where I'm looking at [students'] projects and their presentations rather than giving them tests." Another said that her involvement with JASON encouraged her to try new assessment techniques: "I had heard about portfolios in other workshops, but I hadn't thought about incorporating them until JASON. It lends itself to a portfolio because of the activities, they're usually building something or graphing or sketching something."

JASON increases teachers' use of technology.

- **Serves as an impetus to use a variety of digital tools**
- **Provides a wealth of resources to teachers**
- **Spurs the development of technology infrastructure in schools**
- **Instructs teachers how to take advantage of available technology**
- **Encourages the use of scientific instruments as well as computers**

Teachers claimed their involvement with the JASON Project has pushed them to make greater use of technology than they did previously. Although not all teachers were able to take advantage of Team JASON Online because of limited access to computers in their classrooms or a lack of training in the TJO environment, a number of teachers have said that TJO has given them the impetus to use computers in their teaching. Even one teacher who has not been able to take advantage of Team JASON Online with her students observed that JASON prompted her to use other kinds of technology in her classroom. Teachers noted that the impact of JASON on technology use extends beyond the classroom.

JASON STUDENT PROFILES

We worked with 269 JASON students with different socioeconomic and ethnic backgrounds. More than half (60%) were in sixth grade. They were 44% female and 55% male. They had different achievement levels, with one entire "at-risk" class. Most of these students consider science their favorite subject (82%), work in small groups (56%), have access to computers at different places in their school (70%) and have access to computers at home (74%). They have been in JASON for one year (55%), two years (17%), three years (5%), four years (4%) and five years (3%).

Based on student surveys, we found that JASON students learned about topics such as volcanoes, lava tubes, plate tectonics, Hawaiian culture, animal adaptation, weather and climate, and Hawaiian ecology. They engaged in scientific activities including lab experiments, library research, group projects, data collection, Internet research and live science broadcasts. They also worked with people besides teachers and classmates, built models, made posters, drew conclusions based on data, developed hypotheses and went on field trips.

JASON IMPACT ON STUDENT LEARNING

CCT's evaluation of the impact of the JASON Project on students has focused more on inquiry than on content skills. Inquiry as an activity or concept allows students to develop a critical and flexible ability to query, explore widely, integrate and apply knowledge to a specific task.

The JASON hands-on and environmental exploration activities are engaging and appealing to the students.

- **Keeps students engaged**
- **Appeals to diverse learning styles**
- **Involves the creation of tangible products**
- **Is especially effective with at-risk students**

Both students and administrators cited the hands-on activities as the most effective tools in the JASON Project curriculum. They felt the labs, activities and field investigations offered by JASON held students' interest more than standard teaching methods. According to the teachers, middle school students in particular are in need of a hands-on approach to learning, which fits their learning styles and identities.

Not only did teachers mention that JASON's hands-on projects kept students engaged as they did the activities, they also appreciated the fact that students come away from most JASON activities with a tangible product. This combination is especially effective with students who may otherwise be difficult to reach academically.

The JASON curriculum makes science real and relevant.

- **Makes science real and relevant to students**
- **Allows students to interact and identify with scientists**
- **Exposes students to experiences they would never otherwise have**
- **Helps students ask better questions**
- **Inspires an interest in science that can extend beyond the JASON experience**

Apart from the hands-on activities, the other component of JASON that teachers and administrators felt was compelling for students was the fact that each year it follows an actual expedition and allows students to see science being done by real-world scientists. This makes science more relevant to students and helps them make connections between what they are learning in school and the larger world.

JASON gives students different ways to experience the scientific research going on each year. Not only do they see the videos and attend the JASON Tele-presence, they can also talk directly to the scientists online. Some teachers suggested that these kinds of contact encourage students to ask good questions.

According to one longtime JASON teacher, the interest in science that JASON can inspire in students because of the connections they make with real scientists sometimes endures longer than their exposure to the curriculum. Having participated in JASON for many years, this teacher is in a position to see what her former students are doing.

Most JASON students acquired scientific inquiry and analytical skills, and outperformed non-JASON students.

- **Enhances student process skills**

  Based on the results of a pre-and post-inquiry test that asked students to answer questions by interpreting data and building an argument, the evaluators found that:

  - Most JASON students (66%) made overall gains (from 1 to 10 points).
  - More than half of the JASON students in each classroom made some gains on the test with the exception of students in one classroom.
  - The average JASON classroom gains were all positive (from .44 to 2.45 points).
  - Most JASON students did better in process (66%) than in content (46%).
  - Average classroom gains in process skills were positive (from .16 to 1.55 points) for all classrooms.
  - Average class scores for content were negative in two classrooms and positive in seven classrooms (from .28 to .91 points).
  - JASON students who scored at or above average (87%) did much better in process than in content areas under the two questions they were asked to answer. In content, the percentages increased from 32% to 38% for question one and 28% to 44% for question two. In process, the percentages increased from 24% to 56% for question one and 21% to 58% for question two.
  - Half of the JASON students in all three grades made significant gains, especially in 6th and 7th grades.

- Students who worked in small groups (72%) on a regular basis in their classrooms also made significant gains in the inquiry test.

In the cases where the inquiry test was administered to a control group, we found that:

- JASON students (52%) did better (1 to 7) than the control group (38%) in the inquiry test.
- JASON students specifically performed better in the area of process/scientific argument building.
- The JASON students (59%) did better in both content and process than the control group (20%) in the two schools where the control group was in the same school as the JASON group.

JASON students consistently scored above average.

- **Boosts overall student gains**

A cluster analysis scoring the three dimensions of understanding, critical thinking and communication skills on a scale of 1 to 5 revealed:

- Fifty percent of the students fell into the High Cluster (from 3.6 to 3.7 points). These scores were high and consistent across the three assessment dimensions.
- Thirty-one percent of the sample fell into the Middle Cluster (from 2.4 to 2.6 points). Scores for this cluster were average.
- Nineteen percent of the sample was in the Low Cluster (from 1.7 to 2.1 points).

A further analysis of the videotaped presentations revealed that:

- The overall scores of more than half the students' videotaped presentations were high (3.8).
- Of the students' videotaped performances scoring at or above three (56%) across three assessment dimensions, most of them did better (66%) in critical thinking.
- Ten presentations (31%) from Texas, Long Island, Arkansas, Michigan and Wisconsin scored high (at or above 3) consistently across the three dimensions of scoring. Inferential statistics from the student's survey data indicate that most of the students from these five states knew the general goals of the JASON project and the topic of this year's JASON curriculum.
- Three presentations from Arkansas and Wisconsin scored very high (at or above 4) across the three dimensions. All three projects addressed topics from the JASON curriculum: plate tectonics, cultures and history of Hawaii and volcanoes.

COMMON CONTEXTUAL ISSUES AND CHALLENGES

All of the contextual elements that distinguish the different sites join to create distinct JASON experiences for students in these environments. However, there were a number of common themes across multiple study sites.

The JASON curriculum is adaptable.

- Teachers pick and choose activities from the curriculum.
- Teachers select activities that support state and district standards.
- Teachers reuse activities.
- However, variable topics mean that JASON may or may not support a grade's required curriculum in any given year.

The success of JASON depends on the teacher.

- The project attracts teachers who take a hands-on approach to science and enjoy learning new subjects.
- The project gives teachers ideas for labs and activities.
- The project requires dedication and innovation on the part of teachers.
- The curriculum is often adopted through a bottom-up process.
- When the curriculum is imposed on teachers they are not enthusiastic about it.
- The project does not suit all teachers' teaching styles.
- Teacher enthusiasm can inspire other teachers to make use of the curriculum.

District and school constraints impeded the process.

- Teachers sometimes pay out of pocket for training and supplies.
- Even inexpensive materials add up in cost when used with many students.
- Teachers need to be very organized to assemble all the necessary materials.
- Changing topics require teachers to purchase new materials each year.
- Schools/districts do not always pay for training for all JASON teachers.
- Teachers have no time to coordinate interdisciplinary projects with other teachers.
- Class periods are too short to conduct JASON activities and field experiments.
- Lack of access to technology prevents teachers from taking advantage of online resources.
- High-stakes testing prevents teachers from using the curriculum if JASON content does not appear on the test.
- Stressed teachers cannot integrate new material into the existing curriculum.

RECOMMENDATIONS

Despite some of the challenges noted above, over the course of a year in the JASON program, students demonstrated an increased ability to understand scientific concepts, draw conclusions based on data and build arguments on the inquiry tests administered to them. Not only were most students' post-test scores higher than their pre-test scores, in those cases where a control group was used, JASON students showed higher gains over time than non- JASON students. When given the opportunity to present their own work, most JASON students showed that they could understand scientific concepts, think critically about these concepts and communicate their ideas effectively.

We found that the JASON Project has an impact not only on students' learning but on teachers' practices as well, particularly in the areas of collaboration, project-based learning, technology use and alternative assessment approaches. Each year when they receive the new JASON curriculum topic and materials, teachers participating in JASON must find ways to creatively revise and refine their curriculum in order to align the JASON content and activities to their state standards. For this reason, teacher commitment to the program is crucial to the successful implementation of the JASON Project at the school and district levels.

Based on our evaluation findings, we propose the following recommendations:

- To avoid a one-size-fits-all mentality without jeopardizing what makes the JASON Project a strong program, JASON staff might want to build different portals of entry for individual users of their print curriculum materials such as "at-risk" students, team teachers, and first-time JASON users. This can be done via a booklet or online interactions focused on the identified needs of the audience being served.

- The JASON Project can provide opportunities for teachers to discuss their practice with experts in the teaching field in the area of accountability in chat sessions or online message boards. These opportunities should be well constructed.
- JASON should provide an opportunity for students to share their work with a larger audience of learners. An example might be an online science fair.

Best Practices in Cyberspace: Motivating the Online Learner

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Motivation   Online Learning   Learning Styles   Course Design

Abstract:

The purpose of this paper is to describe what we have learned about motivating online learners. Online instruction has presented teachers with new methods of instruction. At the same time, online instruction has the potential to depersonalize the teacher-student relationship and impede the teacher's ability to understand their students. This study attempts to begin translating the traditional classroom knowledge into "best practice" for the online environment. Over the past three years we collected evidence of personality types from students taking an online course. During the same years, students completed surveys concerning their preferences for a variety of course components. The results of this study suggest that student personalities do play a part in motivating the online learner. The study also suggests general ideas about each personality types' preferred instructional modes and provides suggestions for components to include within an online course.

Introduction

In 1995 Lemay asserted that the use of the World Wide Web as an instructional format was growing at a phenomenal rate. While this observation has not proven valid in every instructional setting, it does continue to ring true and suggest challenges for educational innovators around the world. During the past few years, online instruction has presented teachers at all levels with new and exciting methods of communication at a greater distance than ever before. Yet, experienced and effective teachers faced with the task of developing online courses find themselves struggling with basic questions related to instructional management and delivery. Several concerns have arisen as a result of this "technological explosion." Teachers are expected to create environments that do not frustrate the students' natural tendencies to seek meaning from instruction. Many have mastered these attitudes and behaviors within the four walls of a school or university. Having knowledge of effective teaching in a traditional situation does not automatically translate to effective online instruction (Zhao, 1998). How can the online instructor transmute these skills and abilities into the world of education via cyberspace?

- Will the quality of education received be equivalent to traditional course delivery methods?
- Will opportunities for student interaction be maintained?
- Will teacher/student interactions be as meaningful as in traditional classes?
- What type of students will succeed or fail in web-based course settings?

The answer to many of these questions can be sought through translation of the art and science of traditional classroom instruction. This paper examines one essential element of student learning: motivation. Motivation or "motive" is defined as "something (as a need of desire) that causes a person to act." (Webster, 1991)

Motivation

There is a large body of knowledge related to student motivation in the traditional classroom (Ames, C. & Archer, J., 1988; ChanLin, 1994; Deci, E. & Ryan, R., 1995; Keller, 1987, 1999; Graham, S. & Golan, S., 1991). What educators try to achieve is the incorporation of theoretical frameworks to apparent student learning interests, learning curiosity, and learning involvement. One such study showed that student rankings or evaluation of online courses were no different than those for traditional classes (Spooner, 1999). Another reported that adult learners preferred taking courses online to attending a traditional lecture-type class (Krantz, 2000). These studies describe overall attitude and preferences but do not answer the question regarding what conditions or elements must be present for students to be motivated to learn in an online course. Areas open to investigation are teaching methodology, learning and teaching styles, the personalities of students, types of prior learning experiences, or comfort levels of one's content knowledge.

Keller (1991) delineated the motivational elements of instruction as encompassing four necessary components: engaging and maintaining student interests, relating course content to student interests, enhancing student confidence in understanding course content, and satisfying students' inquisitiveness related to information thus encouraging students' active involvement in learning. These elements were summarized as (A) attention, (R) relevance, (C) confidence, and (S) satisfaction in order to create the "ARCS Model of Motivation".

A modified version of the ARCS Model (Keller, 1999) considers the nature of motivation in the online classroom. Keller indicated that **attention** problems occur when students work independently. In the computer-based environment students may not attend to important information because they do not find independent work interesting. Content in the online setting must be presented in ways that help or motivate students to attend to the information. The level of **relevance** any one student attaches to instruction will differ as a result of their individual background and personal interests. Application is needed to promote learning by utilizing students' prior knowledge and making sure that personal connections to the course content are made. Despite the inclusion of more technology in many schools, not all students have the same opportunity to develop **confidence** with online learning. When students have experience and know what they are expected to learn they will begin to develop self-assurance. The online instructor can facilitate this process by providing manageable structures and reasonable pacing expectations. Motivating students to continue learning can create **satisfaction** when the learning experience is enjoyable and fulfilling. Students need to be made aware of how much they have learned so that the time spent on learning is not considered a waste.

Keller's modified ARCS model corresponded well with our initial efforts at translating what we know about teaching and learning to the online environment. Our efforts have been guided by the belief that sources of motivation are not significantly different in an online course than they are in traditional classrooms. However, we still needed to know how motivation is effected by the nature of online courses. To begin we identified the following barriers to motivation:

- The individual nature of online learning has the potential to depersonalize the teacher-student relationship. Given the social nature of learning, this issue could adversely affect student attention.
- The choices involved in instructional decision-making are also constrained by the nature of online courses. Without choice, students will be less likely to find relevance in the information to be learned.
- The absence of a physical classroom challenges the online teacher to provide a climate that supports learning. Courses that lack identifiable structure and organization could damage the development of student confidence.
- The lack of face-to-face meetings in online courses impedes the teacher's ability to understand and encourage their students based upon their personality types. This introduces questions about the nature of student satisfaction while involved in cyber learning.

In addition, we hoped to identify instructional strategies that were most effective in promoting learning among individual personalities. What has motivated students previously in "traditional" classrooms may not be appropriate or possible in the online instructional environment.

Personality Types

Due to the age range of the students and Internet accessibility, the Jung Typology Test was used to determine individual personality styles. This online test site provides links to a number of personality descriptions. Test results are reported based on four oppositional items. Personalities are expressed first as being either extroverts or introverts. This factor ". . . defines the source and direction of energy expression for a person. The extrovert has a source and direction of energy expression mainly in the external world while the introvert has a source of energy mainly in the internal world." The second factor, sensing or intuitive, ". . . defines the method of information perception by a person. Sensing means that a person believes mainly information he receives directly from the external world. Intuition means that a person believes mainly information he receives from the

internal or imaginative world." The thinking or feeling factor "... defines how the person processes information. Thinking means that a person makes a decision mainly through logic. Feeling means that, as a rule, he makes a decision based on emotion." Finally, the judging or perceiving factor "... defines how a person implements the information he has processed. Judging means that a person organizes all his life events and acts strictly according to his plans. Perceiving means that he is inclined to improvise and seek alternatives." Assuming that the personality type is correctly determined, individual students are likely to be motivated by different instructional strategies. (http://www.humanmetics.com)

Developing Motivating Components in Online Courses

When faced with the task of developing online courses we returned to the Modified ARCS Model and began to look for ways to create interaction between students and teacher, interest in the course content, an organizational structure, and a sense of personal connection. We also relied on the knowledge and experience that we have gained from years of traditional classroom instruction in both P-12 and university level settings.

Components that Promote Interaction

When we began to examine the idea of online teaching, our first reaction was that this would not work. This attitude came from our deeply held beliefs that teacher-to-student and student-to-student interaction was essential to learning. We could not imagine how an online course would allow the social construction of knowledge. We quickly found that a

variety of interaction tools are available to the online instructor. We choose to utilize e-mail and bulletin board postings for interaction.

At the beginning of each semester, students are asked to e-mail an introduction to the instructor. At regular intervals during the remaining portion of the semester, students send e-mails designed to summarize their progress or concerns. E-mail is also used to exchange assignments and feedback specific to the coursework. Students are encouraged but not required to begin e-mail discussions with each other. Bulletin boards are used to promote student-to-student interaction. Students are required to post summaries of readings or reactions to topics on the course bulletin board. They are also required to read the various postings and respond to other students. Chat rooms were not used in these courses. Students enrolled in our courses have consistently reported that they prefer taking an online course because they do not have a common time that they could be "in class". Early efforts to plan a chat time were not successful with our particular clientele.

Components that Supply Content

Providing content in an online course seemed to be an easier task than providing interaction opportunities. Content in the traditional classroom can be given independently via textbooks or reading assignments. The challenge we faced in online teaching was two-fold. First, we were challenged to provide the content that typically would be presented through lecture or discussion. We also found that the Internet provides a new challenge, limiting the course content to appropriate and valuable information. We decided to use a variety of content approaches.

Students enrolled in our online courses were required to purchase a textbook. Scanning articles to place within the course and supplying links to online journals provided additional reading assignments. Some topics in the course required all students to read the same text or article. At other times students were given a choice of reading assignments or the ability to search the Internet for their own ideas or articles specific to their interests and needs. Traditional lecture material was redesigned and presented in textual and visual format within the course website. In addition to text-based assignments, the instructor provided links to appropriate websites.

Components that Convey Structure and Environment

Translating the motivating elements of structure and environment in a traditional classroom to the online context presents an interesting situation. Creating an intriguing classroom in a traditional setting is both a visual effort and an organizational trial. We found it difficult to translate our three dimensional ideas to a virtual space. Additionally, the environment and structure should appeal to a variety of personality types.

We choose to create our course pages using a repeating format and color scheme to give the course a consistent environment. The pages and assignments were then organized into chapters to provide students with a familiar configuration. Every chapter began with a summary assignment sheet. All assignments for the chapter were listed up front and the grading requirements were clearly delineated. In an effort to add humor and enjoyment to the learning process, we added cartoons, pictures, and interesting quotes at regular

intervals. The asynchronous nature of online courses allows instructors to provide flexibility in application and completion of assignments. At the same time, instructors must guard against allowing the asynchronous nature of online courses to enable students who tend toward procrastinate. To address this issue we used a calendar to periodically post target due dates. These dates were designed as reminders to stay on track while maintaining the flexibility of the course.

Examining Online Motivation and Personality

Over the past two years we have collected evidence of personality types from students taking a series of three completely online courses. During the same years, students have completed surveys concerning their preferences for a variety of course components that they have encountered. These surveys have been examined to determine the match and mis-match of personalities to online course components. Data concerning demographics, personalities and preferences were collected from 31 masters level students. All of these students are K-12 educators and each course is taught completely online. The participants included a variety of teachers, administrators, and educational support personnel. Their experience level ranged from new teachers (teaching one year) to veteran teachers (having taught for ten years). When completing the survey, students were asked to rate components of the online course on a 1 - 5 scale with one indicating those items that motivated them the most and five indicating those items that were least motivating. The surveys were compiled to provide a look at the group as a whole. These responses were then compared with the results of the students' personality profiles.

Registering for an Online Course

Prior to completing the surveys, students reported that their primary motivation for choosing an online course was related to scheduling and their desire to maximize their personal time. A number of students involved in this study have given birth to a child during one of the courses. A few students live far enough away that attending classes on campus is difficult. The majority of the students already attend classes in the evenings while working toward an advanced degree. They simply do not want to be away from their families and homes an additional evening. Once the decision to enroll in an online course has been made, the instructor must work to motivation students to learn.

Interaction Components

When analyzing the results of all surveys, we found that e-mails from the instructor were consistently described as providing the highest level of motivation. Other interaction items were not ranked as highly. E-mail communications from other students was given a low motivational ranking. Posting to the bulletin board and being required to respond to other postings was rated as mildly motivating. The lowest ranking among all interaction items was receiving bulletin board postings from other students. These results suggest that students are more motivated by communicating with the instructor and creating postings for the bulletin board than communicating with their fellow students or receiving a response to one of their postings.

Course Content Components

The only component ranked lower than student-to-student e-mail by the entire group was assigned readings from the textbook or an article. Links to Internet sites provided by the instructor were rated as highly motivating. Slightly less motivating was the lecture-based content provided within the course by the instructor and student controlled Internet searches. In each case (text vs. lecture and links vs. searches), content that students perceive as having been provided by the instructor were reported as more motivating.

Structural and Environmental Components

The entire group reported the target due dates set by the instructor, and flexibility allowed as highly motivating. This would suggest that a balance of structure and flexibility is important to many students. Assignment summaries provided at the beginning of each chapter were also rated as highly motivating. Cartoons, pictures, and visuals were less likely to motivate the students. However, these items were ranked more highly motivating than student-to-student e-mail, bulletin board responses from other students, and assigned readings. These findings suggest that while students enjoy the added humor and visuals, they are more motivated by a clear and well-structured course organization.

Components that Correspond with Personality Types

The online students participating in this survey were equally divided between extroverts (E) and introverts (I). The majority of the students were described as sensing (S) rather than intuitive (N) and more students were depicted as feeling (F) than thinking (T). All participants were identified as judging (J) leaving no student identified as perceiving (P).

The personality types of ESTJ and ISFJ were ascribed most often to our students. All other possible personality combinations were reported equally.

Interaction and Personality

All personalities reported teacher e-mail as highly motivating. All personalities also reported a lack of motivation based on bulletin board responses to their own postings. Extroverts, sensors, and thinkers were highly motivated by posting to the bulletin board. Extroverts, intuitives, and thinkers also reported being more motivated by student e-mails than other personality types. The ESFJ personalities consistently reported high motivation for all forms of interaction while the INFJ personalities reported the lowest motivational scores for all forms of interaction.

Content and Personality

The intuitive element of personality was the only single factor that did not list assigned textbook readings as the lowest motivating course component. However, it was still reported as not very motivating. The intuitive personalities reported all other forms of course content as consistently high in motivation. Links provided by the instructor was reported as highly motivating by all expect the sensors and thinkers. The thinking personalities consistently reported course content as low in motivation. ENFJ personalities reported the highest motivation for course content with INFJ personalities close behind.

Structure and Environment Related to Personality

Structure and environment presented the greatest variance between personality types. Intuitive personalities reported consistently high motivation in the area of structure and environment. They were highly motivated by both the target due dates and flexibility. The pictures and cartoons also motivated the intuitive personalities. The feeling personalities were least motivated by structure and environment. The ENFJ and the ISTJ personalities reported consistently high motivation in the structure and environment categories.

Cross Category Analysis

Analysis of the personality types did not show any one factor (E, I, N, S, F, T, J) as determining a higher level of motivation across all components of the online course. However, the ENFJ personality combination was motivated by nearly all components. Only reporting the requirement of responding to other bulletin board postings as not providing motivation. The ESFJ personality combination was also consistently motivated. They did not respond to as many course components at the highest level of motivation.

Conclusion

This study was never intended to control for all variables or be generalized to all situations. We began our investigation into personality types and online course components in order to inform our own practice. Despite years of combined teaching experience, we found ourselves struggling with lessons we had already learned in the traditional classroom. Relearning these lessons required that we take a close look at our students, their preferred learning styles, and our instructional approaches.

The results of this study suggest that despite signing up for online courses based on individual needs, student personalities do play a part in motivating the online learner once the course begins. Preferences for particular course components were marginally predictable based on personality types. Interaction with the instructor is necessary to motivate all students. At the same time, students would not complain if we were to ban all textbook reading assignments in cyberspace. It is clear that instructors need to provide a variety of course components in order to motivate a wide range of students.

This study adds to the limited research available to online course developers. Our findings may provide other researchers with a framework for investigating student personality types and their relationship to course components. The study suggests general ideas about each personality types' preferred instructional modes and provides suggestions for components to be included within an online course. Finally, this study provides a beginning point for all those who wish to translate the traditional idea of best practice into best practice in cyberspace.

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http://www.humanmetics.com

Classroom Teachers Working With Software Designers: The Wazzu Widgets Project

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ABSTRACT

Results of a year-long project involving K-12 teachers working with student software designers to create "learning objects" - small, computer-based tools (known as "widgets") for concepts identified by the teachers as "difficult to learn."

INTRODUCTION

This is a report of the results of a year-long educational software development project facilitated by members of Washington State University's Department of Teaching and Learning, and funded by The Arc of Washington Trust Fund. The project is part of the "Wazzu Widgets" (Learning Object development) project underway at Washington State University. The creation of the Learning Objects yielded a great deal of information about students' and teachers' perceptions of the processes of instructional design and instructional media development as well as the usefulness and usability of the specific Learning Objects developed.

BACKGROUND

Graduate students of education and instructional design (along with one advanced undergraduate student) were matched with local K-12 teachers to develop instructional software designed to meet the teachers' needs. A specific criterion for participation was that the teachers had at least one student with mild mental retardation in their class during the course of the project. Each of the three teachers chose a concept that they found challenging to explain to their students and worked with the software production team to develop a small, interactive software solution known as a Learning Object. The three Learning Objects developed for this project were designed to accommodate their students with mild mental retardation. However, the Learning Objects were not designed in such a way as to limit use to a single individual (e.g. no specific names or places are used).

STUDENTS WITH MILD MENTAL RETARDATION

Some individuals with mild mental retardation have difficulty learning and generalizing concepts, especially abstract concepts that are not easily represented and manipulated using authentic material (Beirne-Smith, Ittenbach, & Patton, 1998). Attention deficits and motivational factors can further complicate the teaching and learning process (Hickson, Blackman, & Reis, 1995). Furthermore, many materials for teaching concepts may not be age-appropriate if students are learning at a level that is several years below their chronological age. Additional and specialized instruction is often necessary to assure acquisition and generalization of learning. Demonstrating and explaining abstract concepts in ways that students with mild mental retardation understand is often a focus of specialized instruction.

One approach to concept instruction that has proven successful with students with mild mental retardation is Active Student Response (ASR) (Heward, 2000). When using ASR instructional methods, students with mild mental retardation are actively and frequently involved in instruction by responding to activities and tasks (as opposed to passive participation in lessons). However, to keep students motivated and actively involved in instruction, it is essential that the salient features of the materials used are visually stimulating and engaging. ASR approaches are not as effective with students if the instructional materials are boring or repetitious. In addition, ASR, or any other instructional approach, will not be effective if students cannot understand the concepts embedded in the instructional task. It is a challenge to find a wide variety of effective and motivating age-appropriate materials for concept instruction for students with mild mental retardation.

The computer is one tool that has been effective in motivating students and is very compatible with ASR approaches to instruction. However, much of the computer-based instructional software currently available focuses on one of two areas: providing additional practice of specific skills; or following a specific curriculum sequence that may or may not relate to the goals and objectives determined by the classroom teacher and/or the student.

DEVELOPING APPROPRIATE COMPUTER-BASED TEACHING TOOLS

Teachers and students are concurrently receiving increased pressure to make good use of computers and computing technologies as learning tools. The problem is a paucity of computing software that teachers can use as part of a larger instructional design. There

are a variety of software packages and Web sites that simulate existing activities (e.g. field trips; math manipulatives), but very few resources for presenting concepts and ideas that support a teacher's lesson. This is especially true in terms of software that presents essential concepts in a manner that is chronologically age appropriate for students with mild mental retardation. Instructional designers are beginning to experiment with "Knowledge Objects" (Merrill, 1996): One portion of a Knowledge Object is the "Learning Object" – a small computer program that uses sophisticated interface design techniques along with images and/or sound to explain a concept. These Learning Objects may be of particular utility to teachers serving students with mild mental retardation.

THE WAZZU WIDGETS PROJECT

The Wazzu Widgets Project in progress at Washington State University is currently developing and testing web-based Learning Objects (the activity portion of a Knowledge Object) that facilitate comprehension of concepts and ideas that are typically difficult to explain using traditional classroom materials (e.g. color theory; multiplication of fractions). The goal is to create a database or "object-base" of Learning Objects that teachers can use in instruction. To date, five Learning Objects have been created, three of them were underwritten by The Arc of Washington Trust Fund.

Employing a user-centered development model, the design and development teams worked closely with K-12 teachers to develop Learning Objects that would be truly useful to the teachers and their students. Care was taken to include everyone in the development and production process. Strategies that were particularly helpful included the development of early paper prototypes; these prototypes allowed the less

technologically sophisticated members of the team a chance to critique and comment upon the design without feeling intimidated or overly impressed by the computing tools themselves.

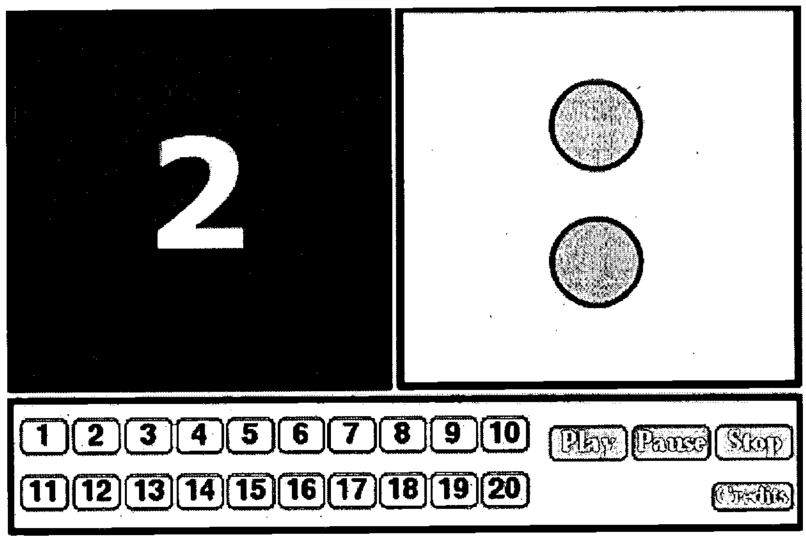

Figure 1. "Counting One to Twenty" Widget (screen grab)

Beyond the design and development of a series of Learning Objects created specifically for students with mild mental retardation, and their distribution through the development of a web site and the distribution of CD-ROMs, the project documented increased collaboration between special education experts (classroom teachers) and instructional design experts (university faculty and graduate students) with the ultimate goal of improving instruction. It is to be hoped that this initial partnership will lead to further collaborative efforts aimed at greater understanding of how computing tools can best be used to support K-12 instruction.

The Wazzu Widgets Web site (http://education.wsu.edu/widgets/) provides access to Shockwave versions of the Learning Objects developed and brief descriptions of their intended use.

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KEYWORDS

Learning Objects, Teacher Education, Instructional Design, Multimedia

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Interactive learning exhibits: Designs for building teacher and student capacity

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The planning, design, production and presentation of interactive learning exhibits (ILEs) by students in elementary and secondary teaching credential programs provided authentic learning experiences in the integration of computers in teaching and learning settings. This paper includes a rationale and brief overview of the theoretical underpinnings of this approach to technology training, a description of the program, some initial findings, and reflections on successes and challenges. To date this ongoing research and development effort has revealed that engagement in the instructional design and enactment of an ILE can be a rich context for preservice teachers' increased learning about planning, pedagogy, content standards, and assessment in the context of a multimedia learning environment. This work has implications for the preparation of teachers to use computers in classrooms.

(Keywords: technology training, preservice teacher preparation, interactive learning exhibits, constructivism.)

A rationale for taking a new approach to technology training in teacher education

The UCI ILE (interactive learning exhibits) project is a response to a continuing problem in technology education: while the number of computers in the classroom has continued to increase, they have not been implemented in teaching and learning at the same rate. Teachers

use computers to produce handouts, record student data, and conduct research on the Internet, while continuing to teach as if these new tools did not exist (Becker, 1998). If we look closely at how teachers are usually taught to use computers, this emphasis on the computer as a productivity tool is not surprising. Meanwhile some educators have been predicting the potential benefits of computers in teaching for some time (Papert, 1980, 1993, Perkins, 1991), and recent research suggests a strong correlation between teachers who use computers in teaching and constructivist practice (Becker, 2001). However, in spite of this evidence and predictions the power of technology to release human potential for teaching and learning has not been fully explored and many remain skeptical of the claims of the benefits of computers in the classroom (Oppenheimer, 1997). We believe that the problems associated with the lack of the use of computers in teaching and learning can be ameliorated by reforming the ways that teachers are taught to use computers. This has been the underlying premise of the interactive learning exhibits project, a new approach to technology training in U.C. Irvine's teacher preparation program, which was developed in collaboration with a U.S. Department of Education PT^3 grant (Preparing Tomorrow's Teachers for Technology). The ILE project addresses the problems associated with computer use for teaching and learning by starting with teaching and learning objectives: teachers decide what students need to know, then design computer-based interactive learning exhibits that engage learners in inquiry and critical thinking, and take advantage of particular learning affordances of multimedia technologies.

Description of the ILE program

The ILE project was implemented as a major component of a 10-week technology course for 120 multiple and single subject credential candidates, in the first half of their teacher

preparation year. (This is a "fifth year" teacher preparation program.) In a project-based learning environment, the preservice teachers worked in teams to solve an instructional design problem. Each team had to conceive, design, construct, and finally enact (with K-12 students) an interactive learning exhibit with the following characteristics:

- **Exhibit as interactive, technology-supported learning environment**. The physical layout of the exhibit area was an instructional space with a teacher computer station, display system and large screen, eight student computer stations, a printer and tables and chairs. Given this layout, the instructional design problem was to create a learning environment where students and one or more teachers would engage in a lesson in which multimedia played a prominent role in supporting the learning and assessment process. Using the authoring program HyperStudio,™ [1] the designers had to create computer-based, multimedia-supported learning activities and employ sound instructional pedagogy that included teacher-directed and guided instruction, student independent practice, student interaction in meaning-making activities that drew on different levels of knowledge and critical thinking, and assessment of learning outcomes.
- **Standards based and assessment-driven instructional design**. Desired learning outcomes were selected from the California frameworks and content standards for a particular subject area and grade level. Multiple subject students designed exhibits with learning outcomes drawn from the history and social studies framework and standards for grades K-6. Single subject students selected learning outcomes from their particular subject area specialization at the middle or high school level. Using the planning model drawn from Wiggins and McTighe's Understanding by Design (1998), desired learning outcomes and assessment

[1] HyperStudio is produced by Knowledge Adventure, Torrance, CA.

strategies were identified first; those decisions drove subsequent instructional activity design decisions.

- **Appropriate and accurate content**. Once learning outcomes and assessment strategies had been identified, preservice teachers had to do research using primary and other source materials to find appropriate content information for their interactive exhibit activities. In many cases, content information was drawn from Internet resources and from books.
- **Testable designs**. The multiple subject student teams that designed interactive learning exhibits also had the opportunity to "test" their instructional programs with K-6 students. With an authentic audience for their instructional products, the preservice teacher designers could evaluate their instructional strategies and the developmental appropriateness of their content, and assess student learning.

A number of support activities were introduced during the ILE project to ensure success as preservice teachers conceived, designed and constructed their interactive exhibits. These included:

- Introduction and/or review of the California frameworks and content standards to aid teachers in understanding the main themes and important ideas that should be considered when planning lessons in a particular subject domain and grade level
- Use of concept mapping software (Inspiration ™ [2]) to identify possible topics and themes for an interactive learning exhibit
- A Design Specification Worksheet to guide preservice teachers through the steps of backwards planning (assessment-driving planning) for their instructional design work and activity planning

[2] Inspiration is produced by Inspiration Software Inc., Portland, OR.

- Use of Inspiration ™ [2] software and/or index cards to storyboard interactive exhibit activity screens that would subsequently be developed using HyperStudio™ software.
- Workshop on the use of content from Internet sources: evaluating its appropriateness and accuracy, and copyright considerations
- Workshop to introduce the use of the HyperStudio™ multimedia authoring software
- Use of rubrics with evaluation criteria for peer formative and summative evaluations of the interactive learning exhibits. Categories of evaluation included: instructional design and learning outcomes; subject matter content; professional considerations; technical design; and aesthetic appeal.

Comparison of the new ILE approach to previous, more traditional approaches used by the UCI education department to provide technology training

Previous, more traditional approaches to preparing preservice teachers to use technology in the UC Irvine, Department of Education were designed to satisfy computer education competencies required by the California Commission on Teacher Credentialing from 1988 through 1998. These early courses included lectures and lab work designed for the preparation of elementary and secondary education teachers to use computer-based and related multimedia in the classroom. While the content of the courses changed as technology progressed, for example with the introduction of the Internet as a classroom tool, the format of the discussions, demonstrations and workshops remained largely the same. These included lectures and discussions about the legal and ethical considerations of using computers in the classroom, and workshops in computer operations, productivity tools such as databases, spreadsheets and Internet design software, World Wide Web research, and courseware evaluation. Each of these topics and activities were designed to "stand-alone" and while the students demonstrated these

computer competencies by producing various documents, what was missing was a unifying thread that linked this work directly to instruction.

In December 1998 the California Commission on Teacher Credentialing (CCT) adopted revised computer education competencies, Standard 20.5: Use of Computer-Based Technology in the Classroom: "Effective Use of Computer-Based Technology in the Classroom for Preliminary Multiple and Single Subject Teaching Credentials and Effective Use of Advanced Computer-Based Technology in the Classroom for Professional Multiple and Single Subject Teaching Credentials (CCT, 1998)." Importantly, now the "factors to consider" by CCT evaluators of California teacher education programs, in addition to the traditional areas such as computer operations, productivity tools and legal and ethical considerations, also included wording that pointed to the "effective" use of computers in teaching and learning itself.

<u>Each candidate:</u>

- Identifies student learning styles and determines appropriate technological resources to improve learning,
- Considers the content to be taught and selects the best technological resources to support, manage, and enhance learning,
- Demonstrates an ability to create and maintain effective learning environments using computer-based technology,
- Analyzes best practices and research findings on the use of technology and designs lessons accordingly (CCT, 1998).

The ILE project provided the missing unifying thread and provided the vehicle to address the persistent problem of the ineffective use of computers in teaching and learning while meeting the revised California Commission on Teacher Credentialing standards for computers in

education. In the process of addressing an instructional design problem that required backwards planning to produce and later enact multimedia-based interactive learning exhibits, the preservice teachers also demonstrated requisite competencies: computer operations; use of productivity tools to map topics, collect and organize data and statistics, and produce multimedia; web-searching capabilities; application of legal and ethical considerations; and sensitivity to the diverse backgrounds and needs of learners in technology applications.

Findings about what pre-service teachers have learned as a result of participation in this program

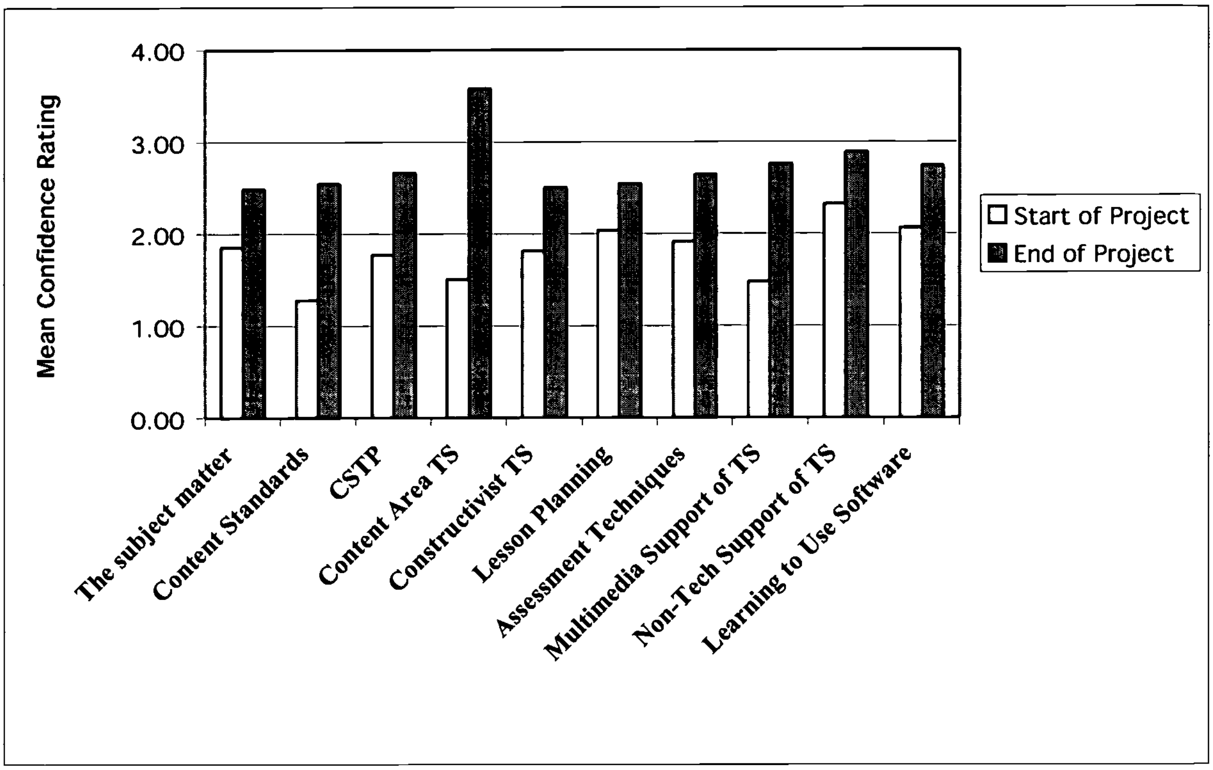
Because we believed that the ILE project provided a context for authentic development of knowledge about pedagogy, planning, models of constructivist learning, content standards, assessment, and other topics central to teacher education, as well as instructional decisions about the use of technologies to support learning, we sought to measure preservice teacher development in several ways. In this paper, we present some initial findings from survey data collected from the multiple subject preservice teachers at beginning and end points of the ILE project.

In pre- and post-ILE project surveys, preservice teachers were asked to rate their confidence about their knowledge and readiness to design an interactive learning exhibit, with respect to the following areas of knowledge:

- Subject matter knowledge of the subject area selected for the ILE
- Knowledge of the California framework and content standards for the subject area selected for the ILE
- Knowledge of the California Standards for the Teaching Profession

- Pedagogical subject area knowledge about effective teaching strategies for teaching the subject area selected for the ILE
- Pedagogical knowledge about general constructivist teacher strategies to foster student learning (for individuals and collaborative groups)
- Pedagogical knowledge about effective lesson planning
- Pedagogical knowledge about effective assessment techniques
- Awareness of the features of HyperStudio software and other multimedia resources that can be incorporated into a teacher's instructional strategies
- Awareness of other resources (non-technology, i.e. books, visual, manipulatives, etc.) that can be incorporated into a teacher's instructional strategies
- Comfort level with using or learning to use software tools and other technology resources

Confidence ratings ranged from 0 (not confident at all) to 4 (Extremely confident). For each area of knowledge listed above, the mean confidence rating increased significantly from the beginning of the ILE project to the end. Figure 1 below summarizes these findings. The largest increases in confidence were for the knowledge areas of a) California framework and **content standards** for the subject area selected for the ILE, b) Pedagogical subject area knowledge about effective **teaching strategies for teaching the content area** selected for the ILE, and c) Awareness of the features of **HyperStudio software and other multimedia resources** that can be incorporated into a teacher's instructional strategies.



<u>Figure 1:</u> Growth in Confidence in Knowledge and Readiness to Design the Interactive Learning Program with Respect Different Areas of Knowledge.

The survey administered at the end of the ILE project also provided some evidence about increased confidence and positive attitudes of preservice teachers toward the uses of technologies for learning, as a result of their participation in the ILE project. In particular, they were asked to rate how they thought their participation in constructing an interactive learning exhibit had contributed to their confidence in different types of knowledge and skills. Confidence ratings ranged from negative 1 (less confident as a result of participation) to 3 (much more confidence as a result of participation). From a list of sixteen different instruction-related skills and knowledge areas, three in particular had mean confidence ratings of two or better. These were a) abilities to use new computer technologies in teaching, b) beliefs about the potential of multimedia

technologies to be used as effective tools to support learning, and c) abilities to design instruction in the future that makes use of multimedia technologies to support learning.

Finally, the post-project survey also asked students to comment on the most important things that they had learned about teaching and instruction in the ILE project that they thought would be beneficial to them as they started their teaching career. Some comments focused on pedagogical and planning issues; others focused on issues of technology integration. Here are a few examples:

- "This project really hit home the importance of backwards lesson planning; that is, starting with assessment and designing a lesson around that. When put into practice, I see how backwards planning makes for a more effective lesson."
- "Teaching even the most boring topic may be potentially enhanced with the use of technologically advancements through computers, the Internet, etc."
- "I learned not to be afraid to try new things with technology."
- "I know from my own experience that I often don't like reading something that is either too long or too busy. I've learned the importance of aesthetics in presenting material to students. I've also learned the importance of interaction in not only maintaining a student's attention, but also in ensuring their understanding."

Findings about what is needed to help students succeed and learn with the ILE model of technology training

While we are pleased with survey results that provided evidence of students' perceived growth as a result of participation in the ILE project, there are several skill areas that posed difficulties for preservice teachers as they engaged in exhibit design and construction. We believe these difficulties arose because we were working with novice teachers who were still learning about the craft of teaching and principles of learning. They brought with them years of their own experience as learners in classrooms, and some of those experiences pose obstacles for new ways of thinking about multimedia-supported learning activities. One challenging area was that of creating constructive, interactive learning activities in a multimedia, online environment. Preservice teachers were more comfortable with designing HyperStudio screens that presented information (much like a PowerPoint presentation). We observed in our conversations with the preservice teachers about their designs that it was challenging for them to conceive of learning activities that engaged the learners in meaning making (constructing knowledge) or critical thinking. Another challenging area was assessment. While most were familiar with a model of multiple choice quiz questions as a means of assessing factual knowledge, they were much less familiar with "performance assessment" strategies that might allow the teacher to gain other types of insight about learner understanding. This challenge was compounded when preservice teachers had to conceive of such performance assessments in an online environment. Finally, we found that often the preservice instructional designers selected content that was appropriate for a particular age group (based on state content standards), but neglected issues of readability and visual organization appropriate for a particular age level when they designed their HyperStudio

screens. Our recognition of these challenges will lead us to provide additional support to help preservice teachers in these areas next year.

Benefits and constraints of collaborations with methods faculty to integrate technology education into core course work.

During the 2001-2002 academic year, the technology methods faculty met regularly to plan for the new design of the technology courses to reflect these new approaches to preparing the teaching credential candidates to use computer-based technology effectively in teaching and learning. In the elementary education program there was additional collaboration with the history-social science methods faculty member who joined in course planning sessions, made presentations about the history social science framework, provided time in her methods course for the candidates to work on their projects, and provided moral support and feedback to the students on the progress of their ILEs. This interdisciplinary collaboration between faculty, technology and history -social science proved highly desirable. The content area faculty member provided insights to the core content of the ILEs that both enriched the content and made it more authentic to the classroom setting. The limitations on this collaboration were that the planning took considerable time and scheduling busy faculty was an ongoing challenge.

Future directions for this program

We have reason to believe that the ILE approach to preparing teacher candidates is more desirable than the former more traditional, piecemeal approach used in the past. The candidates who produced the ILEs have been prepared to view the array of technology tools and capacities available to them as tools to be implemented in addressing instructional problems. The challenge now is to design a teacher preparation program that can address the limitations of the

2001-2002 ILE program. An important limitation was that the multiple subject education candidates had limited knowledge of instructional planning and assessment when they started the technology course in the first quarter of their 5th year program and this slowed down the progress of their ILE planning. A solution that is under consideration for next year is to expand the ILE activities over a longer period of time, in order to take advantage of growing skills and knowledge that preservice teachers gain in the latter half of the year. Additionally, we intend to provide more scaffolding for skill building in areas of weakness during the beginning of the ILE project. Ideally, this can be done in collaboration with other methods instructors and courses.

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Intel Preservice Teach to the Future

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Abstract

Data gathered from 117 preservice educators at the University of North Texas during 2001-2002 is used to compare Intel's Preservice Teach to the Future curriculum to a traditional technology integration format. Major findings are that the Intel curriculum appears comparable to the traditional UNT program in advancing preservice educator Stages of Adoption of Technology and skills in electronic mail, World Wide Web, integrated applications, and teaching with technology.

Key Words: preservice, Intel, technology integration

Introduction

The University of North Texas received a Preparing Tomorrow's Teachers to Use Technology (PT3) Capacity Building grant in 1999 and a three-year Implementation grant in 2000. As a part of the PT3 activities, a four-course sequence was formalized to reach the goals. The evolution of this technology integration course sequence is described in the following section.

UNT Technology Integration Course Sequence

Undergraduate courses at the University of North Texas are numbered in a four-digit sequence for which the first number indicates the approximate year-level of the content and the remaining three indicate the focus of the course. In keeping with this scheme, the first course in the UNT integration sequence is considered a freshman-level computer applications course (1100) that is fairly standard throughout the campus, but the educational version utilizes educationally-relevant examples. The second course is a junior-level teacher productivity course (3440) while the third is a senior-level (4100) classroom/learner technology methods course. Some of the students in the second and third course enroll in the two concurrently. Students completing the entire sequence typically enroll in the third course one or two semesters before student teaching. This three-course sequence has for more than a decade been approved for a Texas Education Agency Information Processing Technologies (IPT) endorsement which can be added to a teaching certificate. Beginning in 1997, in order to prepare future teachers for continuous K-12 technology integration as mandated by the new Texas Essential Knowledge and Skills (TEKS) curriculum, the third course was modified to include a major module on the TEKS. Starting in fall 2001, the Computers in the Classroom course (4100) became a required course for all elementary education majors. This course was also a part of the Intel Preservice Teach to the Future curriculum beginning in fall 2001.

A fourth undergraduate course in the sequence (CECS 4800), focusing on technology integration mentoring, was formulated during this time frame as well, and was offered for the first time during the spring semester of 2000. This course places

students in existing classrooms to work with teachers in technology integration activities. Students concurrently acquire knowledge of classroom management and teaching strategies while contributing technology infusion expertise.

Completion of the four-course sequence listed in Table 1 entitles undergraduates to a University of North Texas certificate in curriculum and technology integration. Although this certificate currently carries no official status other than recognition by the University of North Texas, it is consistent with the needs expressed by several Texas school districts and is closely aligned with the TEKS.

Table 1.
Content for Computer Education & Cognitive Systems (CECS) Courses in Technology Applications Sequence

CECS 1100: Computer Applications in Education This is a tool-based course in which students learn to use an integrated word processing, spreadsheet and database package.
CECS 3440: Technology and the Teacher This course includes the use of presentation software and theories as well as the instructional design of presentation materials.
CECS 4100: Computers in the Classroom Students in this class learn to find appropriate instructional software for the classroom, develop a multimedia project, find Internet resources for classroom use, develop a technology infused lesson plan, and make a web page to link to their instructional resources.
CECS 4800: Technology Integration Mentoring or equivalent from approved list This course includes the pairing of preservice students with classroom teachers to provide technology integration mentoring experiences in a real-world environment.

Intel Preservice Teach to the Future Curriculum

In 2001 UNT received an Intel Pre-service Teach to the Future grant to provide additional resources to students enrolled in the third course in the sequence, Computers in the Classroom. Intel is currently implementing the Intel Teach to the Future program in the in-service K12 education arena in over 24 countries worldwide, with a goal of reaching 500,000 teachers by the end of 2002 (Intel, 2002). Results to date indicate that

the program is a great success with more than 90 percent of in-service teacher respondents reporting that the ideas and skills they learned are helping them successfully integrate technology into classroom activities. Intel has recognized that this program could have significant value for pre-service education and has thus committed to providing resources to interested colleges and universities.

UNT Technology Integration Goals

The focus of the UNT initiative encompassing the PT3 grant and the Intel Preservice Teach to the Future grant is to prepare pre-service teachers to integrate technology into their future classrooms. Included in the Computers in the Classroom course is the opportunity for students to analyze computer uses in education including simple applications that can be integrated into the classroom environment. In addition students gain knowledge in the selection of educational software, become comfortable modeling an educational presentation system, understand the integration of technology into the classroom and the use of other electronic sources for educational classroom resources. Students develop a unit portfolio on a chosen topic that involves the integration of technology.

Research Methodology

Pre-post data was collected online from all students enrolled in the Computers in the Classroom course, including new Intel sections for 2001-2002, as well as traditional format sections offered since 1998. These data included skill measures aligned with the International Society for Technology in Education (ISTE) standards as well as attitudinal

assessments. Statistical procedures such as analysis of variance were used to determine changes in pre-post measures as well as to compare the two curricular approaches. Data from Intel from 2001-2002 was compared to previous semesters for traditional students taking this course, in order to minimize change-of-instructor effects that would confound findings if only single-semester Intel vs. non-Intel indices were compared. This approache was necessary because the three veteran instructors from the traditional course format all shifted to Intel during 2001-2002. Effect Size, which is a standardized measure of magnitude of change, was the primary comparison basis for skill and attitude changes within and across semesters.

Data Acquisition

Pretest and post test data gathered from preservice educators at the University of North Texas between fall 1998 and fall 2001 form the basis of this paper. Undergraduate students completed the following instruments:

1. *Teachers' Attitudes Toward Computers* (TAC) (Christensen & Knezek, 1998), which is a Likert/Semantic Differential Instrument for measuring teachers' attitudes toward computers on 9 constructs.

2. *Technology Proficiency Self-Assessment* (Ropp, 1999) measures educator proficiency in electronic mail, the World Wide Web, Integrated Applications and Teaching with Technology.

3. *Stages of Adoption* (Christensen, 1997) is a self-assessment instrument of a teacher's level of adoption of technology, based on earlier work by Russell (1995). There are six

possible stages in which educators rate themselves: Stage 1 – Awareness, Stage 2 – Learning the process, Stage 3 – Understanding and application of the process, Stage 4 – Familiarity and confidence, Stage 5 – Adaptation to other contexts, and Stage 6 – Creative applications to new contexts.

4. Level Of Use (Griffin & Christensen, 1999) is a self-assessment instrument adapted from the Concerns-Based Adoption Model (CBAM) Level of Use designations for adoption of an educational innovation.

An online data acquisition system was used to administer the same battery of instruments to these university students at the beginning and again at the end of their semester-long courses. Only Stages of Adoption and Technology Proficiency Self-Assessment findings are reported in this paper.

Results

As shown in Table 2 and graphically displayed in Figure 1, progress toward technology integration as measured by self-reported Stage of Adoption was fairly consistent for the UNT course Computers in the Classroom (CECS 4100) across the years 1998 – 2000 (Effect Size = .87 – 1.02). On the other hand, the Effect Size for this class in its first offering in the Intel format during the fall of 2001 was .62. First semester growing pains for instructors teaching a new course could easily account for the difference, and it is worth noting that the Intel-format improvement in Stages of Adoption was still much greater than either of the CECS 1100/3440 comparison classes (ES = .31 and .14 respectively). Data being gathered for the spring 2002 semester (as this article is going to press) may provide additional evidence regarding the consistency and source of this trend.

Table 2.
Preservice Educator Stages of Adoption of Technology, 1998-2001

	Stage Pre	Stage Post	Change	Pre SD	Effect Size	n
UNT/CECS F98 4100	4.36	5.23	0.87	1.0	0.87	22
UNT/CECS F99 4100	3.89	4.89	1.0	1.1	0.91	19
UNT/CECS F00 4100	4.20	5.30	1.1	1.08	1.02	20
UNT/CECS F01 4100	4.1	4.86	0.76	1.22	0.62	64
UNT/CECS F01 1100	3.96	4.42	0.46	1.48	0.31	36
UNT/CECS F01 3440	4.50	4.65	0.15	1.04	0.14	17

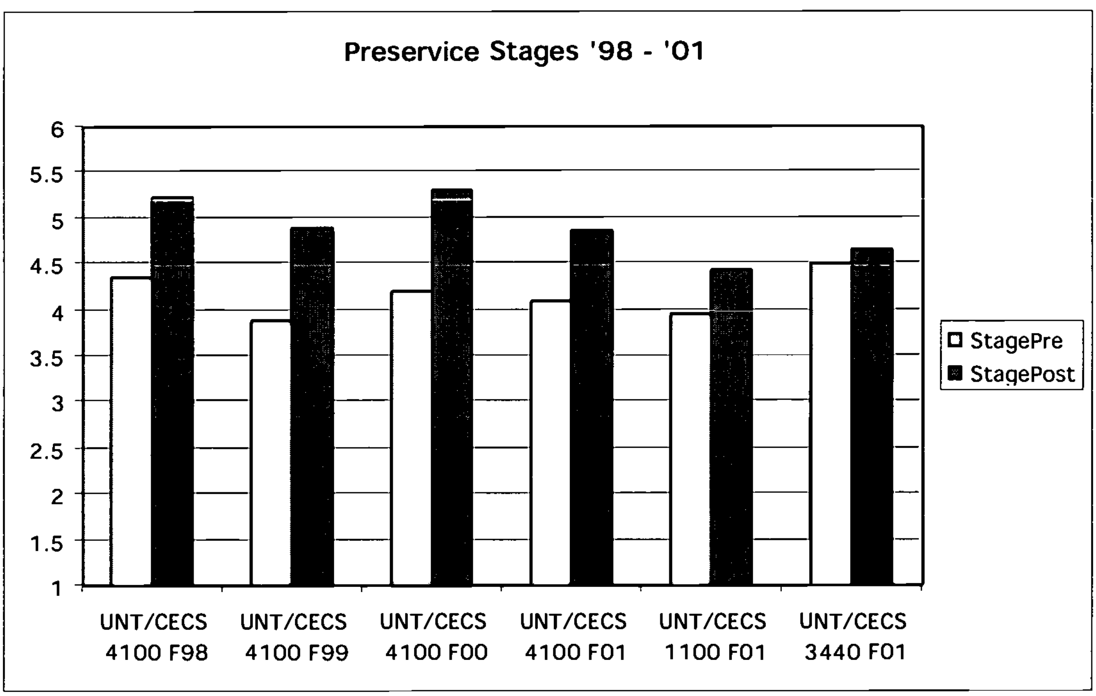

Fig. 1. Preservice teacher Stages of Adoption for UNT Preservice Classes

Contrasts in Skill Development

As shown in Tables 3-6 and graphically displayed in Figures 2-5, specific skill areas as measured by the Technology Proficiency Self Assessment questionnaire (Ropp, 1999) advanced at different rates for different preservice classes. Table 3 and Figure 2, for example, show a sizeable gain for the Intel section of Computers in the Classroom (CECS 4100) and the lower level Computer Applications class (CECS 1100). However students enrolled in Technology and the Teacher (CECS 3440) reported a decline in their perceived level of email skill.

Table 3.
Preservice Educator Email Skill, Fall 2001

	TP Email Pre	TP Email Post	Change	Pre SD	Effect Size	n
UNT/CECS F01 4100	4.07	4.45	0.38	0.80	0.48	71
UNT/CECS F01 1100	4.15	4.50	0.35	0.72	0.49	28
UNT/CECS F01 3440	4.51	4.28	-0.23	0.62	-0.37	18

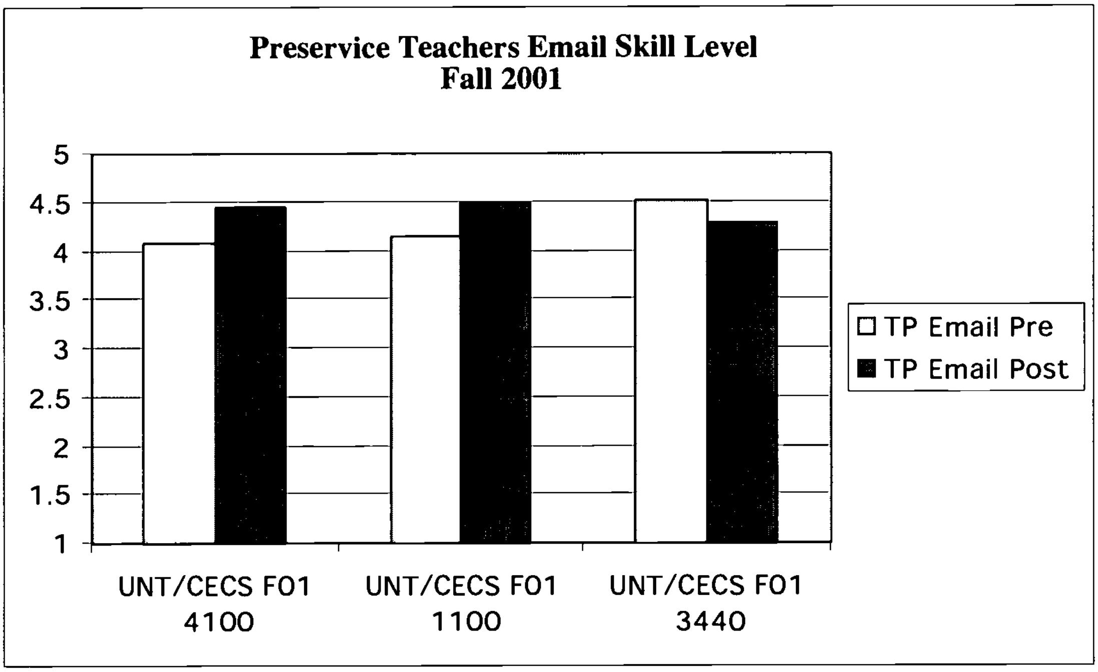

Figure 2. Pre-post changes in preservice educator skills measured by the Technology Proficiency Self Assessment Questionnaire.

As shown in Table 4 and graphically illustrated in Figure 3, for the WWW there was a similar contrast to that previously reported for email. Among the Computer Applications, Computers in the Classroom and Technology and the Teacher students, those in the first two classes reported large gains while those in the third reported declines.

Table 4.
Preservice Educator World Wide Web Skill, Fall 2001

	TPWWW Pre	TPWWW Post	Change	Pre SD	Effect Size	n
UNT/CECS F01 4100	3.94	4.56	0.62	0.72	0.86	71
UNT/CECS F01 1100	3.76	4.20	0.44	0.71	0.62	28
UNT/CECS F01 3440	4.12	3.99	-0.13	0.66	-0.20	18

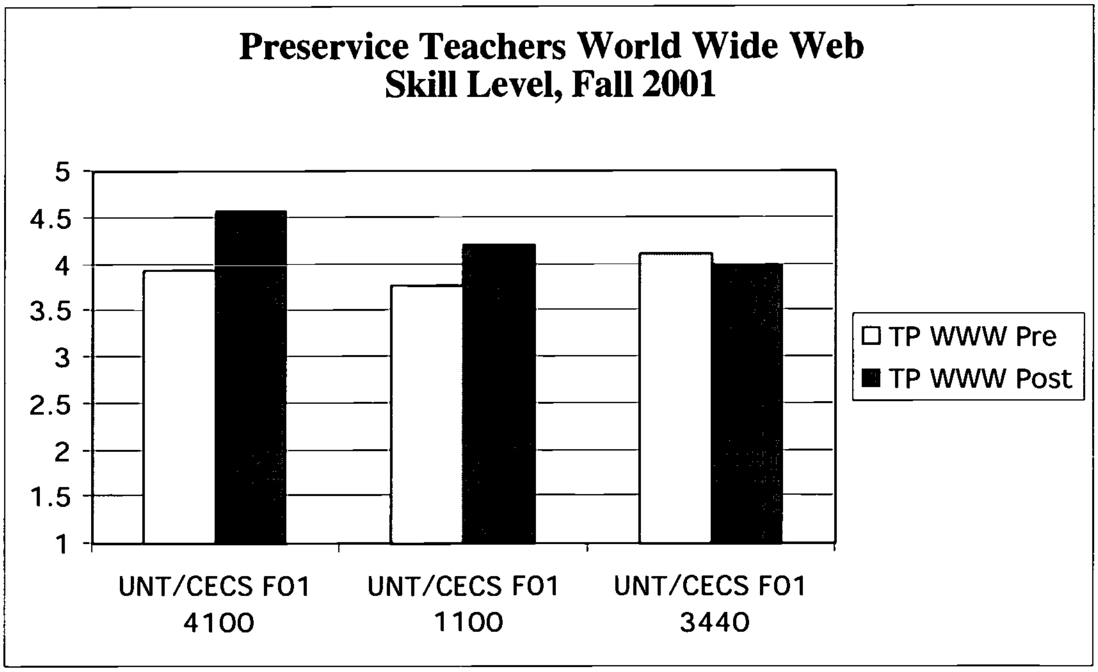

Figure 3. Pre-post changes in WWW skills for preservice educators, Fall 2001

As shown in Table 5 and graphically illustrated in Figure 4, CECS 4100 (Computers in the Classroom) exhibited large gains in the area of Integrated Applications while Computer Applications Tools (CECS 1100) students showed a moderate gain. The slope for CECS 3440 at UNT was practically flat from pretest to posttest in this area.

Table 5.
Preservice Educator Integrated Applications Skills, Fall 2001

	TPIA Pre	TPIA Post	Change	Pre SD	Effect Size	n
UNT/CECS F01 4100	3.38	4.43	1.05	1.02	1.03	71
UNT/CECS F01 1100	3.46	4.16	0.70	1.07	0.65	28
UNT/CECS F01 3440	3.93	3.79	-0.14	0.72	-0.19	18

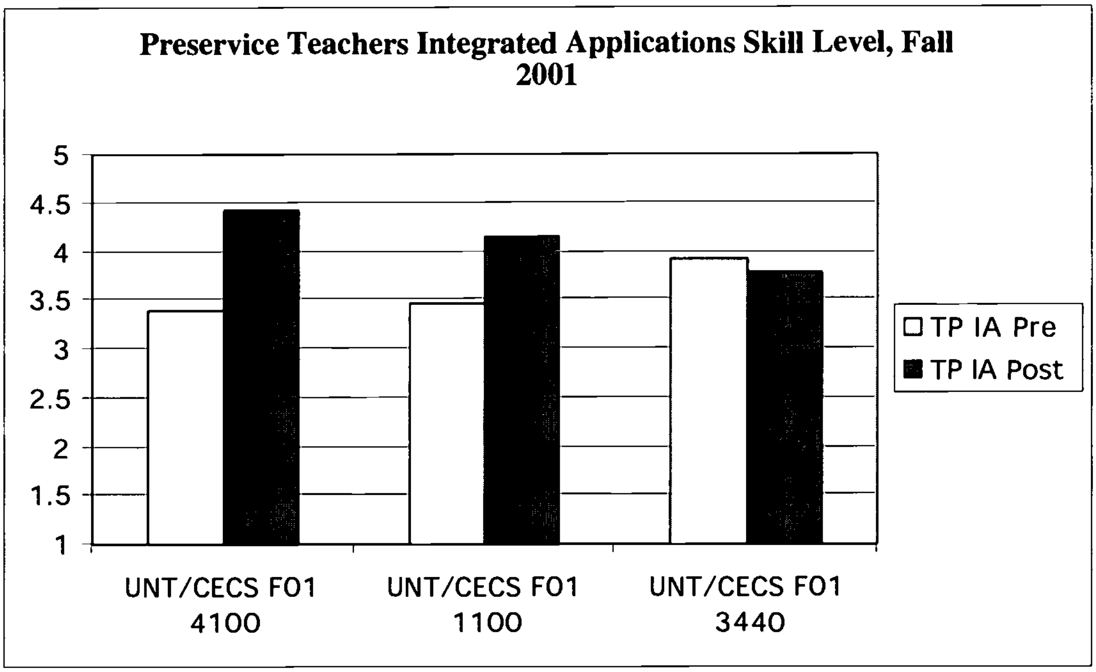

Figure 4. Pre-post changes in preservice educator integrated applications skills, Fall 2001.

As shown in Table 6 and graphically illustrated in Figure 5, the Intel sections of the CECS 4100 course at UNT, which focus on classroom technology integration techniques, showed an especially large gain (ES = 1.41) in the area of Teaching with Technology on the TPSA. Computer Applications students reported small gain in this area (ES = .41) while Technology and the Teacher students reported practically no gain in this area.

Table 6.
Preservice Educator Teaching with Technology Mean Scores, Fall 2001

	TPTT Pre	TPTT Post	Change	Pre SD	Effect Size	n
UNT/CECS F01 4100	3.39	4.46	1.07	0.76	1.41	64
UNT/CECS F01 1100	3.67	3.96	0.41	0.92	0.45	37
UNT/CECS F01 3440	3.92	3.96	0.04	0.78	0.05	18

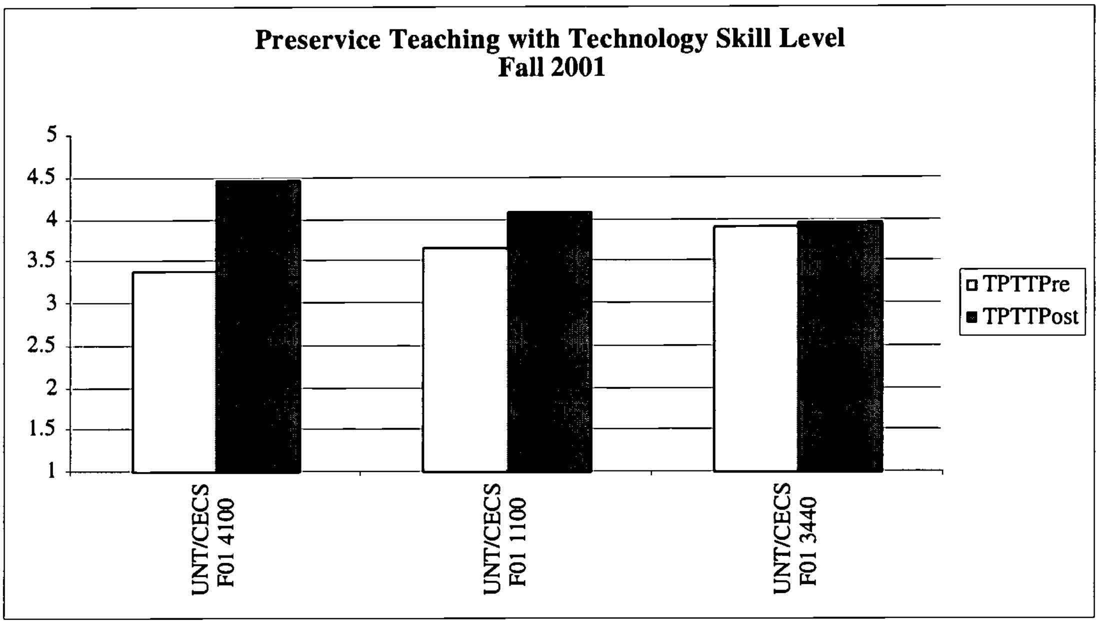

Figure 5. Pre-post teaching with technology skill levels for preservice educators, Fall 2001

Discussion

Effect Size indices (ES = Mean2-Mean1/Standard Deviation1), which are standardized measures of magnitude of change, are convenient bases for comparisons across courses and other training techniques.

> According to Kulik and Kulik, an Effect Size of 0.30 constitutes a 'moderate but significant effect'; Ryan notes that an Effect Size of 0.30 is equivalent to approximately three months' gain in student achievement. Thus, an Effect Size of 0.30 or better in favor of technology-based instruction suggests that such instruction is significantly effective… (Bialo & Sivin-Kachala, 1996, p. 2)

By this standard, the preservice courses identified in this paper range from superior to marginal in their ability to foster classroom technology integration techniques.

Table 7 places technology integration training within the broader context of preservice/inservice education by sorting several classes and training sessions according to effect size. As illustrated by the Effect Size of Fall 2002 CECS 4100 vs. the south Dallas inservice teachers, well-organized technology integration education delivered in the teachers' school building over the course of a school year can result in gains comparable to the Intel-structured preservice class. However, the traditional format of the preservice course resulted in greater gains than either the Intel curriculum or the inservice activities.

Table 7.
Preservice vs. Inservice Stages of Adoption Changes During Technology Integration Training Sessions (Pre-Post)

	Stage Pre	Stage Post	Effect Size	Change	SD	n
UNT/CECS F00 4100 Traditional	4.20	5.30	1.10	1.08	1.02	20
UNT/CECS F99 4100 Traditional	3.89	4.89	1.00	1.10	0.91	19
UNT/CECS F98 4100 Traditional	4.36	5.23	0.87	1.00	0.87	22
UNT/CECS Fall01 4100 (1-3) Pre-service Intel	4.10	4.86	0.62	0.76	1.22	64
South Dallas district Fall 1999 Inservice	3.90	4.67	0.58	0.77	1.33	96
North Dallas district 1999-2000 Inservice	4.44	4.86	0.34	0.42	1.22	428
UNT/CECS Fall01 1100 Preservice	3.96	4.42	0.31	0.46	1.48	36
UNT/CECS Fall01 3440 Preservice	4.50	4.65	0.14	0.15	1.04	17

An analysis of individual item responses was done to compare the TPSA items to the International Society for Technology in Education (ISTE) standards for preservice

teachers. Item # 14 from the TPSA – I feel confident I could use the computer to create a slideshow presentation – addresses the ISTE standard 19: use technology productivity tools to complete required professional tasks. As shown in Table 8, pre-post effect size was large for item # 14 (> 2/3 standard deviation). Item # 17 from the TPSA – I feel confident I could create a lesson or unit that incorporates subject matter software as an integral part – addresses the ISTE standards: 6) identify specific technology applications and resources that maximize student learning, address learner needs, and affirm diversity; 7) design and teach technology-enriched learning activities that connect content standards with student technology standards and meet the diverse needs of students; 8) design and peer teach a lesson that meets content area standards and reflects the current best practices in teaching and learning with technology; and 9) plan and teach student-centered learning activities and lessons in which students apply technology tools and resources. As shown in Table 8, the pre-post changes for item # 17 also reflected a large change.

Table 8.
Preservice Technology Proficiency Item Analysis for TPSA Items # 14 and #17

Course	Pre Means Item # 14	Post Means Item #14	Item # 14 Effect Size	Pre Means Item # 17	Post Means Item #17	Item # 17 Effect Size
CECS 4100	3.62	4.77	.91	3.15	4.52	1.37

Summary/Conclusions

The pilot study reported in this paper indicates that courses utilizing the Intel Preservice Teach to the Future curriculum as well as courses based on other well-formulated curricula can be effective in fostering gains in technology integration skills. Additional pre-post data gathered in subsequent semesters may provide a richer understanding of strengths and weaknesses of each curriculum approach.

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Research, Students with Disabilities, and Technology: Guidelines for Teacher Educators

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Abstract

KEYWORDS: technology, students with disabilities, teacher education, learning disabilities

In light of new technology-related standards used to evaluate teacher education programs, courses related to the use of various technologies to improve learning are being revised. In addition, future teachers must be prepared to teach all learners, even those with disabilities. As educators redesign courses, it is important that they do so with an eye for research-based practices. This paper will review some research about the use of technology with students with disabilities to enhance behavior, monitor progress, and

improve learning. In addition, it will provide some helpful references for teacher educators.

The belief that the appropriate use of technology can enhance learning for all students is reflected in different standards for teacher education programs. Standards, such as those developed by the National Council for Accreditation of Teacher Education (NCATE), the Interstate New Teacher Assessment and Support Consortium (INTASC), and the Council for Exceptional Children (CEC) are used for the accreditation of general and special teacher education programs. Other standards such as those developed by the International Society for Technology in Education (ISTE) provide more detailed descriptions of the competencies expected of both general and special education teachers.

In light of these standards and the fact that all educators are likely to work with students with disabilities, teacher education programs are revising courses that prepare future teachers to use technology with all learners. These courses should be designed to reflect research-based practices. Therefore, the purpose of this paper is to provide an overview of different uses of technology that support students with disabilities.

In order to be most helpful, this overview is organized according to specific classroom uses of technology with students with disabilities. These include, technology to enhance behavior, technology to monitor student learning, and technology to enhance academic achievement. In each section a potential use of technology is described along with a discussion on related research.

Technology to Enhance Behavior

The use of technology to help change behavior involves the use of relatively low-tech equipment that is available in most school settings. Two types of technology that can be very useful for changing behavior include the use of audiotapes to promote self-regulation and self-monitoring of behavior (Johnson & Johnson, 1999), and the use of videotapes to encourage appropriate behavior via self-modeling (Buggey, 1999). In addition to requiring technology that is typically available, self-regulation and self-modeling seem appropriate for use with students across grade levels (Buggey, 1995; Maag, Reid, & DeGanni, 1993; Kahn, Kehle, Jensons, & Clark, 1990).

Teaching self-regulation of behavior typically involves helping students observe, assess, record, and reinforce their own behavior. The use of an audiotape with tones that sound at variable intervals is typically used in the beginning stages after having identified a target behavior and teaching students to ask a monitoring question. For example, when the tone sounds, students ask a monitoring question such as, "Was I looking at, or reading my book or paper?" If the answer is yes, the student indicates this on-task behavior on a recording sheet that has been provided.

The use of videotaped self-modeling (VSM) has been used successfully to enhance motor skills (Dowrick, 1983), cognitive skills (Schunk & Hansen, 1989), and behavior (Buggey, 1999). When using VSM, teachers must identify a target behavior and teach the behavior using role playing with the identified student. The student can then be videotaped demonstrating the appropriate behavior during the role play. Tapes are typically brief and only positive examples of behavior are included. Research suggests that viewing the tapes for 3 - 5 minutes per day can result in positive changes in behavior.

Videotaping with adult feedback was used successfully as part of a program by McCullough, Huntsinger, and Nay (1977) to teach an adolescent to control his aggressive behavior in a school setting. In this study, the student was videotaped during a role-playing situation. The student then reviewed the videotape with an adult to identify his own aggressive behaviors and to determine their effect on others. The use of this videofeedback resulted in reducing the frequency and intensity of aggressive behavior.

Sufficient research exists to support the use of audiotapes and videotapes to produce positive changes in behavior when used appropriately with students with various disorders and disabilities. While this technology may not be computer-based, teachers should be made aware of its potential for use in the general education setting. Also consideration could be given to integrating VSM into other forms of multimedia for instructional purposes.

Technology to Monitor Student learning

Computer Grade Book Programs

Students with disabilities, particularly those with learning disabilities, often have deficits in their metacognitive awareness (Swanson, 1996). These deficits make it difficult for some students to monitor their own learning. Monitoring one's learning would include the ability to determine progress toward goals and to evaluate the quality of one's work. Computer technology that allows students to independently check on requirements and due dates for homework assignments and access grades on an ongoing basis would seem beneficial to many students.

Research indicates that low achieving students often misunderstand even simple grading practices (Evans & Engelberg, 1998). The ability to access grades on an ongoing basis shows promise for improving task completion and improving academic performance (Hunter & Chen, 1992). Since this field test completed with seventh grade low-achieving students (Hunter & Chen, 1992), schoolwide technology that allows students to access grades has become easier to use and readily available. Such technology may be referred to as student information systems software, gradebook software with web interfaces, or courseware management software. The ability to access this information using a web browser can also improve parent-school communication. In addition, current standards demand that students be active participants in the assessment process (IPSB, 1998).

CBM software and graphing programs

Curriculum-based measurement (CBM) has a sound research base to support its use as a method for monitoring student progress and making databased instructional decisions (Stecker & Fuchs, 2000). CBM relies on short-timed probes conducted on an ongoing basis to assess student progress in reading, mathematics, spelling, and written expression. Progress is assessed using measures of fluency which are then graphed to provide a visual representation of student learning.

Monitoring Basic Skills Progress (MBSP) is a software program available to assist teachers interested in using CBM. With this software the computer administers and scores tests, provides students with immediate feedback, saves students' scores and prepares graphs displaying progress over time. These programs also analyze the graphed

performance and provide teachers with suggestions for instructional changes. Future teachers should be aware of the potential of CBM to enhance student learning.

IEP Software

A recent report by the Council for Exceptional Children (2000) suggests that all special educators should be given state of the art case management software and the training necessary to use it effectively. Clearly teacher education programs can begin such training by requiring future special educators to develop competence with IEP management software. In addition, special educators should be acquainted with research that suggests computerized IEPs might have some unintended disadvantages.

Schenck (1981) has suggested that without proper preservice training, we may find that we reduce paperwork demands, but undermine the validity of the IEP. Majsterek, Wilson, and Mandlebaum (1990) provided some early suggestions for evaluating IEP software. Their guidelines encourage the prospective teacher to examine the software for its consistency with required components of the IEP, hardware requirements, amount of time to learn, and compatibility with curriculum. In addition, special educators should review programs with an eye for the ability to individualize goals and objectives, and to customize these so they are compatible with state standards.

Technology to Enhance Academic Achievement

Computer-assisted Instruction

Researchers have been interested in the use of computers to enhance the academic achievement of students with disabilities since the mid 1980s (Woodward & Rieth, 1997). Much of this research investigated the effect of various design features including feedback

(Collins, Carnine, & Gersten, 1987; Torgesen, Waters, Cohen, & Torgesen, 1988), massed and distributed practice (Hasselbring, Goin, & Bransford, 1988), and explicit strategy instruction (MacArthur & Haynes, 1995). Later researchers began to investigate videodisc programs (Kelley, Gersten, & Carnine, 1990) and anchored instruction (Cognition and Technology Group at Vanderbilt University, 1990). It was much later before researchers began to investigate the use of computer-assisted instruction with students with autism and low incidence populations (Higgins & Boone, 1996).

Extensive reviews of research investigating technology and academic achievement of students with disabilities are available and should be examined by both general and special educators (Fitzgerald & Koury, 1996; Shiah, Mastropieri, & Scruggs, 1995; Woodward & Rieth, 1997). In addition, a separate review of technology applications and literacy skills may also be helpful to educators (MacArthur, Ferretti, Okolo, & Cavalier, 2001) and will be referred to in the section on technology and writing. Results of this research is mixed, however, the research on the use of computer-assisted instruction with students with disabilities suggests that the computer is as effective as teacher directed instruction in one-on-one instructional arrangements (Higgins & Boone, 1990; Higgins & Boone, 1992). The critical role for teachers may be to select software that incorporates the critical variables found to promote learning along with determining the best ways to connect computer-based instruction with traditional instruction (Woodward & Rieth, 1997).

Software and Multimedia Selection

The importance of teachers' ability to select carefully designed software was highlighted in a study by Higgins, Boone, and Williams (2000). These researchers contacted 33 educational software publishers to request information about the product development practices, specifically those related to field-testing. Of these 33 publishers, five admitted they did not engage in any evaluation of their products. This cavalier attitude on the part of software publishers makes it critical that educators understand variables to consider when selecting software for use with students with disabilities.

Educators can find a comprehensive set of guidelines in an article by Higgins, et al. (2000). These scholars provide a flowchart for guiding classroom teachers through the necessary steps in evaluating software and a specific list of critical components to keep in mind when examining specific programs. The components related to enhancing learning to be evaluated include: teacher options, software options and design, screen design, instructional options, sound, feedback, and instructional and screen design. Equally important are the steps in the flowchart where teachers are encouraged to create pretests and posttest measures to determine student learning. Finally, these researchers also include a set of questions for interviewing students to determine their perceptions of software effectiveness.

A similar article by Wissick and Gardner (2000) presents a comprehensive overview of effective instructional principles that should be integrated into multimedia to guide purchase and instructional decisions. They provide a list of specific programs that include these instructional principles, and their associated websites. Finally, they point out potential problems for students with disabilities and suggests interventions to correct these problems

(Wissick & Gardner, 2000). Both articles described should be included in readings for future educators who will be in the position of purchasing or designing CAI or multimedia in inclusive settings or more traditional programs for students with disabilities.

Word processing and written expression

Students with disabilities often find written expression to be an especially difficult area of the school curriculum. They experience difficulty with the higher order processes involved in writing such as planning and revising to clarify ideas, the transcription part of writing, and the mechanical aspects of writing (MacArthur et al, 2001). MacArthur et al. (2001) reviewed 20 investigations that examined these various parts of the writing process. Benefits from the use of technology were reported in 12 of them. Of these 12, five investigated the use of word processors and spell checkers combined with strategy instruction, writing instruction, or strategic peer revision. All five studies investigating this combined approach had positive results for students with disabilities. These studies may be an example of the importance of the active involvement of teachers if technology is to enhance academic achievement (Woodward & Rieth,1997).

WebQuests

As a result of passing the 1996 Telecommunications Act, many children in our nation's classrooms have increased access to the Internet. While there is little research on the impact of using the WWW on academic achievement, locating information on the World Wide Web is a regular activity for students. Along with searching for information, students use the WWW to conduct elaborate research projects (Goldstein, 1998). An increasingly popular learning task involves working with WebQuests (Kelly, 2000).

WebQuests are described as inquiry-oriented activities in the form of a webpage (Dodge, 1995). Activities are often designed using collaborative learning arrangements. Guidelines are available for designing webquests (Kelly, 2000). These guidelines are consistent with examples of WebQuests at the following website: http://edweb.sdsu.edu/webquest/webquest.html and include the following components described by Kelly (2000): (a) Introduction, (b) description of the specific task, (c) linked Internet resources, (d) steps to guide students to completion, (e) methods of evaluating student work, and (f) a conclusion linking the activity to state standards. Teachers are likely to find that using webquests provides students with the opportunity to engage in higher order thinking skills as they complete an authentic task.

Conclusion

The purpose of this article was to review existing research, and provide resources to guide teacher education programs as they review technology requirements for future teachers. Increasingly, all teachers must be prepared to meet the needs of students with disabilities in general education classrooms. As teacher education programs review their current technology requirements, they should keep on eye on research that can guide them in identifying promising practices. This article was written to provide an overview of such research-based practices.

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Systems Analysis of Learning Theory Through Causal Influence Diagrams

Key words: learning theory, causal influence diagramming, systems analysis, instructional design, cognition, assessment

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Systems Analysis of Learning Theory Through Causal Influence Diagrams

Theoretical Framework

The components of complex domains have dynamic, interdependent relationships that are often unstable. A useful method for representing relationships among elements in complex systems is causal influence diagramming, often described as concept mapping.

According to Jonassen, the act of concept mapping enhances the interdependence of declarative and procedural knowledge to produce structural knowledge, knowledge that provides insight into why things are the way they are (Jonassen, 1996). Theories of learning are complex systems that all teachers must be prepared to navigate in order to design instruction that is meaningful and appropriate. Educational psychology course are often the first place students are introduced to these complex systems. Modern technologies have increased awareness and understanding of how humans learn while providing new and efficient tools for expressing relationships within these complex systems. Providing a variety of methods for students to communicate their understanding of complex systems is an important goal for educators teaching courses on learning theories and developmental psychology.

Advances in technology have stimulated interest in providing methods that support learning about complex domains (Spector and Davidsen, 1997), but there is no evidence that causal influence diagramming improves ability to analyze complex domains, although measurement instruments are currently under development. Spector suggests that tools borrowed from the realm of system dynamicists be employed to assess understanding of complex and dynamic systems (Spector, 2000). Dabbagh discusses the benefits of two concept mapping software tools that support the representation of complex systems and details the successes of previous studies on concept mapping and academic achievement (Dabbagh, 2001). Instructors and instructional designers now possess the resources to facilitate representation of complex systems through the creation of causal influence diagrams. Additionally, combining causal influence diagramming with a case-based approach to the study of learning theory provides students with a

complex system to analyze and a method for representing their understanding of the relationships among components within the system.

This approach uses two pedagogical techniques that have been proven effective. Presenting a complex domain in the form of a case study allows prospective teachers to experience classroom life while encouraging detection of specific issues and problems within a safe, yet complex authentic context (Harrington, 1996). Contemporary software applications provide tools that support learning and analysis of complex domains (Spector & Davidsen, 1997), and classroom cases are easily obtained. This study employs the use of software applications, traditional assessment, and case studies to support systems analysis of learning theories through the development of causal influence diagrams (CID) and seeks to determine the extent to which causal influence diagramming affects performance on traditional assessment measures. A second goal of this study is to determine whether causal influence diagramming of a case study affects student performance on case study analysis.

Methodology

A partnership was formed between the faculty members responsible for teaching Educational Psychology courses in the elementary and secondary undergraduate programs. The faculty worked together to select appropriate software, identify important systems covered in the course, and establish a unified curriculum for teaching the systems targeted for the study. Students in undergraduate Educational Psychology courses were taught to use *Inspiration* software to express their understanding of causal relationships within learning theory and classroom systems. The software application facilitates the use of directional arrows, text fields, and graphics to indicate relationships between

components within a complex system. Enough licenses of the software permitted installation of the application on each student's laptop for the semester, and the instructors taught the students to use the program during one 75-minute class period.

Present Study

The research design for the present study was refined after reflecting on the results of a pilot study. In the present study, students completed two descriptive causal influence diagrams and one analytical causal influence diagram. One descriptive diagram required students to demonstrate their awareness of the relationships between components of Piaget's theory and the other descriptive diagram required students to demonstrate their awareness of the relationships between major components of the Individuals with Disabilities Education Act (IDEA). These tasks were considered "descriptive" because the causal influence diagrams identified the complexity of the relationships without critical analysis of how the various components relate to classroom practice. Students completed these diagrams outside of class and submitted them on the day the class focused on the respective topics.

The analytical causal influence diagram required the students to determine motivational issues for a student case. This diagram was considered analytical because students were required to analyze the components of motivation represented in the case and show the relationship between the components and teaching strategies within a dynamic system. The instructor led students in an analysis and discussion of a motivational case prior to the deadline of the analytical diagram. Upon completion of class coverage of how motivation influences engagement and performance, students were

presented with a narrative that depicted a typical classroom motivation case about a fictitious student named Wayne (See Table 1).

TABLE 1. Causal Influence Diagram Assignments and Assessment Criteria

Descriptive Causal Influence Diagrams	
Piaget (15)	Design a causal influence diagram that reveals the relationships between components in Piaget's theories. Criteria: Stages with minimum of 2 related concepts, adaptation, organization
IDEA (15)	Design a causal influence diagram that reveals the relationships between components of the IDEA. Criteria: Include components of IDEA from evaluation to due process and detail relationships between each component
Analytical Causal Influence Diagrams	
Guided practice case study – from Woolfolk, Anita. (2001) *Educational psychology, 8th edition*. Allyn and Bacon. Defensive Diana doesn't have her lab manual-again. You tell her that she may share with another student. Then Diana pretends to be working, but she spends most of her time making fun of the assignment or trying to get answers form other students when your back is turned. She wants everyone to know that she "isn't really trying." That way, if her grades are low she has an excuse. She is afraid to try because if she makes an effort and fails, she fears that everyone will know she is "dumb."	
CID assignment-Wayne's case (15) You begin class. . . . "Get out your research notes, your prewriting notes, and the current draft of your persuasive essay. We're going to continue writing and peer-editing body paragraphs today." The moaning begins and several students have questions about your expectations. A few students pull out their notes and get started, but Wayne slumps in his chair and tries to become invisible. Wayne doesn't have his research notes, but he does have a draft. He flips his papers and pretends to be editing his draft, making minor revisions and crossing out words and phrases. Wayne is unable to move forward with his essay because he has once again forgotten to bring important resources to class. Wayne always comes through in the end with a C or D quality product. Wayne doesn't keep track of his grades or his work. Instead, he relies on his "sense" of his performance and occasionally checks his current grade average, just to get his bearings. It appears that Wayne is sabotaging his chances for good grades. His grades are somewhat better in chemistry and algebra, but it's not like Wayne to try to impress anyone with his academic performance. Criteria: Design a CID that reveals the relationship between Wayne's motivational needs and teaching strategies that might help Wayne improve his academic performance. Include: type of learner, locus of control, goals, self schemas (motivational style, self-efficacy, view of ability)	
Formal assessment-Bridgett's case (5) Bridgett is usually the first student in the door for your World History class. She is an excellent student and is well liked by her peers. Helpful, prepared, and insightful, Bridgett possesses the work habits of an AP student. You've spoken to her about moving into a more advanced section of World History, but she refuses and says she doesn't want to lose her "A". Criteria: Analyze Bridgett's motivational tendencies based on the concepts we discussed in class. You may represent your analysis through narrative, listing, or diagramming. Include: type of learner, locus of control, goals, self schemas (motivational style, self-efficacy, view of ability)	

Students were asked to create a list of influential components in the motivation case and to identify the influence of each component on other components (Figure 1). Students also created a causal influence diagram that depicted their analysis of the relationships between components of the motivation system depicted in the case (Figure 2). All causal influence diagrams were evaluated based on criteria established by experts in educational psychology. Table 1 shows the three causal influence diagram topics, the case used during the class on motivation, and the criteria used to evaluate the causal influence diagrams.

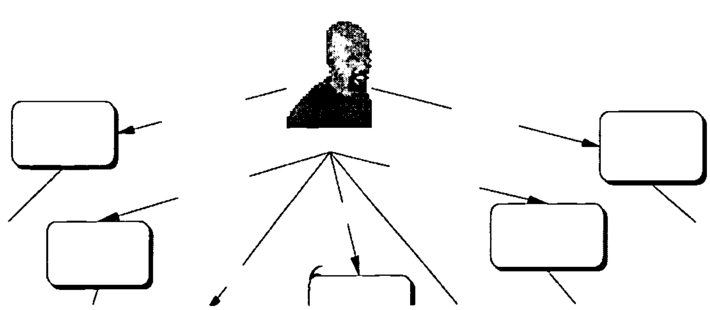
Figure 1. Chart outlining components and relationships for the analytical CID

DIRECTIONS:
Use the table to identify the variables associated with motivation theory in the scenario. Then, use this data to create a causal influence diagram that reflects your understanding of the theoretical and practical implications of the scenario

Name of the Concept/Variable	Value/Meaning of the Concept	Concepts Influenced	Teaching Strategy
Type of Learner: Work-avoidant	Doesn't work to look smart; wants to avoid work	Pays little attention; difficulty focusing; does work simply to finish – not to learn; low level of engagement; surface processing	Engaging activities; show the value of learning; connect material to meaningful experiences; authentic tasks; autonomy and responsibility; high teacher expectations
Type of Motivation: Extrinsic Motivation	Caused by external factors such as rewards and punishments	Learning for rewards, not for the sake of learning itself; surface processing	Show value of tasks; authentic tasks; high teacher expectations; autonomy and responsibility
Motivational Style: Failure-accepting	Avoids failure by "sticking to what they know," not taking risks, and claiming to not care	Performance goals or no goals; external locus of causality; entity view of ability; learned helplessness; gives up easily; low self-esteem and self-concept	Recognition – authentic praise that focuses on progress, growing competence and independence; cooperative learning; de-emphasis on grades – emphasis on learning; set high (but obtainable) teacher expectations
View of Ability: Entity/fixed	Belief that ability is a fixed characteristic and cannot be changed	Set performance goals (if any at all); surface processing; low self-esteem or self-concept	Problem-based learning; autonomy; recognize progress and ability; encourage deep processing
Self-Efficacy: ??			
Type of Goals: Performance Goals (if any)	Goal is to try to look good to others	Surface processing; do work to finish – not for learning	Authentic tasks and problem-based learning; autonomy; recognize progress and challenge seeking; de-emphasize grades and focus on learning
Locus of Causality: External	Something outside of the learner is causing behavior	Extrinsic motivation; performance goals	Recognize effort and progress; autonomy and responsibility; high teacher expectations
Motivational Style: Learned Helplessness	Expectation, based on past failure, that all one's efforts will result in failure	Little motivation; external locus of causality; entity view of ability; work-avoidant; failure-accepting; pessimistic view of learning; low self-esteem and self-concept	Recognition; high teacher expectations, cooperative learning; comparing progress to self-best, not others; encourage student participation in evaluation

In an effort to determine the extent to which causal influence diagramming affects performance on traditional assessment measures, multiple-choice questions not related to the causal influence diagramming activities were identified for two tests. Multiple-choice questions on subjects included in the causal influence diagramming activities were identified and labeled as lower and higher level cognitive processing based on Bloom's taxonomy (Bloom, 1956). Multiple choice test items were also identified for the causal influence diagramming topics of Piaget, IDEA, and theories of motivation.

Figure 2. Causal Influence Diagram Analyzing Motivation Theory in a Case Study



Upon conclusion of the final causal influence diagram, students were asked to respond anonymously to questions about causal influence diagramming and their perceptions of the effects on test performance. Data used to determine the extent to which causal influence diagramming influenced the ability to analyze complex systems came

from causal influence diagrams created by the students, performance on multiple-choice test items, and anonymous student responses to open-ended questions.

Results

High performance on causal influence diagramming and accuracy on multiple-

TABLE 2. Descriptive Statistics for Performance on Causal Influence Diagrams

	Piaget	IDEA	Motivation
Mean	12.6	11.4	11.8
Median	12	11	13
Mode	12	11	14
Std. Dev.	1.9	2.1	3.6

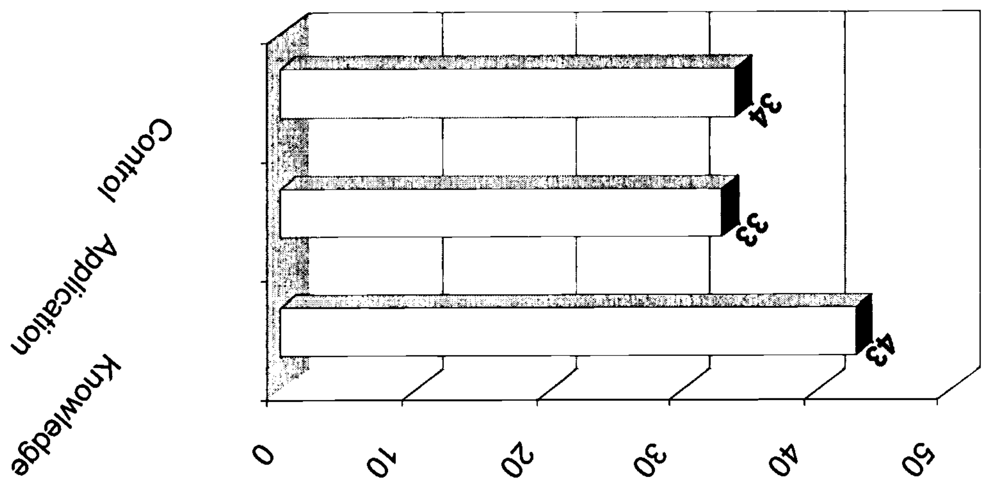
choice test items were common for students in this study. The causal influence diagram on Piaget was used to assess student knowledge of Piaget's theories as well as student ability to manipulate the software. It was evident by the quality of the products that the students had no difficulties manipulating the software. Student performance on causal influence diagrams was measured by comparing performance to expectations established by experts (see Table 1). Each causal influence diagram was worth fifteen points and full credit was earned if specific criteria were represented accurately on the diagram. Students were expected to demonstrate awareness of the relationships between components by using directional arrows labeled with text descriptors of the relationship. Mean, median, mode, and standard deviation were determined for performance on each diagram (see Table 2). The difference between the means of the diagrams is minimal and the standard deviation is the greatest on the analytical diagram. The large deviation and the high mode on the analytical causal influence diagram indicate that a few members of the group had poor performance while the majority earned high scores.

Student responses to multiple-choice questions on unit tests were also totaled and compared. Performance on each test item was assessed and a "1" was recorded for

correct responses and a "0" was recorded for incorrect responses. Each set of questions yielded the same total points enabling easy comparison of question sets.

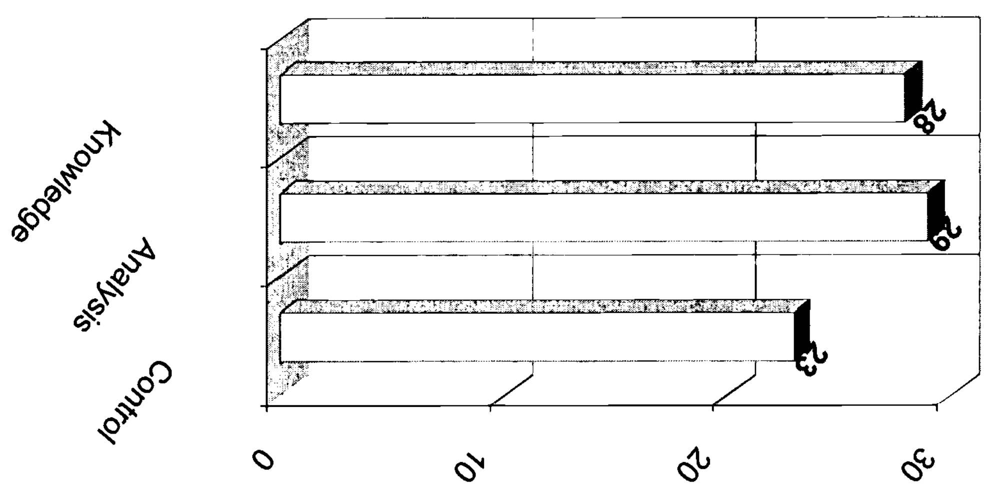
On the first test, frequency of responses on three questions not related to Piaget, three questions on Piaget's theory at the application level, and three questions on Piaget's theory at the knowledge/comprehension level was determined, total point value for each question set was 45. Figure 3 shows the total scores on the three sets of questions from the first test. Frequency of correct responses was the highest for knowledge level questions about Piaget's theory. The score for the control set of questions was lower than the knowledge level set of questions and only 1 point higher than the total score for the application level questions. Frequency of responses to multiple-choice questions was also calculated for the test on motivation. Student responses to two questions on topics other than motivation, two questions on motivation at the knowledge level, and two questions on motivation at the application level were tabulated and Figure 4 shows the results of those calculations. Total scores for each set of questions was 30 points. Total points earned on the control questions was 23, total points earned on analysis level questions was 29, and total points earned by the students on the identification/knowledge level

Figure 3. Frequency scores for multiple-choice questions on Piaget, N=15



questions was 28. Results indicate that students performed better on the questions related to the topic of motivation than they did on the questions about topics not addressed with causal influence diagrams.

Figure 4. Frequency scores for multiple choice questions on motivation, N=15



Student performance on the analytical CID and a case analysis on a test were compared to determine the relationship between causal influence diagramming activities and performance on the case analysis. Table 4 presents the mean, median, mode, and standard deviation for both the diagram and the case analysis from the test. Higher modes for both measures indicate that most students performed well on the diagram and on the case analysis. The decrease in the standard deviation and high mean on the case analysis indicate that even more students were successful on that assessment item.

TABLE 3. Comparison of performance on CID to performance on motivation case analysis, N=15

13	Median	4
Causal Influence Diagram (1-15)		Motivation Case Analysis (1-5)
11.87	Mean	4.26
14	Mode	4
3.642	Standard Deviation	0.593

Student responses to questions about their perceived value of causal influence diagramming were also collected and analyzed. Student perceptions of how causal influence diagramming activities affected their understanding of the complex systems of Piaget's theory, IDEA, and motivation were measured by responses to three questions. The students responded anonymously to the following questions:

1. To what extent did causal influence diagramming affect your understanding of Piaget's theory, IDEA, and motivation theories?

2. To what extent did causal influence diagramming improve your understanding of the relationship between motivation theory and teaching practice?

3. Did you use *Inspiration* for other classes? If yes, briefly describe how and why you used the software.

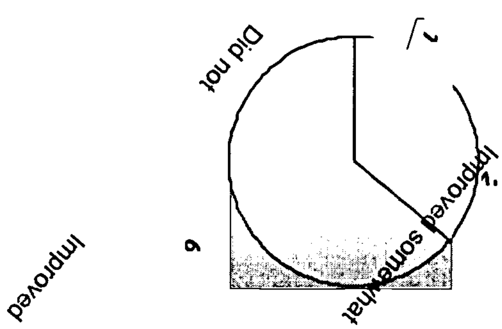
For question 1, student responses were categorized at three levels, did not affect, affected somewhat, and did affect. Figure 5 presents the frequency of student responses to

question 1 and reveals that the majority of students believed that causal influence diagramming activities had a positive affect on their performance.

Figure 5. Frequency of responses to open-ended question 1, N=14

Figure 6 shows the frequency of responses to the second open-ended question. Student responses were categorized in three areas, did not improve, improved somewhat, and improved. Results of frequency analysis revealed that the majority of students perceived the causal influence diagramming activities as helpful.

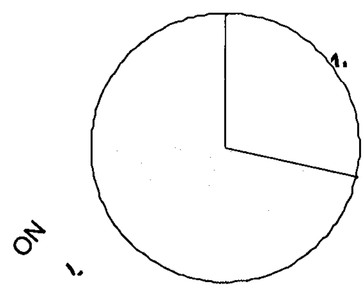
Figure 6. Frequency of responses to open-ended question 2, N=14



Students were also asked if they used the software application for the causal influence diagramming activities in other classes. Figure 7 presents the frequency of responses to

question 3 and reveals that most students did not use this application to support work in other classes.

Figure 7. Frequency of student responses to question 3, N=14



It is evident that this group of students perceived their experiences with causal influence diagramming as helpful on the study of complex educational systems. Students perceived descriptive causal influence diagramming as an effective tool to support understanding of complex systems. Fewer students indicated that analytical causal influence diagramming helped them recognize the relationships between theories of motivation and classroom practice. Slightly less than 1/3 of the students reported that they used the software application to help them in another class.

Discussion

Most students performed well on the causal influence diagrams and the test items. Comparison of student performance on multiple choice test questions related to both types of causal influence diagramming activities and multiple choice questions not related to the causal influence diagramming reveals that the activities affected student performance in a positive way. Student performance on the first test showed that correct responses to questions at the knowledge/comprehension level exceeded correct responses to the set of control questions. Accuracy on the application/analysis/synthesis level

questions almost equaled the accuracy of responses to the set of control questions. Additionally, student self-reports show that attitudes toward the activities were positive.

Comparison of performance on multiple-choice test items on motivation revealed that scores for both sets of motivation questions exceeded the total group scores for the set of control questions and performance on analysis/application level questions was slightly higher than performance on knowledge/comprehension level questions. The majority of students felt that the activities were beneficial in helping identify relationships between theory and practice, and the performance on the test items supports their perceptions. The comparison of performance on the analytical causal influence diagram and analysis of a case on a test support the idea that critical analysis skills transfer. Students who performed well on the diagram performed well on the test. Although causality between performance on diagramming activities and test performance cannot be substantiated by this study, it can be assumed that the activities had some influence on student performance. The results of multiple-choice test questions on motivation theories indicate that the combination of a case study and a causal influence diagramming activity affected student performance more than descriptive causal influence diagramming. Student experience with the software, the activities, and more guided practice complicate interpretation of these results. It appears, however, that the combination of a case study and a causal influence diagramming activity had more impact on student performance than descriptive diagramming assignments.

Implications for Teacher Educators

The results of this study provide a starting point for a more controlled investigation of the effects of causal influence diagramming on the analysis of complex educational systems. Since student performance was consistently high on the diagrams and the multiple choice test questions on the diagrams, performance at causal influence diagramming can be a strong indicator of performance on traditional evaluation measures. Student self-reports indicate positive attitudes toward the activities, most likely facilitated by unlimited access to a computer and the software throughout the course.

A case study approach to an analytical causal influence diagramming activity has the potential to improve student performance beyond that descriptive diagramming alone. Integrating a systems analysis approach and computer software to facilitate the representation of complex systems in an educational psychology course is an excellent method for improving test performance, helping novice teachers recognize the value of non-traditional computer-based approaches to assessment, and modeling methods for addressing diverse learning styles. Engaging future teachers in such experiences throughout all phases of their preparation can only increase the likelihood that these methods will be integrated into their instructional design repertoire in the future. Meanwhile, causal influence diagramming activities prepare them to move into a closer study of the complex domain of teaching and learning in their professional preparation courses.

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The Adventure of the Discussion Board

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Abstract

The article describes the frustration with the lack student involvement in classroom discussions regarding significant issues of the California State History Social Science Standards specifically on politics and media. The initial use of a discussion board produced disappointing results. Very few students participated and their responses did not reveal significant insight or thought regarding the topic. However, the implementation of discussion boards using support tools to help the students guide their thinking and design their responses increased both the level and quality of student involvement when discussing the pro and con arguments of NAFTA.

Assumptions

Six years ago I worked with a team of teachers who successfully wrote a grant to create interdisciplinary classes linking literature and social science. An integral part of the proposal was the integration of technology into the curriculum. Therefore, a network of 52 computers in four classrooms servicing approximately 250 students in the 10th, 11th and 12th grades was designed. Each room had Internet access, and a networked scanner, camera and printer. Knowing very little about computers except word processing and the resource of the Internet, the six teachers in the team realized that now the daunting task was to create rigorous and challenging curriculum using the "new" tool we had at our disposal. As the grant paid for teacher planning time, the team developed essential questions to guide the development of the curriculum.

- How can the curriculum be student-centered as opposed to teacher-centered?
- How can the students demonstrate their learning in "real-world" projects?
- How can students SUCCESSFULLY collaborate in cooperative activities?
- How can we involve students in more rigorous academic pursuits?
- How can we help students see the connections between disciplines?
- How can technology help us achieve answers to the other guiding questions?
- What skills, both academic and technological, will be developed at the 10th, 11th, and 12th grades to create a spiraling curriculum that will continue to reinforce previous skills and challenge the students' greater achievement?
- In addition, when we began to create learning activities using technology we asked, "Why does the integration of technology make this activity a more powerful learning experience than more traditional strategies?" We wanted to avoid lots of flash with no substance.

We definitely made mistakes, and some of the early projects are no longer included in our program. However, the questions guided us well as we developed portfolio projects,

Oral Presentations supported by PowerPoint, Virtual Museums, and Internet-based research projects. In the process, I became a technology lead teacher, with a paid preparation period to work with any teacher who wanted help integrating technology as the new Digital High School grant was being implemented at my site.

Problems

I teach in a blocked class of 60 seniors who chose the class because they are attracted by the integration of technology into the curriculum and the interdisciplinary teaching methods. British Literature and Government and Economics are taught together in thematic units so students are frequently challenged to draw conclusions linking the two disciplines. Yet, as I considered the essential questions above, I realized that in the typical classroom discussion, I was actually involving about five to ten students in a lively discussion. Furthermore, I was primarily asking questions of them. They were responding with answers they knew I wanted to hear and occasionally asking me some questions in return. The other 45 to 50 students in the class sat quietly but never entered the discussion or actually pondered the issue being discussed. If I offered "points" I would have a few more students respond but most seemed rather happy and relieved that other more diligent souls were thinking and responding for them. Even more depressing was the fact that the students in my class who were English Language Learners *never* chose to participate in the open forum of the classroom discussion. Therefore, I struggled with the question, "How do I get ALL students, and especially ELL students, engaged in the discussion, wrestling with important issues or concepts?"

I believed that a discussion board might create greater and more thoughtful participation. In a discussion board, one person posts a topic, either in the form of a question or a statement. These statements are called threads. Participants read and reply to the threads and then later return to the board to read other participant's replies and respond to the new posts. Thus, the discussion ensues. Using my Blackboard.com site, an online classroom environment, I developed a discussion board where I posted four threads to which the students were directed to respond. I established a due date when all of the postings should be completed. In addition, I designed a scoring rubric with descriptions of quality responses for the entries, stressing the importance of insight and supporting evidence. Each afternoon I would read current postings, make a note of the content and share general feedback with the students as a whole at the beginning of class the next day. I was not pleased with the results. Only six students posted the first week the discussion board was open. Working under the typical mentality of procrastinating teenagers, most waited until the last minute. The majority only responded to my threads with very little discussion generated. Of the seven ELL students in my class, four responded, but only two responded to all four threads. Two of the ELL students' responses were honest attempts to respond to the threads but the responses did not make much sense due to their lack of English skills. Statements such as "***what people say of the Internet and the democracy and the votes and what people say that they look at in the Internet of Goverment and Democracy***" were posted when students were to respond pro or con to the thread which stated "***Although the Internet's lack of control introduces great risks, especially for children, it is this freedom that increases the Internet's use as a tool for democracy.***"

There were only 97 total responses to four threads with about half of the students participating, even though it was an assignment. While this was a much greater percentage than would have been involved in a class discussion, I was still disappointed. However, I did note that some students who were reluctant to share in class did share some insightful postings. For example, one student who would literally never raise her hand in class to participate in a discussion wrote in response to the same thread above, ***The Internet does lack control and can introduce great risks for children but it is the parents responcability to shelter their children from inappropriate materal. There are programs that parents and imployers can by to block inappropriate material. Becides the Interent is a great scorce for information. In seconds anyone with Internet access can find anything. Like a picture of the Constitution or the Magna Carta. With the continual growth of the Internet people in other countries can see how our democratic nation functions. And with this information it may change people's views of how their own country runs things. The Internet is also a way for people to speek freely with little or no control from the government. This is a good and a bad thing. Some believe that the government should not be able to control what is shown or written on the Internet, because it is a violation of their first amendment right to freedom of speech, and it would be a violation of their fourth amendment right of search and seizure. While others argue that people should let the government control the Internet for security purposes and therefore it would be better for everyone.*** (Misspellings in the posting have not been corrected.) While there are some errors both in the argument and the grammar and spelling, this student was going through a thinking process, synthesizing content learned from class, the text and Internet resources. Nevertheless, there was only "discussion" between my best students, those that would have done the same in class. For example, one student posted ***I agree that the freedoms of the internet pose a great risk when dealing with the credibility of websites, but it is that freedom which allows the internet to contain a wide variety of opinions from all different types of people. It is important for the false information to be seen so that the information can be addressed and the politicians can see how the public reacts to their actions.***

Another student replied, ***ultimately, the Internet has demonstrated many promising avenues towards the expansion of worldwide communication. Approximately thirty-five million americans presently use the internet. The internet could be utilized to help increase the voting participation in America. The internet could be used as an outlet for recruiting voters and debating viewpoints on political issues. The internet provides a place where everyone's voice has the right to be heard. By having the opportunity to hear the opinions of people from "different walks of life", it enables the common citizens to have a broader understanding on the issues and needs of the community. In a democracy, the people have the ultimate political authority. Now it is the people's obligation to use their authority wisely. By obtaining knowledge on what the community needs and what is best for our country, the people can then make decisions on bettering our society. Therefore, the internet is an excellent place for hearing the opinions of people from different places, backgrounds, age levels, etc.***

Proposed Solution

While some of these responses were encouraging, I abandoned the discussion board because the results were not what I had hoped. However, while participating in the TRIP

project (Teacher Researcher Initiative Project) at UCLA, I was introduced to Dr. Bob Bain from the University of Michigan. Dr. Bain discussed the concept of creating "tools" to support the thinking process of students, assisting them to complete tasks they would be unable to successfully complete on their own. I then realized that while I had provided the ***forum*** for students to participate, I had not provided the ***support structure*** for the ***thinking process*** required for this type of activity. Therefore, I began the plan to revisit the discussion board as a learning tool, creating the appropriate supports for the students.

1. I recognized the learning activity must assist students in the acquisition of content and critical thinking skills as outlined by the California State History Social Science Standards. As I examined the standards, I was searching for a topic for which students would be required to assume a particular viewpoint. The California standards require the integration of analysis skills into the content. Particularly, I wanted to focus on helping students to "understand the meaning, implication, and impact of historical events and recognize that events could have taken other directions" (Schools np). Hence, an online debate regarding the effects of free trade zones, specifically NAFTA, seemed ideal.
2. I provided a **graphic organizer** for the students to organize background knowledge about free trade vs. protectionism for their textbook reading.
3. I designed the discussion board **Planning Log** (see appendix) to assist the students to formulate their thinking ***before*** they posted. The **Planning Log** included
   a. clear directions explaining the concept of the discussion board, especially pointing out that a successful discussion board requires students to post and check back regularly in order for the ***discussion*** to occur. Therefore, students could not all wait until the night before the postings were due to post. (Their class calendar then provided guideline dates when students should post to the four threads.) Providing this schedule prevented procrastination while allowing flexibility.
   b. directions explaining the process of navigating the threaded discussion board.
   c. Internet sites to use as a resource which had strong viewpoints or provided evidence regarding NAFTA or free trade. The sites were designed to show the students the variety of viewpoints from a displaced worker, labor unions, a university site providing statistical data and a simple online encyclopedia video clip of President Clinton's comment regarding NAFTA. The students were directed to go to the sites in the order given above, starting with the most emotional response, moving toward more analytical responses, and finally to the video clip of the president. I realized if I would have sent them to the University of Texas site first, students would have been overwhelmed with the data and probably would have not participated. By engaging them emotionally first, they were more willing to tackle the more difficult resources. The order of the resources became a support mechanism itself to enhance student involvement.
   d. directions of the location of the most pertinent data to consider at each website so that the students did not suffer from "info-glut."
   e. a place to write the thread topic.

f. a place to write a summation of the thread detail.
g. a place to plan the student's response
h. a place to list the textual evidence used to support the response either from the text reading, from the website provided, or from the student's own Internet research.
i. instructions to avoid pronouns in order to provide the clearest responses.

After completing this log entry (which in essence "forced the issue" of thinking through the student's thread reply) the student then posted the response.
(In the future I plan to refine this activity by making the log larger, providing more room for planning. Except for the most talented students in my class, students stopped thinking about the subject when they ran out of room on the planning guide!)

4. I also provided the students with sample postings on another topic as a model. In class we pointed out to the students the nature of these thread responses. The samples also served to show students how to appropriately respond to another student's response. However, I need to add to the planning log transitional response guides to assist the students to link to the threads and thread responses as opposed to just making an unconnected statement. Transitional response guides might include, "While I understand your viewpoint regarding ___________(*summarize the viewpoint in the blank*), I think you should also consider _________(*describe the data you believe needs to be considered and why*)." Another guide response would be, "In your response you stated ______________________(*summarize the statement*), but I disagree with you because ____________ (*provide the opinion supported by evidence in the blank*).
5. I provided the students with a revised scoring rubric. The new rubric not only included descriptors of the quality of the responses, but also included the number of postings required of that quality in order to be awarded that score. This was included to encourage students not only to respond to my initial threads but also to respond to each other.
6. I planned to read the postings each afternoon and respond to each student personally.
7. I required each student to turn in the Planning Log. The responses recorded in the Planning Log were the ones that would be scored using the rubric. Therefore, students could not skip the planning process and just "post."

Analysis of Results
With these new student support tools, I began a discussion board on the Pros and Cons of NAFTA. These structural supports radically changed the results for the new discussion board. First of all, there was much greater student participation. There were 240 responses to four major threads. I had almost 100 % participation in the boards.
By responding each afternoon to the postings the students made the previous day, I was able to ascertain a student's level of understanding of that particular subject and provide immediate feedback. For some of the students who were not as apt to participate in a class discussion, I often would not know that they did not understand a concept until I was grading a major project, essay or test. Now I understood where the students needed help and redirected their thinking, clearing up misconceptions before the final

assessment. For example, some students provided responses which led me to believe they thought NAFTA was a *company* sending jobs to Mexico.

Through the discussion boards, I was able to develop a rapport with more reserved students that would never have had an open discussion with me either in a class discussion setting or even after class or at lunch. I announced to all of the students that I would play the devil's advocate, challenging their viewpoints and supporting evidence no matter which side they took. This encouraged them to revisit their postings and see what Mr. Davis had said. This enhanced student participation and thoughtfulness.

While students did attempt to wrestle with the ideas presented them, the postings were not always sophisticated, sometimes lacking insight and sometimes "borrowing" too heavily from a source. For example, one student did not actually defend a viewpoint but simply shared an excerpt from as article when he posted, ***The other firms' NAFTA job creation numbers were not impressive. TRANSMEX/USA, Inc., a transportation logistics management service in Hickory Hills, Illinois, claims to have created 10 new U.S. jobs due to their increased business with Mexico. It is worth noting that the company adamantly maintains that their increased business with Mexico would have occurred with or without NAFTA. Kronos, a producer of titanium dioxide in Highstown New Jersey, claims to have created "about twenty" new U.S. jobs due to their increased business with Mexico since NAFTA.*** This is only about one third of the excerpt he included. To prevent the submission of evidence without creating a viewpoint, next time I will instruct the students to place textual evidence in quotation marks or add lengthy evidence from the Internet as an attachment.

Despite these drawbacks, more students examined the material, planned a response and took part in the discussion than had ever happened with other class activities. Most of the students' postings revealed they had clearly read the required material, drawn some conclusions and offered evidence to support these conclusions. The postings of the two ELL students with extremely low English skills still did not make sense ***but*** they posted regularly. They ***participated*** and I could ***immediately*** understand what they did ***not*** understand and provide appropriate assistance. Their Planning Logs also helped me to evaluate the thinking process they used to reach their conclusions.

After the first two threads, students began to develop their ***own*** threads responding to details of the original topic with statements such as, **What about all the workers?** Then, using the information from the text and the websites in the Planning Log the student posted ***One major point that we are forgetting when it comes to NAFTA are the workers standard of living. With the opportunity for businesses to move to Mexico where they can pay less wages, have poor working conditions, and not abide [by] strict labor & union laws, they hold something over the heads of workers. Business owners can now take advantage of workers because they have what the workers need, money and employment. If business owners are dissatisfied with their employees, they can just pick up and go to Mexico with no consequence.***

As the activity was drawing to a close, I was excited to note twenty-two original threads created by the students including topics such as

- **Is NAFTA fair?**
- **What about all the workers?**
- **Ignoring worker's Rights**
- **Is NAFTA safer than protectism**

- **Free Trade vs. Protectionism**
- **Why is mr. davis making us do this assignment?**

I had not directed them to post their own threads. However, this is where much of the ***discussion*** occurred. In fact, I could not respond individually to the number of postings. In two days there were more than 70 postings. The debate "heated up." At this time, I had to just read the responses and discuss the overall nature of their arguments. How lively and exciting this class time was! I was able to come to my students and share my excitement about the fact that they were taking the responsibility for their own learning, wrestling, each student at his/her individual capability with a current controversial subject. One original thread posted by a student (who was often absent or tried to sleep in class) was **Thread to end all threads: IN CONCLUSION, I THINK WE CAN ALL AGREE THAT NAFTA IS NOT A GOOD IDEA. NAFTA IS CAUSING THE U.S. UNEMPLOYMENT LINES TO GET LONGER AS I SAID BEFORE. WORKERS ARE BEING TREATED UNFAIRLY AND LOOK PASSED AS RYAN AND MELINDA STATED IN THE THREAD "IGNORING WORKERS RIGHTS". AND I BELIEVE MR. DAVIS WAS TRYING TO CHANGE OUR MINDS ABOUT NAFTA BY THROWING THAT LITTLE GRAPH, BUT ALL THAT SHOWED ME WAS MONEY AND THE BOOM BUSINESSES WERE TAKING INSTEAD OF OUR COUNTRY. NAFTA IS JUS A BIG RIP OFF. IT MAY BE A CONSPERICY IN ITSELF AS WELL. I WONDER IF THE BIG COMPANIES ARE GIVING ANY MONEY TO THE GOVERNMENT? BECAUSE YOU KNOW THE GOVERNMENT HAS TO BE TRYING TO BENEFIT SO WAY FROM THIS. THIS IS THE UNITED STATES GOVERNMENT WE'RE TALKIN ABOUT HERE. THEY ALWAYS GOT SOMETHING UP THEIRE SLEEVES.** (Capitalization is student's) When I read his posting, I knew he had finally awakened! The post was not exactly the most persuasive argument or thoughtful conclusion. Nevertheless, one of my ELL students replied, **I don't think that Mr. Davis was trying to change our minds about NAFTA, but more to use our minds to make our own judgement and to see the pros and cons of NAFTA. All in all, I do agree with you in the aspect that NAFTA isn't doing much for the economy or for the American people. It's more just to benefit the businesses.** This statement, along with others, helped me to realize that while the discussion board had not produced flawless understanding or arguments, students were researching viewpoints, participating in discussions and giving and receiving feedback from both fellow students and me. The discussion board was a part of the journey to a better understanding of the complexity of the topic. I was gratified with the results of this second attempt at using the discussion board as an instructional tool. With the revision noted earlier, I plan to revisit this strategy next year.

Appendix

The Challenge and Adventure of the Discussion Board

The **Discussion Board** allows the opportunity for ALL students to participate in an intelligent, professional conversation about viable topics. In a traditional classroom setting, this conversation would be the domain of a few uninhibited, extroverted, or "quick-thinking" students. However, "quick-thinking" is not always the best thinking. The evaluation of significant ideas takes careful thought and requires evidence to support the arguments. Furthermore, some students have relied on other students to "carry the thinking load" for them, rarely engaged in thought provoking discussions themselves. The **Discussion Board** *requires* that *all* students participate.

PLANNING LOG

This type of professional conversation, either virtually or face to face, where ideas are probed and examined will be crucial in both the career and college arenas.

For a discussion board, you will need to take a position and support your argument with evidence. You may agree or disagree with the posting OR offer an alternative interpretation. Just remember to SUPPORT your argument with EVIDENCE.

The evidence can be found in the text readings, the online readings OR if you are really ambitious, your own research! You will use the following form to plan your postings and keep a log.

To begin your "Blackboard.com" Discussion you must access the CARTA 12 class at Blackboard.com.

- *From home or DHS computers*: Access the Internet. Then type in http://blackboard.mvusd.k12.ca.us Then go to the CARTA12 site.
- *These directions are in Assignments, where the links are live.* You do not have to type them in
- Then, click on **Communication.**
- Then, click on **Discussion Board**

Overall Topic International Trade

- Free Trade or Trade Restrictions. BEFORE posting read pages ___ to ___ in the textbook
- Read the article at http://stopftaa.org/info/info_publiccitizen.html
- What does the author of the article believe about NAFTA and the FTAA? What is the evidence that the author claims is the reason for these beliefs?
- ____________________
- ____________________
- How would the authors of the text respond? (Support your answer by quoting textual evidence)
- ____________________
- ____________________
  - **Discussion Thread One OR Response to DT#1**: (list the thread or response)
  - ____________________

    ____
    - Discussion Leader: ____________________
    - Plan your response in the space below
    - Write your discussion response generalization or judgment:

    - Your "textual" evidence either from the text or article.

- Free Trade or Trade Restrictions. BEFORE posting read pages ___ to ___ in the textbook.
- Read the article at http://www.aflcio.org/news/2001/0419_ftaa.htm
- What does the author of the article believe about NAFTA? What is the evidence provided for these beliefs?
- ____
- ____
- How would the authors of the text respond? (Support your answer by quoting textual evidence)
- ____
  ____

  - **Discussion Thread Two OR Response to DT#2**: (list the thread or response)
  - http://www.aboutglobalization.com/
  - ____
  ____
    - Discussion Leader:________________________
    - Plan your response in the space below
    - Your Discussion response generalization or judgment:

    - Your "textual" evidence either from the reading or news events.

- Free Trade or Trade Restrictions. BEFORE posting read pages ___ to ___.

- Read the article at http://www.citizen.org/pctrade/nafta/reports/jobs97.htm Read down only to the part of the article discussing Zenith's partial compliance to create new jobs.
- What does the author of the article believer about NAFTA creating new jobs? Why?
- ____
- ____
- How would the authors of the text respond? (Support your answer by quoting textual evidence)
- ____
- ____

  - **Discussion Thread Three OR Response to DT#3**: (list the thread or response)
  - ____

  ____
    - Discussion Leader:______________________________
    - Plan your response in the space below
    - Your Discussion response generalization or judgment:

    - Your "textual" evidence either from the reading.

- Free Trade or Trade Restrictions. BEFORE posting read pages ___ to ___.

- Examine the graph at http://lanic.utexas.edu/cswht/tradeindex/
- What does the article and data seem to reveal about NAFTA's benefits for trade and the economy? Why?
- ____
- ____

___

- How would one of authors of the previous two articles respond? (Support your answer by quoting textual evidence)
- ____
- ____
    - **Discussion Thread Four OR Response to DT#4**: (list the thread or response)
    - ____

      ____
        - Discussion Leader:______________________________
        - Plan your response in the space below
        - Your Discussion response generalization or judgment:

        - Your "textual" evidence either from the reading.

- Free Trade or Trade Restrictions. BEFORE posting read pages ___ to ___.
- Listen to President Clinton's speech (or read the transcript—scroll down) http://encarta.msn.com/find/MediaMax.asp?pg=3&ti=761579853&idx=461519503
- What did President Clinton believe about NAFTA's benefits for trade and the economy? Why?
- ____
- ____

___

- What support would you find for this belief in the University of Texas site? (Support your answer by quoting textual evidence)

- ____________________
- ____________________
  - **Discussion Thread Four OR Response to DT#5**: (list the thread or response)
  - ____________________

____

- Discussion Leader:____________________
- Plan your response in the space below
- Your Discussion response generalization or judgment:

- Your "textual" evidence either from the reading.

INSTRUCTIONS FOR

✓ Click on the Thread shown in red.

✓ Click on **RE: Reply** just underneath the **Message.**

✓ Type in the **Subject** by analyzing the key words in the question.

✓ In the **Body Box**, type in your response that you have planned. You *always* explain WHY you have made that statement with EVIDENCE. (Avoid beginning your answer with statements such as "Well, I think or "In my opinion")

✓ Then, scroll down and click on **Post Message**.

✓ Remember, you do NOT have to respond to the main thread but to a response. You must be courteous and professional or you will get a ZERO.

✓ To do this, scroll down to **Thread Detail:** you will see other responses and can reply to them.

✓ Continue to revisit the different postings and add your significant *documented* insights while building upon the other student's answers. *Just listing data from your text WITHOUT a generalization will not fulfill this activity's requirements.* SEE RUBRIC.

✓ **REMINDER: This is a professional forum for the exchange of important ideas supported by evidence. You must post relevant, significant data at all four sites. DO NOT post greetings or other messages of any sort.**

SAMPLE POSTINGS on a different topic:

Subject: The Great Depression's Effect on the American Family
Thread: How was the Great Depression's effect on the American family reflected in the literature about the period?
In the play, Tennessee Williams paints the ultimate picture of the dysfunctional family. For example, the daughter Laura has not just been crippled physically by her disease, but has been crippled emotionally due to the father's abandonment of the family and her mother's own inability to realistically cope.

Reply to post: The role model that Laura had from her mother was to escape into the past. Amanda escapes to her girlhood in Blue Mountain as evidenced by her "beau" stories and the dress she wears when the "gentlemen caller" for Laura comes to dinner.

Reply to post: Laura follows her mother's lead by escaping into the records left by her father, and her glass menagerie.

Reply to post: Tom also follows his mother when he escapes to the movies. But his father has had an even greater impact on Tom. Tom drinks, as learned from his conversation with Laura in Scene 4 and will ultimately try to escape completely by doing just what his father did, abandon the family.

Rubric for Discussion Boards

A

- Student clearly and directly addresses all posted topics.
- Student responses are thorough, yet concise, revealing insightful analysis and/or critical thinking.
- Student supports responses with relevant and specific textual evidence.
- Student posts a minimum of 10 times responding both to the initial thread and another student.

B

- Student clearly addresses all posted topics.
- Student responses are complete, yet concise, revealing some analysis and/or critical thinking.
- Student supports responses with specific textual evidence.
- Student posts 8 times responding both to the initial thread and another student.

C

- Student addresses all or most posted topics but not less than 3.
- Student responses are complete but show little evidence of analysis and/or critical thinking or may just share textual evidence without drawing generalizations or judgment.
- Student supports responses with textual evidence though may rely solely on generalizations or blanket statements.
- Student posts 5 times responding to the initial thread.

Does not meet Standard—no credit

- Student addresses all, most or some posted topics.
- Student responses are incomplete and/or literal, relying on generalization without relevant evidence.
- Student attempts to support responses with some evidence. May be sporadic or simply a list without establishing relevancy.
- Student posts less than 5 times or postings are inadequately developed as described above.

Does not meet Standard—no credit

- Student addresses all, most or some posted topics.
- Student responses indicate lack of preparation or effort and/or lack of understanding of the requirements of the assignment.
- Student may or may not support responses or offers "blanket statements" or data without establishing relevancy.
- Student posts less than 4 times or postings are inadequately developed as described above

Works Cited

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Key Words

Discussion Board
Support tools
Planning guide
Classroom discussions
English Language Learners

Online Professional Development:

Building Administrators'Capacity for Technology Leadership

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Abstract

This research examined changes in administrators' ideas about technology integration and technology leadership while participating in an online professional development course. Eight administrators, enrolled in a semester-long course, participated in 16 discussion forums related to k-12 technology implementation issues. Pre- and post-course surveys indicated significant changes in ideas about technology integration as well as methods used to support teachers' integration efforts. Analyses of interview and course discussion data suggest that administrators view technology leadership as a "shared responsibility" that requires both administrative skills and technical knowledge.

Online professional development:

Building administrators' capacity for technology leadership

In 1997, the President's Committee of Advisors on Science and Technology (PCAST) suggested that in order to achieve effective use of computers in schools, a ratio of four to five students per computer was needed. Now, just a few years later, this ratio has been attained. According to recent reports from Market Data Retrieval (Education Week, 2001), in the year 2000, the student-computer ratio in U. S. schools dropped to an all-time low of 4.9 to 1, with 60% of the available computers now connected to the Internet. Given this increased access, expectations for both teacher and student use have increased as well. As Dickard noted (Education Week), "We have blasted ahead in computer penetration in the last few years. The real challenge now ... is using the infrastructure to maximize impact" (p. 47).

In response to these changing expectations, efforts to provide professional development for teachers are increasing. According to Flynn (Education Week, 2001), "Across the board, the level of conversation around professional development is certainly more of a focus now than just talking about hardware and infrastructure" (p. 50). Latest figures from Market Data Retrieval (Education Week) support Flynn's contention, indicating that funding for professional development increased by 3% between 1999 and 2000 with approximately 17% of schools' technology budgets now being

spent on staff development. Although these figures still fall below recommended levels, nearly 90% of teachers surveyed by the National Center for Education Statistics (NCES, 2000) indicated that a variety of professional development activities were available and that they participated in them.

Yet, despite these increases in resources and training opportunities, teachers are still struggling to achieve high levels of integration (Becker, 2000; NCES, 2000). While it is necessary to provide teachers with access to technology and ongoing opportunities for professional development, these conditions appear insufficient to support the kinds of changes that integrated technology use seems to demand from teachers. Although Cuban (1993) claimed that the use of computers is incompatible with the traditional requirements of teaching, others have argued (Becker, 1994, 2000; Dexter, Anderson, & Becker, 1999) that if computers are placed within supportive school cultures teachers can, and will, maximize their potential. While a strong infrastructure will be necessary to *initiate* technology into the school culture, strong leaders will be necessary to *promote* and *sustain* it. Abundant access and ongoing training will not lead to effective use if teachers are not encouraged, or expected, to use computers in meaningful ways. Without a doubt, strong leadership is critical (Anderson & Dexter, 2000).

Few educators today would argue with the notion that the principal plays an important role in facilitating technology use in the schools. According to Crystal (2001), building administrators are the "nexus through which all issues flow" (p. 36). Yet many of our administrators are novice technology-users and have gained little experience or training in the knowledge and skills needed to be effective technology leaders. Even though administrators *understand* the importance of implementing and supporting technology use in their schools, the development of technology leadership skills seems to have been left almost completely to chance. According to Mehlinger and Powers (2002), "Graduate school programs generally are doing a poor job in preparing school principals and superintendents to be technology leaders" (p. 218). Since it is possible to obtain a principal's license without knowing anything about technology, how, then, are our administrators expected to develop these critical skills? What type of leadership role should they be prepared to take and what exactly do they need to know?

According to Schmeltzer (2001), administrators will need a broad set of experiences in order to be effective technology leaders. Above all else, these experiences should help them develop (1) an understanding of how technology can improve instructional practices, and (2) a repertoire of strategies for supporting teachers' efforts to use technology in the classroom. In short, they need both a *vision* and a *plan* to achieve it. According to Strudler and Wetzel (1999), these two characteristics are what *define* a technology leader: "At the core of informed leadership is a person who has internalized the complexity of effective technology integration [i.e., knows what it looks like] and who exercises influence [i.e., provides support] to ensure that the various enabling factors are in place" (p. 68, parenthetical comments added).

Sergiovanni (1999) outlined five potential roles that leaders assume within school settings including management engineer (focused on technical, organizational aspects), human engineer (focused on human relation supervision and conflict management aspects), clinical practitioner (focused on professional and pedagogical aspects), chief (focused on symbolic and visionary aspects), and high priest (focused on values, beliefs, and cultural aspects). Although Sergiovanni described the first three roles as essential to achieving *competent* schooling, the symbolic and cultural leadership roles were considered essential to achieving *excellence* in schooling. Because school culture governs group values, as well as norms, expectations, common meanings and shared assumptions, a cultural leadership role seems best suited to creating the type of environment, advocated by Becker (1994, 2000) and his colleagues (Dexter et al., 1999), as required for sustained technology use. As Duttweiler and Hord (1987) stated, "... in addition to being accomplished administrators who develop and implement sound policies, procedures, and practices, effective administrators are also leaders who shape the school's culture by creating and articulating a vision, winning support for it, and inspiring others to attain it" (p. 65).

Unfortunately, there is very little research delineating best practices for preparing administrators to be technology leaders. Until recently, professional development efforts have generally focused on the needs of the classroom teacher, with little attention paid to administrators' needs. Most school administrators have acquired their technology knowledge and skills on the job, with

occasional training provided by assorted vendors, professional organizations, and, to a lesser extent, colleges and universities (Mehlinger & Powers, 2002). However, initiatives by both private (e.g., Bill and Melinda Gates Foundation; California School Leadership Academy) and professional organizations (e.g., Institute for the Transfer of Technology in Education; National Association of Elementary School Principals Leadership Academy) have recently been designed to address leadership-training needs. Furthermore, a national collaborative has drafted a set of six technology standards for school administrators (TSSA, 2001) that can guide the redesign and/or development of new graduate courses and training experiences.

Colleges and schools of education have also started to consider ways to address the technology needs of administrators, most commonly by adding or modifying courses within their school administration programs (O'Neill, 1999). For example, Georgia State University recently redesigned its beginning leadership course, required for students in school administration, to simultaneously introduce students to technology issues and to the fundamentals of leadership (Mehlinger & Powers, 2002). An ongoing challenge with this approach, however, is maintaining a balance between leadership and technology issues. Given the number of issues that need to be addressed in both areas, innovative approaches will be needed if administrators are to gain the pedagogical, as well as the technical, knowledge and skills needed.

Purpose of the Study

This study was designed to examine changes in administrators' knowledge and skills, related to technology integration and leadership, as they participated in a semester-long online professional development course. By requiring administrators to *use* technology to *examine issues* of technology leadership, we hoped to support the development of administrators' ideas related to technology leadership, while simultaneously building their confidence and competence related to technology skills. Specifically, the questions guiding data collection and analysis included:

- What are administrators' ideas about technology leadership and how do these ideas change while participating in an online professional development course?
- What knowledge and skills do administrators need to affect technology leadership in

their schools and to what extent can participation in an online professional development course build both knowledge and skills?

Methods

Overview

We gathered both quantitative and qualitative data to examine changes in the knowledge and skills of eight administrators enrolled in a 3-credit course, *Integration and Management of Computers in Education*, during the fall semester of 2001. This course was one of two courses that participants were required to take during their first semester in the university's cohort doctoral program in school administration. Although cohort students had been required to take this course in the past, this was the first time the course was offered completely online. Furthermore, this was the first time the course enrolled only administrators; previous offerings of the course included a mix of administrators, undergraduate pre-service teachers, graduate in-service teachers, and graduate students in educational technology. Having a homogenous audience in the course allowed for a more extensive focus on technology leadership issues than had been possible previously.

Description of Course and Participants

All eight administrators agreed to participate in the study. Participants included two females; four participants were assistant principals, three were principals, and one was a district-wide instructional technology coordinator. Teaching experience ranged from 3 to 18 years, with an average of 7 years, while administrative experience ranged from 2 to 8 years, with an average of 4 years. At the beginning of the course, participants had varied levels of technology skills. Seven of the 8 administrators had completed at least one technology course during their previous degree programs, yet this was the first course any had taken that specifically dealt with technology integration or leadership issues. Most participants ($n = 6$) indicated that they used e-mail "as an integral part of their lives," yet only 3 indicated previous experiences with bulletin boards, while only 4 had used chat rooms previously. In general, participants described their uses of technology as being limited to "word processing and surfing the Web." None of the participants had previously taken an online course ("WebCT is completely new to me, as well as chat rooms and message

boards."). Participants expressed some initial uncertainty about learning via an online approach ("At this point, I am still uncomfortable using this type of technology to communicate.").

The 3-credit course was designed to help administrators gain both the competence and confidence needed to facilitate and support effective learning environments supported by technology. Participation in the course comprised a variety of virtual interactions and discussions and incorporated three primary strategies (modeling, reflecting, and collaborating) that, based on previous research, were judged to be effective in supporting teacher and school change. For example, participants observed (via the Web and CD-ROM) a number of model teachers, engaged in ongoing reflective conversations, and collaborated with each other for the completion of various course activities. As a cumulating activity, each participant created a WebQuest that they planned to implement with their building teachers during the spring, 2002.

Role of the Researchers

The research team consisted of a faculty member and seven graduate students enrolled in an advanced educational technology research course at a large midwestern university. Students had varied background experiences, in both corporate and postsecondary contexts, and were seeking masters ($n = 2$) or doctoral degrees ($n = 5$) in educational technology. The team worked collaboratively to design the study and develop data collection instruments. Each researcher then took primary responsibility for collecting and analyzing both discussion board and interview data from one participant. Group discussions, related to both quantitative and qualitative data analysis, allowed for pattern-finding and consensus building. Consistency of the research method was increased by agreement on recorded data collected by the research team. Multi-method strategies were used to increase the design validity by allowing triangulations at various stages of data analysis.

Data Collection and Analysis

Participants completed three online surveys at the beginning of the semester. These related to 1) previous experiences with technology applications, 2) specific ideas about technology integration, and 3) current technology practices within their schools. The first survey (15 questions) gathered

information about participants' current positions, previous uses of computers, and comfort with specific technology applications (e.g., chat rooms, discussion boards). The second survey (10 items) examined administrators' perceptions of how well they could conceptualize and define various components of technology integration. Survey items were presented in a Likert-style format; participants rated their level of agreement (from 1-strongly disagree to 5-strongly agree) with statements related to the possession of specific ideas regarding technology use (e.g., "I have specific ideas about how to define teacher/student roles in a technology integrated classroom."). The third survey, comprised of 44 items, examined the technology practices of both the administrators and teachers within the participants' school environments. Although this survey provided important information about the contexts in which our participants worked, not all items were relevant to our research questions (e.g., "Teachers' technology use is focused on student productivity." "Internet access is available in all classrooms."). However, 13 items, representing two subscales, were particularly relevant. One subscale (6 items) examined administrators' personal uses of technology (e.g., "I use technology to support lectures and/or professional development.") while the other subscale (7 items) asked the administrators to rate the extent to which they supported *teachers'* efforts to use technology (e.g., "I give individual feedback to teachers during technology use."). On a scale from 1 (entry) to 4 (proficient), administrators rated their current levels of practice. The second and third surveys were completed again at the end of the semester in order to measure changes in administrators' ideas about, and strategies for providing, technology leadership in their schools.

Cronbach's alpha was used to measure the internal consistency of the survey instruments. Calculated Cronbach alphas were .88 on the second survey (Ideas survey), and .77 and .70 on the two subscales of the third survey, respectively, suggesting that the instruments were moderately reliable.

In addition to survey data, all assignments (including the completed WebQuests) and discussion board postings (917 total messages) were used as data. Weekly discussions included, among other topics, administrators' reflections on their current visions for technology use in their

schools; roles they play in supporting high-, medium-, and low-level technology users; strategies for supporting teachers' early efforts; incentives and barriers to technology use, and so on. Weekly electronic chat sessions, focusing on issues of technology leadership, were also recorded for analysis purposes. During the 12th week of the semester, during a scheduled campus meeting for their other cohort course, all administrators participated in an in-depth interview that was tape-recorded and later transcribed. Questions built on earlier survey responses; we examined participants' current ideas about technology leadership and probed for any changes that may have occurred during the course (e.g., What does it mean to you to be a technology leader in your school? How have your ideas about technology leadership and technology integration changed since the beginning of the course?).

Data analysis began during the first week of the course and continued throughout the semester. Both quantitative (descriptive statistics and paired *t* tests) and qualitative (pattern seeking) analysis methods were used to determine the extent to which the online course offered a viable method for increasing administrators' understanding of, and capacity for, technology leadership.

Results and Discussion

Perceptions of Technology Leadership

Participants were asked to define technology leadership and to describe the skills and knowledge needed by a technology leader. In general, administrators defined technology leadership as the methods they, and others, use to encourage and support teachers' technology use. Similar to the description provided by Strudler and Wetzel (1999), participants indicated that strategies such as visioning, modeling, and coaching were key to being an effective leader. Although all 8 of the administrators believed that they, themselves, played the role of technology leader in their schools, most participants noted that they shared this role with others, either their technology-using teachers, the technology coordinator, or some other person in the school. As one elementary principal noted:

> I would not say I was the leader. I am more of a cheerleader. I view my role as a role model but also as a cheerleader who focuses teachers on what is the best. I have the opinion that I should not be the smartest person in the building, that it should be the teachers who are the

best resources. And that, thankfully, in my school, certainly is the case.

Carr (1995) refers to this style of leadership as participatory, suggesting that power and control are shared, at least to some degree, among constituents. This participatory style was commonly discussed, and agreed upon, by the administrators in this course. Although they believed that they, themselves, needed to initiate and support the technology integration efforts in their schools, they felt that others shared responsibility for seeing these efforts through: "I think it's ultimately my role ... but then we're all in this together. It's a building effort; it's something we all need to take responsibility for."

This perception of technology leadership as a shared responsibility may also reflect, to some extent, our participants' lack of technical expertise, as well as their relative unfamiliarity with classroom integration issues. This inexperience may have forced them to depend on others' technical knowledge as well as their teachers' classroom efforts to model a vision of meaningful use as well as inspire others to attain it. Still, all 8 administrators recognized the need to be strong role models:

> Technology leadership is defined by how well the instructional leaders of the building model the use of technology. I don't think I am going to be an effective leader if I am not using it myself. Now obviously there are some ways teachers are going to be able to use it differently than me, but I think as administrators we need to model.

Changes in Perceptions of Technology Leadership

Prior to taking this course, few of the participants had given much, if any, thought to their roles as technology leaders; technology leadership was not part of their daily conversations. For example, a high school assistant principal commented:

> I never even really knew that there was such a thing as technology leadership. And I guess I didn't know that it should come from the administrator. I thought, 'That's why they have a technology coordinator' but now I can see the importance of technology leadership...it's got to come from multiple sources.

By the end of the course, all of the administrators noted that they had gained ideas relevant to

being effective technology leaders; that is, they believed that they had increased both their understanding of technology integration as well as their knowledge of specific strategies needed to support teachers' efforts. "I feel that this class is leading more towards understanding how to integrate technology and how to facilitate that with staff." As one middle school principal inquired, "How can you lead by example if you don't understand the full potential of technology?" Another middle school principal described how his ideas had changed:

> When I entered the class I was unclear about the proper integration of technology. I would encourage teachers to use the Internet, drill and skill software, and word processing. Other than that, I did not have a good handle on the many possibilities. Since then I have really begun to better understand the use of technology in the classroom ... (I have also gained) the techniques and confidence to lead the staff as a technology leader in the building. It is something that I had not been very concerned about prior to this class.

Perceptions of Knowledge and Skills Needed by Technology Leaders

When asked what knowledge and skills they needed to be effective technology leaders, participants mentioned the need to be models for their teachers, but were unsure if they needed to know *more* than their teachers in order to be effective. For example, one principal explained:

> I don't know how to teach all the math and how to teach all the English and social studies. What I do know is how to work with those teachers to help them focus on areas that they're strong in. And I don't think I need to learn everything about technology to be an effective technology leader.

Similarly, another principal suggested that a good technology leader identifies the exemplary users in his school and then "gets out of their way." However, another principal disagreed, "Obviously, in order to have technology leadership in this building and in education, first, you have to model that. " Another principal suggested that he "had to believe in it, had to use it, and had to model it." Certainly, the administrators agreed that they needed to have enough knowledge to hire the right people, to acquire the best resources, and most importantly, to know what good technology integration looked like so that they could encourage their teachers to continue to grow. In addition,

they agreed that they needed to know how to evaluate their teachers' technology efforts. Still, according to one assistant principal, "These skills are just good leadership skills, not necessarily technology knowledge skills. These are people skills, management skills."

Administrators agreed that an online course, focused on technology integration and technology leadership, filled an important need for practicing administrators. By requiring them to "live and breathe technology" they increased their own skill levels. As one elementary principal noted:

> The course design is inculpable... It has been unbelievable ... even to gain knowledge about technology, (I have) to use technology... and I am forced to communicate with my cohorts in this class through technology ... In this technology class, every single thing that I have done, every movement I have made in this class, has related to technology.

Given this increase in their own skills levels, the administrators also increased their expectations for their teachers. A high school assistant principal noted:

> The whole WebQuest concept has changed the way I talk to teachers about integrating technology into their classrooms... It's opened up ideas now that I can share with teachers in all subject areas ... it helps not only to think about uses of technology, but use of technology in various courses.

By developing a strong personal vision of technology integration, the administrators now believed that they could, in turn, support the development of their teachers' visions.

Developing the Skills and Knowledge of a Technology Leader via an Online Course

In order to determine the impact that this online professional development course had on the development of administrators' technology leadership knowledge and skills, pre- and post-course survey results were compared. A two-tailed paired t test ($df = 7$) indicated a significant increase in administrators' ratings of perceived ideas about technology integration (survey 2) from pre- to post-course ($t = 3.81$, $p = .007$). Average ratings increased from 3.7 (undecided-agree) to 4.0 (agree). This suggests that, as the course progressed, administrators gained ideas about what technology integration should look like, as well as how technology might be implemented within various classroom contexts (e.g., one-computer classroom; in support of content-learning). Given

that administrators play a key role in establishing a technology vision for their schools, as well as evaluating teachers' efforts toward achieving that vision, it is critical that they gain specific ideas about effective technology use. These ideas, then, represent an important component of being able to both lead and support teachers' efforts.

Although no significant differences were noted from pre- to post-course ($t = 1.19, p = .14$) on the first subscale of survey 3 (administrators' personal uses of technology), average ratings of competency on the second subscale (administrators' support of teachers' technology use) increased from 2.0 (emergent) to 2.4 (emergent-fluent). This increase was significant ($t = 2.82, p = .01$). Thus, as the administrators participated in weekly discussions, focused extensively on technology support issues, they were able to identify and implement new ways to support technology use among their teachers. As one principal noted:

> Taking this course has brought technology to the forefront for me ... it's something that I discuss more with teachers ... I have started conversations with them about what they can do to help bring more technology into their classrooms. I ask them what are some of the things they need in order to accomplish the things they are thinking about. This course has helped me to go out of my comfort zone and to do a paradigm shift in my thinking on instructional practices in the classroom.

Ongoing discussions with the administrators suggest that this approach to professional development may be an effective way to increase confidence for, and ideas about, technology leadership. Administrators also agreed that the course increased their understanding of how to support technology use among their teachers, as noted by this assistant principal:

> (When I was a teacher) I did not have any training on how to effectively integrate technology in my classroom. Actually this is the first course that I have had that teaches how to integrate technology. Too bad I am not a teacher anymore. At least after having taken this class I will have an idea of how to assist someone in integrating technology.

Limitations and Directions for Future Work

Besides the small number of participants and the relatively short timeframe within which the

research was conducted, additional factors may limit the impact of this study. For example, because we did not have a control group, we are unable to determine the exact cause of changes in participants' ideas and support practices. Furthermore, although administrators described changes in their ideas about technology integration and leadership and reported that they developed specific ideas about how to support their teachers, it is unclear whether they will actually apply these ideas in practice. It would be useful to revisit these administrators after a year's time to determine the extent to which their ideas have been implemented and to identify other issues that may impact technology leadership as it is practiced in schools.

Educational Significance and Implications

The results of this study suggest that participation in an online course, focused on technology integration and leadership, offers one means to increase administrators' understanding of the complexity of the integration process and to advance their use of effective support strategies with their teachers. The participants noted that the course had increased their technology skills while also changing their ideas about how to support meaningful uses of technology in the classroom.

The administrators in this course described both benefits and challenges to taking a course that met entirely online. Specifically, participants valued both the synchronous (chat) and asynchronous (discussion board) interactions with their peers and agreed that the discussion of relevant issues, along with the completion of relevant assignments, were the most meaningful aspects of this course. Whereas this type of course format provided the flexibility needed to fit the course requirements into their already busy schedules and enabled them to avoid a lengthy drive to campus (from 1 - 3.5 hours, one-way), they still described limitations to this approach. Online communication can become overwhelming in terms of the amount of reading and writing that is required. Our participants, especially, found it difficult to complete group work and suggested that these types of requirements be limited or modified in such a way that individuals could complete separate pieces of a project, on their own, prior to combining them into a group project. In addition, trying to learn technology skills at a distance can be complicated and, perhaps, unnecessarily frustrating. Our participants all suggested that a few face-to-face, hands-on work sessions would have been useful

supplements to our online work. These are important considerations to keep in mind when preparing to offer this or similar courses in the future.

Conclusion

Schmeltzer (2001) noted that: "while bringing administrators up to speed on technology—and providing ongoing training—may seem like a massive task, designing a course that addresses technology in the context of leadership and management is a good place to start" (p. 22). Based on the results of this study, requiring administrators to deal with technology issues as part of their ongoing course participation allows them to experience, first-hand, both the benefits and challenges of dealing with technology in a meaningful and substantive way.

According to Mehlinger and Powers (2001), "It is no longer possible for administrators to be both naive about technology and be good school leaders" (p. 218). Yet, to date, the professional development needs of the administrator, as a technology leader, have been virtually ignored. Despite the large amount of time, money, and resources being directed toward supporting *teachers*' efforts to integrate technology in the classroom, little has been done to either recognize or support the needs of the administrator. "Clearly, it is not reasonable to imagine that teachers, the 'followers,' are going to get very far ahead of the 'leaders,' their administrators" (Mehlinger & Powers, p. 213). The results of this study highlights the importance of the administrator in helping schools achieve sound technology practices, and proposes one strategy (participation in an online course) for increasing administrators' capacity for technology leadership.

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Faculty Technology Professional Development: A Pedagogical and Curricular Reform Model

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Key Words: faculty development, project-based learning, instructional technology

Abstract
A technology professional development project with sixteen arts and sciences and education faculty members engaged in the preparation of preservice teachers served as the vehicle for pedagogical and curricular reform. The objective of the project is to change the teaching and learning of preservice teachers through the adoption and integration of instruction technology by teacher educators. The barriers and supports to meaningful and appropriate inclusion of instructional technology by faculty were identified from data collected via qualitative and quantitative methods during a single academic year at an urban, public college. Barriers included bureaucratic obstacles, cultural features of professional programs and elements indicating individual resistance to change. Components of the professional development that facilitated pedagogical and curricular reform included the use of support teams, a project bulletin, and on-site, just-in-time technology support.

Background

At the start of the 21st Century the information age continues and the reliance on technology, especially digital technology is evident. From automobiles to cellular phones to PDAs to package delivery, computers are common features of contemporary life. Instant messaging, surfing the Internet and e-commerce pepper our vocabulary. Similarly, education at all levels is undergoing a transition as vast amounts of hardware, software and Internet connectivity proliferate throughout learning environments. According to the National Center for Educational Statistics in 1999, 95% of all public schools had access to the Internet, ranging from 94% of elementary schools to 98% of secondary schools.

Bridging the digital divide

Less the statistics indicate that the technology diffusion and penetration is complete, only 62% of instructional rooms have Internet access in public schools (NCES, 1999). Approximately 54% of students have the Internet available to them on a regular basis after regular school hours, ranging from 46% of elementary students to 80% of secondary school students (FRSS 79, 2000).

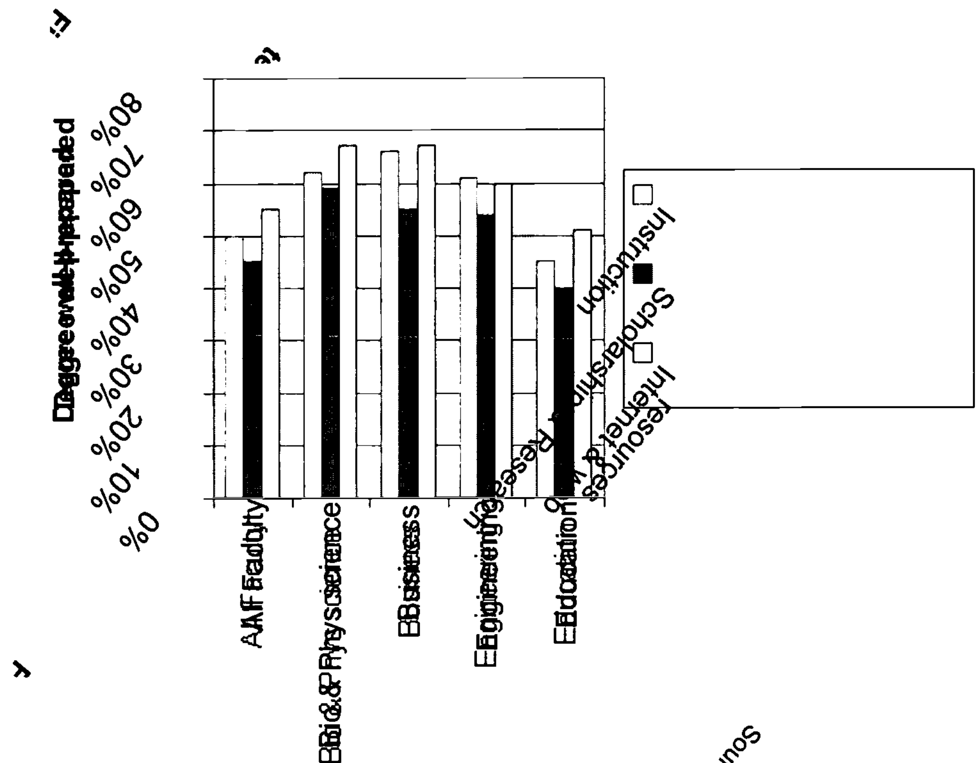
In higher education the goal of a "computer on every desk" has expanded to high-speed communication technologies, multimedia offerings, networked campuses and web-based instruction and learning. In a recent survey of higher education administrators in response to the question, "How well prepared are faculty members for using technology as a resource?", Cleary and Lee (2002) found that, on average, faculty members were better prepared for Internet and web resource uses than they were for instructional or scholarship and research uses of technology. There were differences in preparedness across the three areas among faculty in different disciplines. Unfortunately, in each instance teacher educators were below the average for all faculty (Green, 2001).

(Insert Figure 1 here)

Why is it difficult to engage teacher education faculty in the use of technology?

There can be many barriers to faculty adoption of instructional technology, including bureaucratic, cultural and psychological ones. Many identify bureaucratic or organizational factors as primary obstacles to the effective incorporation of technology in teacher education. For example, Abdal-Haqq (1995) suggests that organizational barriers are important including: 1) limited availability of hardware; 2) lack of faculty training; 3)

lack of instructional and technical support staff; 4) lack of faculty time to gain mastery in hardware and software; 5) lack of faculty time to translate technology knowledge and



skills to a specific course or curriculum content; and 6) lack of software and other materials appropriate for preservice teacher education curricula. Similarly, Wedman and Diggs (2001) suggest that technology use in teacher education is limited when performance is not the main focus. Their "performance pyramid" model identifies "tools, processes and facilities" as one of the required components for faculty modeling technology use in teaching. As a result of these barriers in teacher education, traditional instructional technology teaching is more likely to focus on learning *about* technology rather than learning *with* technology (Office of Technology Assessment, 1995). Another challenge to technology adoption is the culture of teacher education programs. The culture may be characterized by skepticism about the utility and efficacy of new

technologies in the teaching learning process (Abdul-Haqq, 1995; Campoy, 1992). For example, in one study methods faculty utilized more traditional technology approaches in instruction like word processing, web-based student assignments, and email communication. Other technology tools, data bases and spreadsheets, which are more likely to engage higher order thinking skills and problem solving strategies, were less likely to be a part of their pedagogy (Brown, 2001). It is sometimes the case that faculty will use technology for instructional purposes to streamline instruction and assignments rather than to enhance the learning and performance processes in their teacher candidates (Blanco, 1996). Finally, the lack of clear programmatic goals for teacher education in general and technology in particular can hinder the use of instructional technology in pedagogical and curricular reform (Abdul-Haqq, 1995).

There also may be debates in teacher education about the proper placement of instruction about technology (Mehlinger & Powers, 2002). Should the knowledge and skills be developed in isolated courses with technology experts as instructors? Should infusion knowledge of technology, modeling of instructional uses and required teacher candidate performance occur across the curriculum under the supervision of diverse faculty? Or should some combination of the two extremes be available?

The presence of incentives for technology-driven pedagogical and curriculum reforms is another feature of the culture of teacher education. The incentive can include monetary compensation, released time, and inclusion in the promotion and tenure process (Lan, 2001). The use of technology in the routine administration, management and assessment activities can create a climate supporting technology adoption and integration in pedagogy. While this may not be an overt incentive, the use of technology becomes part

of the demand characteristics of carrying out normal academic business. These context factors form part of the foundation for ongoing infusion of technology in teacher education programs according to Stevens and Lonberger (1998).

The final set of barriers to technology use in teacher education is psychological and is related to resistance to change. While it is the case that in any organization a small percentage of individuals will eagerly adopt and utilize an innovation (early adopters) because of their beliefs, values and higher levels of self-confidence, the majority of organization members will take a "wait and see" attitude until there is ample evidence that adoption of the innovation is valuable (Rogers, 1986,1995). For example some faculty may become more engaged in a technology-base pedagogical and curricular reform process if they believe in constructivist modules of learning (Becker,1999). There is also evidence that educators who see themselves as instructional designers in addition to knowledge transmitters will find powerful educational applications that effectively utilize the unique characteristics of specific technology tools (Briggs 1977; Harris 2001).

Methodology

The current project, *Bridging the digital divide: Preparing today's faculty to prepare tomorrow's teachers to use technology* (Kelly, Graves, LeBlanc & Lee, 2000), is part of the PT3 initiative in which the integration of technology into curriculum and pedagogy is seen as a critical element in the transformation of teacher education from knowledge-centered to learning centered. The current project was designed to address the barriers and obstacles to effective integration of technology in teacher education programs.

<u>Project description</u>

Bridging the digital divide has four goals:

- Increase the effective use of technology in the teaching-learning process.
- Model the use of technology by master teachers in field experiences.
- Change curricula to require that teacher candidates demonstrate effective uses of technology.
- Enhance preservice teacher support services with technology products.

The major vehicle for pedagogical and curricular change is faculty technology professional development. The faculty technology development model is comprised of the following key components: 1) technology workshops; 2) the use of external experts; 3) a project bulletin outlining the steps to develop and implement a technology-based instructional activity; 4) individual faculty mentoring and support by a technology specialist with expertise in the multiple uses of technology; and 5) faculty technology teams (a collegial support group). This model was implemented over two semesters for the first cohort of faculty participants.

The project's technology development model uses a project-based learning approach to facilitate the instructional technology development of individual faculty. The technology project should address specific learning outcomes in teacher candidates and relate to content and technology standards for teachers and P-12 students. Each project is a technology-based, instructional activity designed for a specific course. Once implementation of the project occurs, faculty members are expected to collect data from teacher candidates about the effectiveness and utility of the project for their teaching and learning.

The technology project must include the following elements:

1. faculty modeling the use of technology in instruction

2. use of technology to enhance learning within a specific course

3. required use of technology by the preservice teachers

4. identification of applications of technology in P-12 classrooms by pre service teacher candidates

5. use of standards to guide the instructional design process

6. evaluation of the technology project by pre service teacher candidates

Subjects

Sixteen faculty members compose the first cohort in the project-based, technology development process. They include teacher educators from the School of Education who provide classes for preservice undergraduate and graduate teacher education candidates. The teacher education faculty includes members from psychological and social foundations of education, curriculum and teaching and special education. In addition, there are faculty from the School of Arts and Sciences, in particular from the Chemistry and Romance Languages departments. All are faculty who provide instruction to preservice teacher candidates in their respective departments. Finally, mentor teachers from four public schools within our partner district serve as consultants to the teacher education faculty. These educators are cooperating teachers and their schools serve as field sites for our preservice programs.

Data sources

Baseline data was collected about 1) technology knowledge and skills of faculty; 2) faculty access to computers and peripheral devices at home and in the workplace; 3) faculty use of technology for instructional and professional purposes; and 4) the penetration of the instructional technology in curricula of the faculty participants.

Bridging the digital divide

Evaluators collected data on the implementation of the critical components of the technology professional development process including: 1) the impact of technology workshops; 2) the utility of external experts; 3) the role of the project bulletins, which outline the steps to develop and implement a technology-based instructional activity; 4) the effectiveness of individual mentoring by a technology specialist with expertise in the multiple uses of technology; and 5) the value of faculty technology teams, a collegial support group. Self-reflective journal entries, focus groups and action research data based in the college classroom enhanced the data sources. Finally, data was collected on the identification, articulation and inclusion of content and technology standards in the technology-based projects.

Results

Baseline data document the diversity in faculty knowledge and expertise and access to appropriate technology. Over the course of the academic years, bureaucratic barriers were overcome and faculty in the project were given greater access to a range of technology facilities in their offices and in specialized classroom facilities.

Insert Figure 2 here

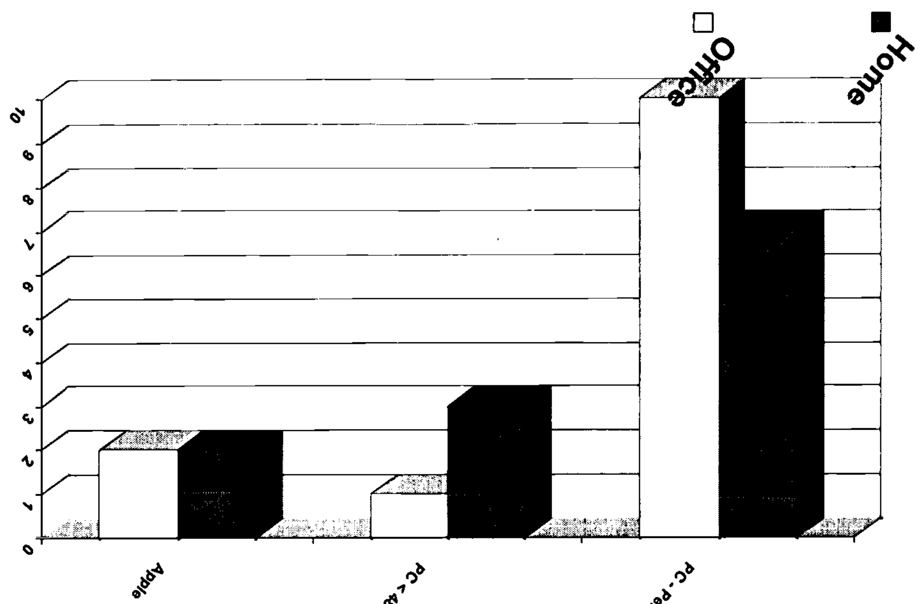
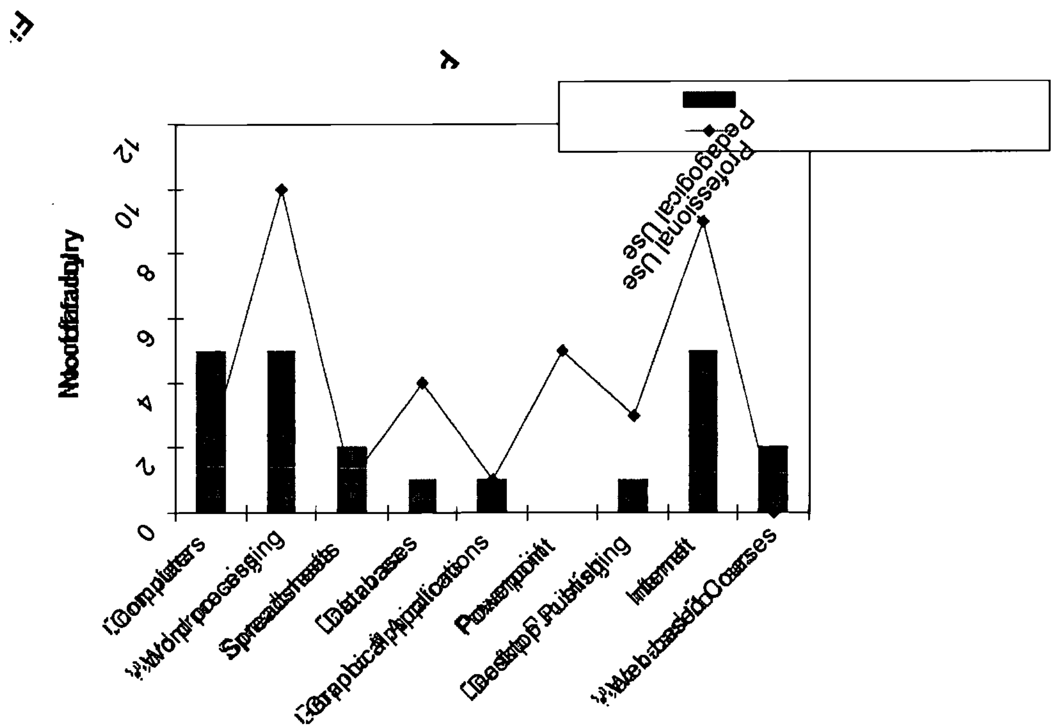


Figure 2 Faculty Access to Computers

Most faculty members used technology for professional purposes prior to the implementation of the project. However, this use was largely confined to word processing, email and for a few, Internet searching. Curricular and pedagogical analyses at baseline revealed fewer than 3 faculty members who included any instructional technology in teaching or required teacher candidates to demonstrate computer knowledge or skills. When technology was included in instruction, pedagogical uses were very limited. For example, none used PowerPoint or any other type of presentation software. Certainly the faculty was not using spreadsheets or databases that might require teacher candidates to utilize higher order thinking. The most frequent pedagogical use was the requirement that written materials from teacher candidates be word-processed.

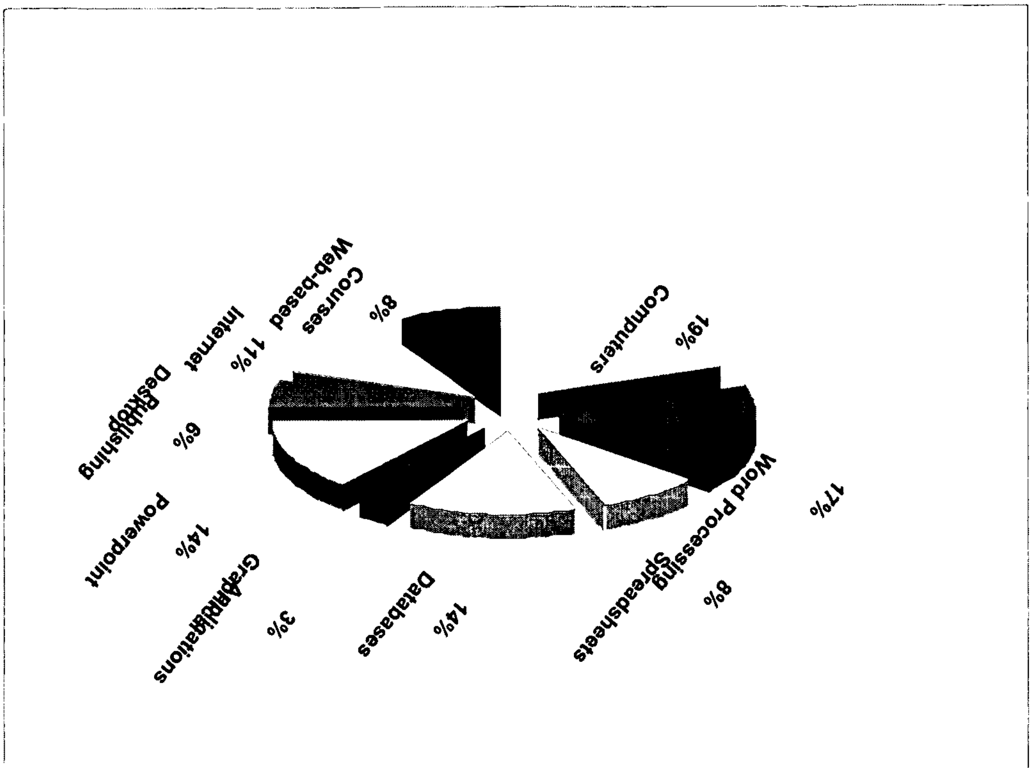
Insert Figure 3 here



After the introduction of the professional development process, the uses of technology in pedagogy changed dramatically. Almost half of the group enrolled in at least one course in the college's Blackboard course management system in addition to the PT3 training and workshops. A similar number incorporated PowerPoint for presentation purposes in their classes. The presence of faculty initiative to seek out additional technology training represented a different attitude from their prior experiences with technology training.

Insert Figure 4 here

Figure 4 Faculty Prior Technology Training



The composition of the technology team was a significant factor influencing the likelihood of adoption and integration of instructional technology into teacher education courses. In particular, technology team participation was most effective when team members shared a common area of expertise, taught similar courses and had a strong, charismatic and enthusiastic group leader. This leader served, as a catalyst for other members, helping to identify needs for additional technology training, for access to specific software and hardware and for expertise about the application of the various content and technology standards.

Another important feature leading to faculty adoption and integration of technology in instruction was the project bulletin, a curriculum and instructional design guide. The project bulletins were associated with the establishment of clear, measurable instructional

objectives by faculty members, as well as the incorporation of standards in their technology projects. Many faculty members reported that without the bulletins they would not have incorporated these standards into their instructional technology projects. Other factors were related to the different levels of impact including: initial level of technology competence; the disciplinary heterogeneity of the technology teams; availability of a technology specialist and the level of technology competence of the mentor teacher on the team. Finally, the role of incentives and external curriculum reform pressures also played an important role. The case studies will provide additional details about the interaction of factors that fostered or inhibited in the adoption and integration of instructional technology into teacher education pedagogy and curricula.

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Using Threaded Discussions As A Discourse Support

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Key Words: Scaffolding, Reciprocal Teaching, Content Literacy, Threaded Discussions

Abstract

Students construct meaning from text through conversation and social interaction. The aim of this research was to examine how the use of an online, threaded discussion, as a discourse support, can facilitate deeper levels of student understanding. The basic assumption being tested is that using discourse supports, applying various discussion strategies like reciprocal teaching, creates an underpinning to do intellectual work and that these supports can be employed in an online discussion environment. Four online discussions were conducted over a period of two months, two in my Advanced Placement American Government classes, and two in my college-prep American Government classes. . In an online discussion, the students and the teacher have a visual record of the conversation and the quantitative and qualitative aspects of the conversations. The online discussion environment allowed more students to participate in a class discussion and increased the amount of their participation.

Preface

I have based my research activities on presentations made to the California History-Social Science Project-TRIP participants, the professional reading I did prior to starting my project, and conversations with my wife, a reading specialist, who has been participating in RISE, a San Diego-Orange County Project to educate secondary teachers and administrators on the importance of content literacy by helping participating schools develop their own content literacy plans. As I write this, I have not received any in-service training on the classroom use of reciprocal teaching strategies.

I would like to especially acknowledge University of Michigan Professor Robert Bain for his contributions to my understanding about the use of discourse supports.

Introduction

Students constructing meaning from text through conversation and social interaction, teachers creating scaffolds to support those activities – these are ideas that I have only recently begun to consciously apply to my teaching strategies. Intuitively and through my model for teaching, the Socratic method, I know I have been basically doing the good things for my students. However, I realize that I have missed the theoretical underpinnings that might allow me do more or be more consistent in what I do. Equipped with a better theoretical understanding, I am energized by the prospect of creating a stronger environment for my students in both classroom work and the use of the Internet as supports for learning.

What started this journey for me was that during my course coverage of the 2000 Presidential election in my AP American Government, I had written a short editorial about the irrelevancy of the minor political parties and posted it on my web site, The Learning Porch. The students' assignment was to read the editorial, write a short reaction, and post it on the discussion board section of the web site. Since I had not used a web site with my classes before, this assignment was just an experiment without any expectations other than that they complete the assignment. I was amazed by what happened as they did their homework.

Not only did they complete the assignment, but they also replied to the posted messages of their classmates. The amount of unprompted dialogue was extensive. Their work reflected serious thinking about the subject and demonstrated as much learning as any other activity I had done in my classroom.

For the rest of the semester, I tried, but could not come up with an idea to duplicate the experience and still cover the AP course content. I believe part of the reason for my lack of repeat success was that I was operating without a clear idea about the application of constructivist learning theories in my classroom strategies.

My weekend experience as a member of the CH-SSP TRIP project, in early February 2001, provided the inspiration to research the use of online discussions as a way to support deeper understanding of course content. It motivated me to investigate the literature about constructivist ideas and learn about discourses strategies like reciprocal teaching.

I think many teachers have "ah ha" experiences in their classrooms without a lot of background in the learning theory to explain the results. Similar to my experience, they have difficulty repeating the same outcome in other elements of their teacher strategies; successful activities become hit and miss. However, if more teachers had access to examples of teacher research, they could use these as templates for their own research. Far more beneficial than obtaining sample lesson plans, teacher research models provides teachers with ways to apply sound learning theory while transforming their classrooms into learning laboratories. This is an exciting way to teach.

Research Question

How can the use of an online, threaded discussion, as a discourse support, facilitate deeper levels of student understanding?

Assumptions

1. Discussion engages students in more thinking than listening to lectures or just responding to teacher questions.
    a. The discussion experience contributes to deeper understanding and retention of concepts. The literature concerning social constructivist theories and reciprocal teaching strategies emphasizes the relationship between learning, social interaction, and students talking to each other. Studies into the effects of reciprocal teaching strategies confirm the relationship between discussion and understanding (ncrel.org).
2. The use of discourse supports, various discussion strategies like reciprocal teaching, create an underpinning to do intellectual work in ways that provide assistance in deeper levels of thinking and understanding. As Professor Robert Bain has stated, "Until internalization occurs, all performance must be assisted" (Bain, TRIP).

   a. The reciprocal teaching strategies, as I used them to support content comprehension were presented and explained to the students in the following order: prediction, clarifying, summarizing, and questioning. Recognizing that the four steps can be used in different combinations, I found that for my purpose, that order worked best.
3. The use of a internet discussion board creates the opportunity to extend a discussion outside the class time, allowing for more reflective responses and create a record of the discussion that can be referred to at a later time.
   a. Online discussion strategies can also contribute to the creation of new knowledge.

The Research Plan and Observations During the Process

Phase One - Instruction in the reciprocal teaching strategies.

Using a short section of our government textbook, in my college-prep American Government classes, I read out loud a very basic introduction to the study of American Government. First, I modeled the four parts of reciprocal teaching strategies for them: prediction, clarifying, summarizing, and questioning. Second, using a couple more paragraphs from the same section, we used the reciprocal teaching steps to read it together. Finally, after organizing into groups, I assigned the class to do another short part of the text. Recognizing the students' tendency to take directions literally, I stopped them to point out that not every vocabulary term has to be dissected. Starting this process, I had one person in the group act as a "checker" – to ask the group if there were any terms people didn't understand. Later, as the students became comfortable with the process, this wasn't needed.

I did the same modeling for my Advanced Placement American Government sections, but used a paragraph from Article III, Section One of the Constitution. They then read Section Two, paragraphs 1-3 as a whole class, and a short reading on judicial review in small groups.

Phase Two - Checking for understanding of the short readings and feedback on their first use of these strategies.

The initial reaction from all six of my classes was positive. These are all seniors. Not all of them are particularly willing to volunteer, to the whole class, that they just learned something helpful. Ironically, the shy or "too cool" groups of students will later find their voice in the online discussions. Other observations:

In one of the other periods, students had trouble starting the process. Does classroom environment/pressure of being viewed by others affect the participation in the activity? Or is something else? Despite the slow start, the class still gave positive feedback and recognized that support from the group aided their individual understanding and extended their thinking to other government related topics.

As I proceeded from one period to the next, I gave better directions and the students worked more effectively. The directions are part of the scaffold. Or are they a scaffold to the scaffold? I need to script the directions more precisely. That's a challenge for me, a teacher, while always prepared, still likes to improvise.

As a result of changing the directions, students did a better job of being on task and good conversations occurred at all tables, even with material that was not that all exciting. However, some groups need more prodding to do all four parts. They are not used to this kind of class activity, especially the clarifying of vocabulary. They like to

discuss/talk, but miss some of the key concepts because some will not volunteer that they have a word or phrase they would like assistance understanding.

Jig sawing the parts of the reciprocal teaching strategy helped with the clarifying piece. One person became responsible for reading for the meaning of difficult vocabulary. However, jig sawing is not quite the same as the group developing shared predictions, shared understanding of vocabulary, shared summaries, and shared questions for re-enforcing understanding.

Phase Three - Integrating reciprocal teaching strategies into the daily life of the class.

Before I could give them an assignment to use the discussion strategies online, I wanted to be sure my students were comfortable with the reciprocal teaching process. The groups, in my AP classes, read a longer, more difficult reading on judicial philosophies. The difficulty helped keep the groups on task, but the students had a good suggestion to stop at certain intervals and check for understanding. Based on my observations of their notes, group conversations, and the follow-up whole-class discussion, more of the students had a better understanding of the pertinent concepts than if they had read the article by themselves before discussing it in class.

After also practicing reciprocal teaching with readings in class, the American Government classes had their first online discussion. I used a video about the Berkeley free speech movement in the 1960's. After the video, we went to the library and had an online discussion using the discussion board on my web site. The students had to post a reaction to the video and then reply to the posted messages of the other students. In a space of about 30 minutes, the threads of the discussion extended over several screen pages. The production by everyone exceeded what I have ever seen accomplished, in that space of time, in both whole class and small group discussions. A major difference is that sitting in front of a keyboard "forces" them to communicate their thoughts. Once posted, they start looking for people to reply to. Even if they are only replying to their friends, everyone got involved and surprisingly or not, they all stayed on the topic. It is clear that they left the experience having thought and produced important insights about the topic of free speech. When students have the opportunity to write down their thoughts in this manner, they produce thinking that become part of the dialogue about the topic. They are adding to "sum" of thinking on the subject matter; they are creating information. Produced online, it becomes available for the "world" to access and be better informed because of the students' thoughts.

The AP students' first online discussion using reciprocal teaching strategies was based on an editorial about IBM and the holocaust during WWII. The editorial was read and discussed in the context of studying the concepts of Judicial Activism and Judicial Restraint. Like the discussion of the Berkeley video, the students were assigned to react to the editorial and to each other. I required a minimum number of posted thoughts and replies to other students. As they started the discussion, similar results to the video occurred, but my web site started having technical problems. The issue turned out to be the FrontPage support my provider was not giving my site, forcing me to switch to another company to host my site. This delayed the online part of my project for about three weeks and reduced the number of online discussions I was able to conduct during the research phase. If the technology can fail, it probably will at some point. As teachers, we just have to adjust while keeping the focus on student learning. As a result of the web site problems, I did a few more in-class reciprocal teaching activities with short readings. I also experimented with more jigsaw activities as compared to the groups developing a

common set of reading notes because that was how the online text discussion eventually would be accomplished.

Once the web site problems were resolved, we proceeded, in the American Government classes, to using the online discussion for deeper understanding of a textbook reading. The text reading covered a number of civil liberties topics (See assignment description in the appendix.) The classes were divided into groups and had one week in which to complete their online discussion of the assigned pages. The time gave everyone, even the students without Internet access at home, adequate time to post their work. Nearly every student completed his or her online responsibilities at a percentage greater than the normal number of students completing homework. Additional observations are included in the Findings section below. Sample screen shots are also included in the appendix.

In the AP classes, after the web site was back up, we used an online discussion to support a group research project on policymaking. Because of the content that needed to be covered before the Advanced Placement exam, I was not able to do the same kind of online text discussion as the government classes. Instead, I required the students to post messages on their research progress. While there was no required structure to the online activity, other than updates on their research, the posted messages allowed group members to share written information with each other rather than information given over the phone. In addition, posted messages about useful resources helped members of other groups.

At the conclusion of the two online discussions, all of the classes, approximately 170 students, completed an evaluation of their two online experiences. The results are summarized in the findings and the form used is included in the appendix.

Findings

How can we measure the success of online discussions? Amount of participation? Length of posted information by each student? Scores on the exam following the discussion? A comparison of test results from the previous semester? Student Feedback? As a result of this research experience, answers to these questions and other questions have started to emerge; continued study should clarify the value of online discussions.

Despite having used a reciprocal teaching strategy to facilitate an online discussion of text materials only once with the American Government classes, the test scores in two of three classes slightly exceeded the test scores, on the same exam, of the class the first semester. There are many variables that can account for the differences, for example, student differences in ability and study habits. I did not change the test from one semester to the next; the test itself may be more of a product of the way I presented the same materials during the first semester. After looking at what the students produced in their online discussions, I think that my exam should have been more of a test of the students' ability to articulate and defend their understanding of what they read as reflected in the discussions. I think that, while a one time comparison is not very reliable, I would not want test it "scientifically" by teaching one class without using reciprocal teaching strategies and one class with those strategies. There is already significant literature demonstrating the value of reciprocal teaching and the use of discourse supports to support learning. Just for the sake of having a control group, I do not want to deprive my students of those activities that will improve their ability to better understand what they are reading and increase their opportunities to communicate that understanding.

If the value of reciprocal teaching strategies has already been established by the work of others, the next step for me is to continue to examine the use of this strategy in the online environment. Next year, our district will provide the Blackboard 5™ web-based course management environment to its teachers complete with threaded discussion capabilities. This should create the stability that I was not able to consistently maintain with my web site. That stability is a critical part of the process, one recognized by the students in their evaluation of the online discussion experience. Technical problems are also a big factor deterring the less technologically experienced teacher from experimenting with the integration of technology.

One of the best indicators of the value of online discourse was the student comments in the evaluation. They are summarized below:

- Describe the things you **like** about participating in an online discussion.
  - I can share my ideas with the entire class
  - The people bring up points that revolutionize your thoughts on a subject and you may not even know who they are.
  - It helps to further develop your own thinking if people make comments and suggestions.
  - It's cool to see the outcome of a thread.
  - You know what everyone else is thinking.
  - I can refer to the discussion later.
  - Comparing your notes with other students.
  - I like having a couple of days to work on the discussion.
  - I can think about what I want to say before saying it.
- How would you **compare your level of participation** in an online discussion vs. the amount of talking you do during teacher-led class discussions?
  - I feel more comfortable online.
  - I don't like to talk in front of people.
  - During a teacher-led discussion, you don't get to put in your opinion as much as an online discussion.
  - Allows me more time to think about what I have to say
  - I like online more; it's more fun.
  - I talk more (overwhelmingly, most students replied with this comment).
  - I talk less (this comment came, predictably from the students who sometimes can dominate a class discussion if the teacher would let them).
  - I talk the same (significantly less number of these responses compared to the "more" responses).
- In what ways do you think that online discussions **COULD aid** your learning and/or understanding of course content?
  - It could provide students with clarification of something that confuses them and lets students summarize things in their own words.
  - I can get ideas from other people.
  - I learn from my peers.
  - You receive a broader spectrum of ideas.
  - Allows easy replies to clarify answers.
  - I have 30 different understandings of something, including mine.

- It's like an online textbook summary, with other people's comments aiding my understanding.
- It helps you go over what you've already learned.
- The postings and discussion stay there so you can go back and study them.
- I can look at what other people have said before I say something.

- In what ways do you see online discussions being the **MOST beneficial** to students?
  - You are able to go back and review the topic.
  - It helps us to interact as a class.
  - To continue to discuss a topic outside of class.
  - Allows everyone to do something, no one can zone off and not participate.
  - It's a more comfortable environment than class.
  - Study notes for exams.
  - Shy people share their opinions.
  - It's easier to talk to people.
  - Everyone can participate in a discussion at the same time.

- What do you consider to **obstacles** to effective use of online discussions?
  - The web site not working.
  - Students might not be interested in discussing after school.
  - It's slow.
  - Access to computers.
  - People not putting their work in the assigned order (during a reciprocal teaching strategies online sharing of textbook reading).
  - Computer failures.
  - Learning how to post messages and reply.
  - People don't always want to read what you have to say.
  - Some things people say aren't correct.
  - Remembering to post things.
  - When there are too many messages to read.

The student comments are very insightful as findings. Having worked with these young adults all semester, I know their reactions are honest, reflecting their personal experiences in the activities, and they re-enforce the literature concerning student talk as a vehicle for learning. A telling point in the students' evaluation of the experience is the number of students who normally do not like to participate in a face-to-face class discussion indicating increased participation in the online discussions. The shyness factor seems to be overcome in the online environment.

The online experiences of my classes demonstrated, to me, the usefulness of online discussions. In an online discussion, the students and the teacher have a visual record of the conversations, both in the quantity of talk and quality of the conversations. While the teacher can give students "robust" comprehension strategies for face-to-face talk, the teacher does not usually require a transcript of the conversations. The online record creates links between assessment and student accountability.

Concluding Thoughts about Teacher Research

One very important question for me is how to bring in the discipline-specific scaffolding tools to "do" political science as my students cover course content? This is an

area requiring more research. Additionally, I want to improve my understanding of teacher research, constructivist theories, and the supporting teaching strategies.

Another question, which I am exploring as the semester ends, is whether or not the online conversation about a reading can improve a subsequent, whole class discussion? Can the students' understanding of the reading enable the teacher to add additional things for the students to think about? There might be issues and ideas that the students would not otherwise been able to see or reflect on without a good understanding of what they had read. This is particularly important with readings that are more difficult than the textbook, but also as a vehicle for taking students' thinking further after reading the textbook.

This project has made an impact on my teaching and creates important implications for the teaching strategies of other social science teachers, if not all content area teachers. If discourse supports are effective in increasing student understanding of content, teachers not using discourse supports in their strategies, need to alter what they are doing with students. If online use of discourse supports can extend those effective strategies even further, teachers need to rethink their use of the Internet.

Change is a big challenge for many teachers. They generally need strong incentives to transform their classes from being teacher centered to student centered. Administrators can provide those incentives and leadership to facilitate the change process. Unfortunately, administrators are to often, infrequent visitors to their teachers' classrooms. Perhaps the dissemination of the products of teacher research, rather than the simple sharing of lesson plans, can be part of the catalyst for change.

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Appendix A

American Government
Civil Right and Civil Liberties

Textbook Coverage

1. 1. Chapter 14
    a. a. Section 3. pp. 398-405. "The Rights of the Accused."
        i. Search and Seizure
        ii. Guarantee of Counsel
        iii. Self-incrimination
        iv. Double Jeopardy and Cruel & Unusual Punishment
    b. b. Section 4. pp. 406-410. "Equal Protection of the Law
        i. Meaning of Equal Protection
        ii. Proving intent to discriminate
        iii. The struggle for equal rights
    c. c. Section 5. pp. 412-418. "Challenges for Civil Liberties."
        i. Affirmative Action
        ii. Discrimination against women
        iii. Citizens' right to know
        iv. Citizens' right to privacy
2. 2. Chapter 15
    a. a. Section 1. pp. 427-428. "Law in America"
        i. Due Process of Law

Deepening Understanding of the Textbook Materials

Starting Friday March 30 and ending on Friday, April 6, you and your group will work together to discuss these pages on line using the reciprocal teaching strategies. A group leader will be selected who will coordinate the discussion process. The leader's job can be rotated and the leader will receive extra credit for facilitating the discussion. The web page is: http://thelearningporch.org.

You will click on the links, ***My Classes/American Government*** and then click on the link for your period. The directions will be posted on the starting page for the discussion.

Our goal is to use the reciprocal teaching strategy to support and deepen each person's understanding of the textbook reading.

Appendix B

This page will connect you to the discussion pages of your class period.

Period 2A	Period 2B	Period 3B

The Current Discussion Assignment

- Chapter 14 and 15 - Civil Rights and Civil Liberties
  - You and your group will read and discuss the assigned pages using the reading assignment handout and the reciprocal teaching strategies of clarifying, summarizing and questioning.
  - Starting Friday, March 30, groups will have one week to complete your online discussion.
  - Work on the chapter sections by using the reciprocal teaching strategies for each sub-section listed on the handout. You do not need to do predictions, just clarifying vocabulary, summarizing and questioning. Develop one question for each sub-section.
  - The group leader will assign/divide the jobs for each sub-section. Since the group leader will receive extra credit for doing this job effectively, the job can be rotated. Divide the jobs by assigning individual group members the jobs of clarifying, summarizing, and the sub-section question.
  - Use replies to ask further questions or comment on the messages. You need to check to see if anyone has replied to your posted information and you must reply to their replies. This is required.
  - Remember to only put your first name and last initial.
  - Make sure the information in the subject line is very specific.
  - The leader will also be responsible for starting the discussion thread of the leader's group.

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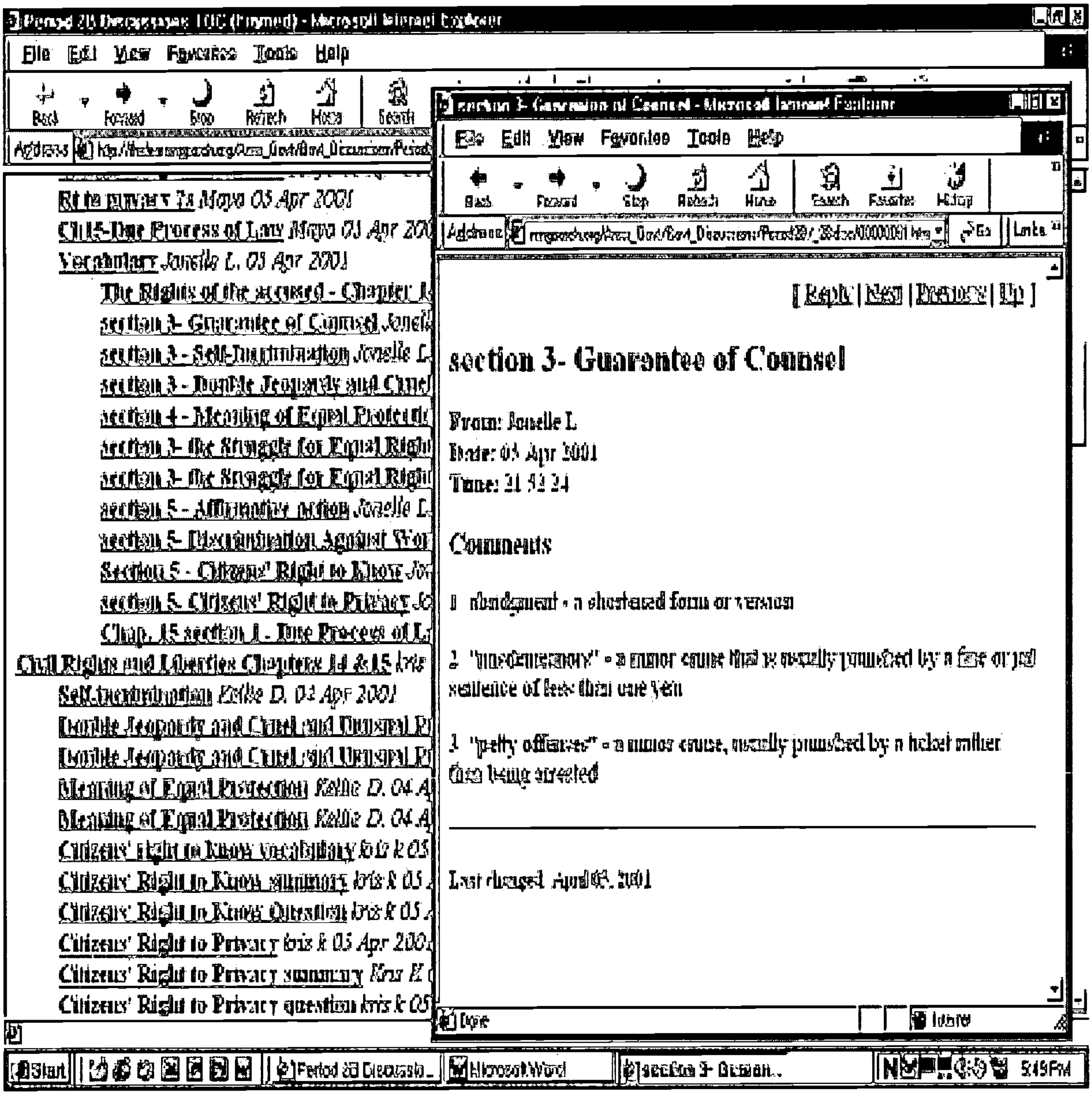
Appendix C



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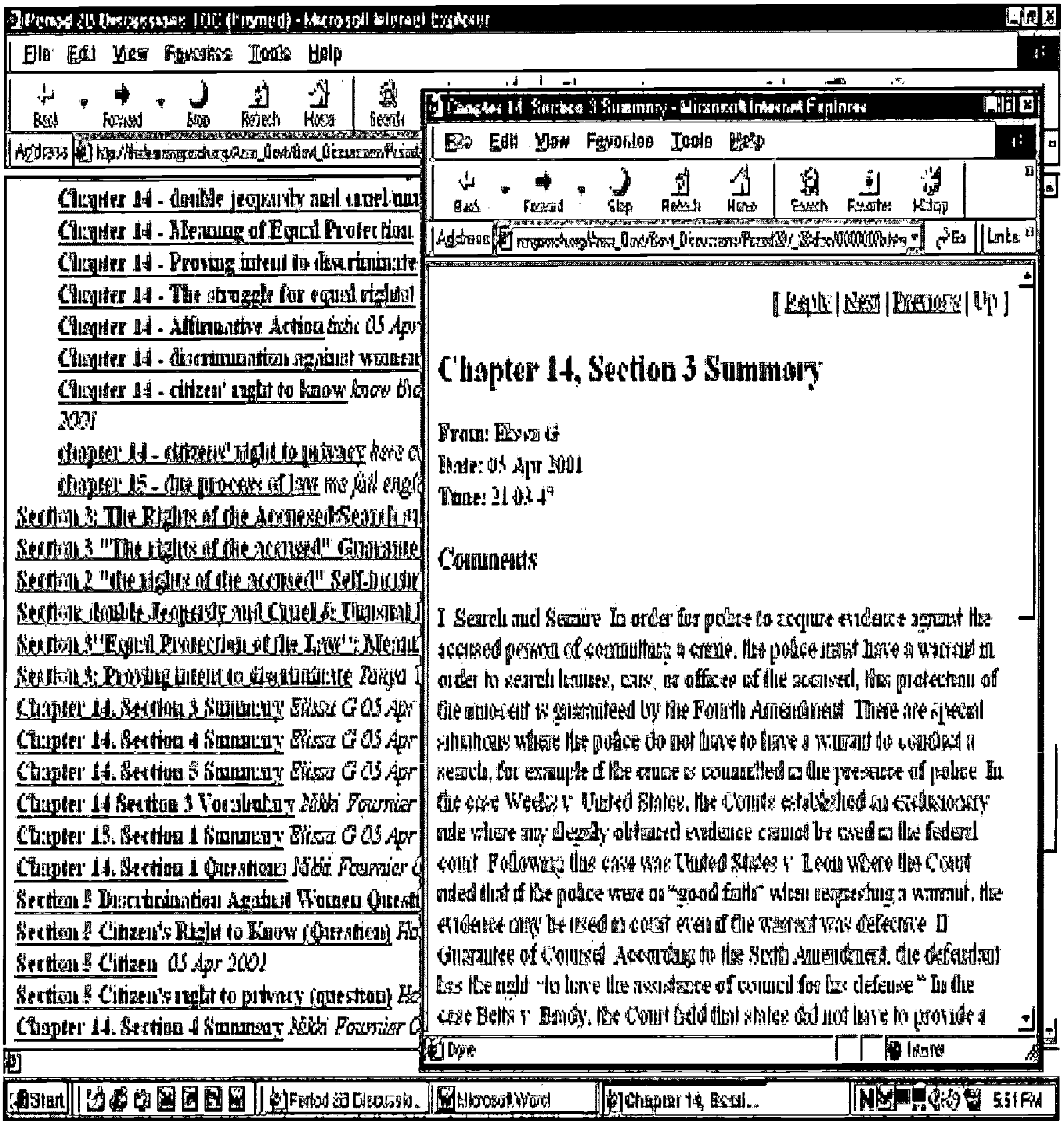
Appendix D



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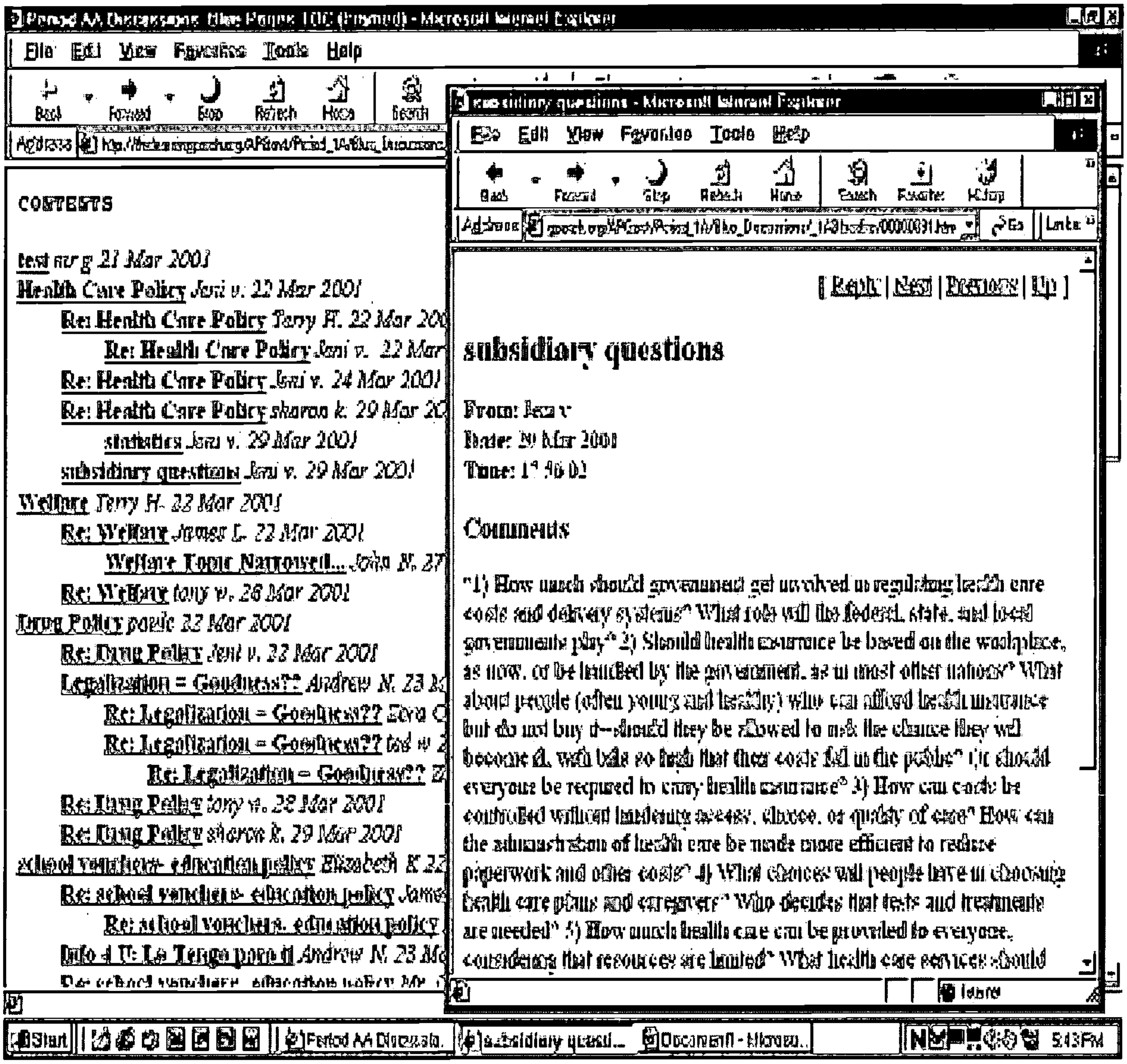
Appendix E



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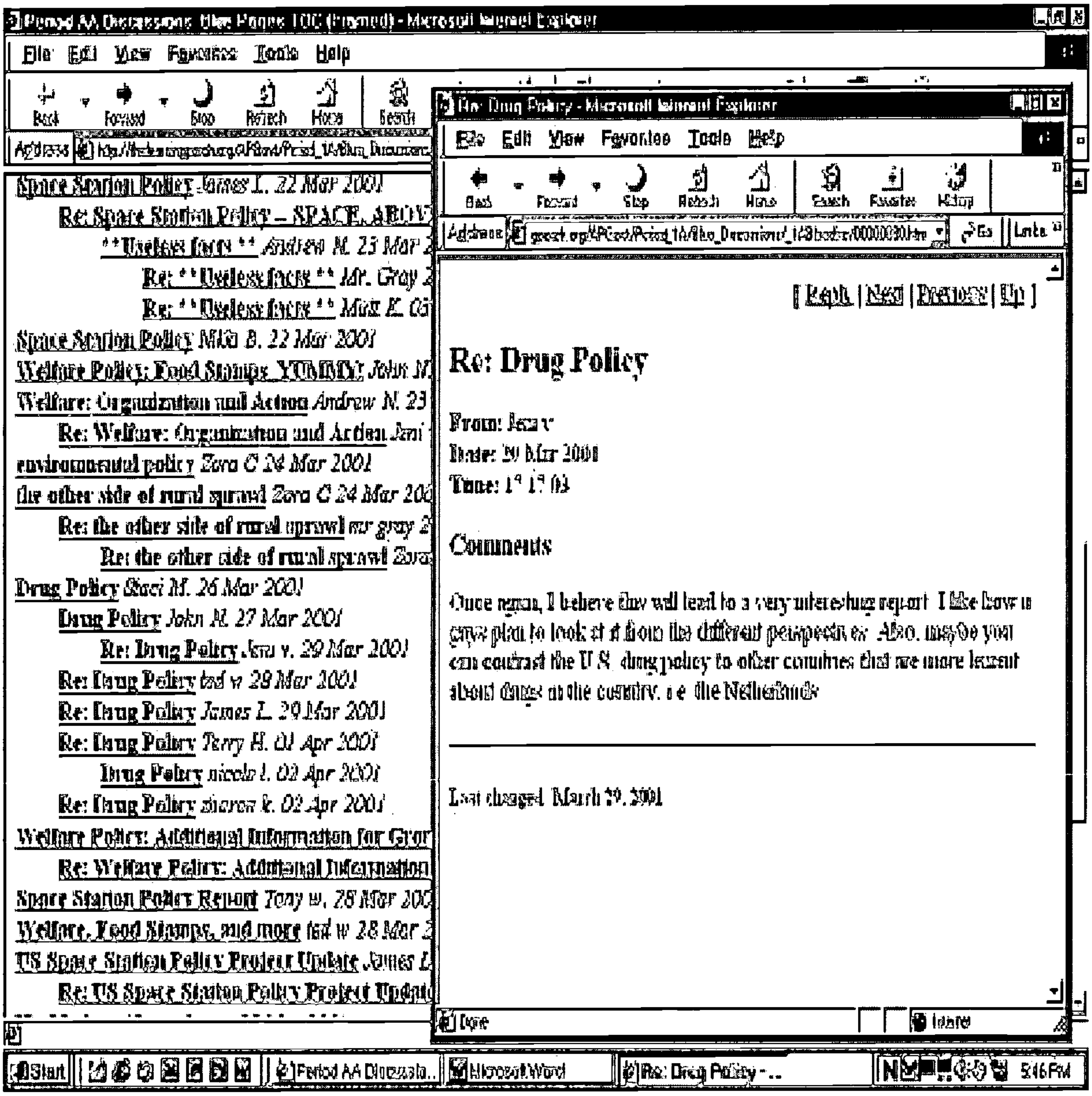
Appendix F



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Appendix G

Threaded Discussion
Evaluation Form

NAME:

1. Have you ever used/participated in a threaded discussion before this class?
2. Have you ever used an "instant messaging" program?
3. Have you ever participated in a chat room environment?
4. Describe the things you like about participating in an online discussion.
5. Describe the things you do NOT like about online discussions.
6. How would you compare your level of participation in an online discussion vs. the amount of talking you do during teacher-led class discussions?
7. In what ways do you think that online discussions COULD aid your learning and/or understanding of course content?
8. In what ways do you see online discussions being the MOST beneficial to students?
9. What do you consider to obstacles to effective use of online discussions?

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The Impact on Student Academic Achievement Using an Online Process Provided to Students and Parents

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Key Words: web-based, technology, student motivation, parent communication, student information management systems, PowerSchool

Abstract

This action research project investigated the effectiveness of having immediate access to grades, attendance, homework, and teachers' comments for parents and students alike. There are many involved in the success of children including the administration, teachers, parents and the students themselves. Advancing technology helps students become more accountable and parents more involved in their children's education. Seventy-seven of the 137 sixth grade students were used in the study. Utilizing PowerSchool, a web-based student management program, the teachers organized and mandated weekly computer access to students' grades during the first and third quarters of the school year. During the second quarter, access by the students was optional. GPAs (Grade Point Averages) were compared at the end of each quarter of the school year to determine the impact of easy access to grades on student academic progress.

Introduction

At the present time, web-based programs for student management are relatively new to school districts. Some schools have gone from DOS-based programs, to Windows programs, to the new web-based programs. The Internet has unlocked great possibilities for improving education, including bridging the communication gap between parents and schools, by increasing opportunities for more parental involvement. The new web-based student information management programs report accurate student information in a significant medium for parents and students alike (Keel, 2000).

Many changes in schools today can be credited to the utilization of computer technology. Students and parents are becoming more comfortable with computer technology and have the opportunities to communicate electronically with their school and teachers from home and the workplace. Web-based computer technology is proving to be a useful tool to promote communication between home and school, encouraging active collaboration among teachers, parents, and students in order to build greater student achievement in school (Patrikakou, Weissberg, & Rubentstein, 1998).

Student Involvement

Students should be more accountable for their academic progress; however, students do not always have an accurate, objective view of their academic abilities. Student perceptions of their education experiences generally influence their motivation more than the actual, objective reality of those experiences (Hicks-Anderman & Midgley, 1998). Kosakowski's (1998) summary of research on the benefits of information technology in learning environments indicates that students learn to think analytically and critically and to work collaboratively using

technology, thus gaining more control over their learning. Additionally, a 1996 Department of Education study confirmed that technology has a positive influence on students' attitudes, self-confidence and self-sufficiency toward learning. As students learn to use technology to take control of their learning, it is a reasonable leap to use technology to give them easy access to information about their academic performance.

Parental Involvement

Parental involvement makes a difference in the scholastic progress of children. When parents get involved in education, children try harder and accomplish more at school (Maynard & Howley, 1977). Culyer (1988) identified three critical parental responsibilities: send the children to school to learn, support the school, and compensate the children for academic gains. While many factors sway children's scholastic successes, Faucette (2000) found that the exact forecaster does not deal with income or social status, but rather the degree to which children's families are able to create an environment that supports learning, provides high expectations of their children, and includes active involvement in their children's learning.

Modern life places restrictions on parents' involvement in their children's education since parents, often single or both working, are progressively more stretched for time to be involved in their children's scholastic performance (Keel, 2000). A web-based information system that would allow parents easy access to information about their children's scholastic performance would be a big factor in increasing their active involvement and collaboration with the schools.

School Involvement

When parents are involved in their children's education, the schools as well as the students profit. The benefits are increased teacher self-confidence, better teacher ratings by parents, greater family support of the school, and higher student success (Faucette, 2000).

Riley (1995) suggests making schools parent-friendly, contacting families and removing barriers that make the parent unwilling to get involved in school activities. "When children are surrounded by adults and communities that value education, they get the message that their education is important" (Riley, 1995, p.1).

Patrikakou, Weissberg, and Rubenstein (1998) have provided the five "Ps" as a vision of a true and effective method to involve parents in a meaningful way. Teachers demonstrate *partnership as a priority* to show parents that they are interested in what parents think and how they can interact in the education process of their child. By *persistent communication,* parents are kept informed on a regular basis. Because phone calls are not always possible, the writing of notes, and even journaling keeps the frustration level at a minimum. It is of utmost importance to let parents know the *positive things* their children are doing in the classroom. *Personalized communication* that is initiated by the teacher lets the parents know that the teacher really cares. Parent-teacher conferences offer opportunities for parents and teachers to share information about the children. Teachers can offer *practical, specific suggestions* to show parents how to help their children at home. By using a web-based information system, teachers and parents can maintain regular communication about student progress and individual student accomplishments.

Technology Bridges the Gap

Technology provides tools to help schools administer an immense amount of information regarding students. One such tool is an electronic grade book that allows the teacher to record, average, and report grades. The grade book can state the level at which the objectives were met. The grade book can also be the tool that reports and links period-by-period attendance to the school management system (West, 2000). The Internet provides parents a venue into the classroom to view grades, attendance, assignments, and exam schedules. This serves as a link for

teachers and parents in the electronic world (Trejos, 2000).

Teachers have used various grading programs, and most school districts now have a student information package that allows the district to track students more easily. One of the benefits of having such a package is the ability to communicate with parents by e-mail; another benefit is the ease with which teachers can maintain and update their grades in an electronic grade book at any time (O Lone, 1997). However, merely providing online access to grades may not be enough. Parents have fears because they have heard upsetting news reports about the Internet and technology. The school needs to support the parents and help them learn the necessary skills for using the Internet. All, including students, parents, teachers, and administrators, should be involved when planning and using technology in the education place. It is vital to set up family technology programs to hopefully create competent technology users. When the parents are competent technology users, they will guide children in the home setting, and will become more involved with school (Faucette, 2000).

PowerSchool is an on-line student management program that allows teachers to instantly input grades, attendance, and comments; it enables both students and parents to view the current grades, attendance, and comments at any time. If access is provided to parents and students, will it make a difference in the academic achievement of the students? The purpose of this action research project was to describe the impact of an online student information management system on student achievement. The research focused on four questions:

1) Will students using an online program to regularly check their grades improve their academic progress?
2) Will parents becoming more involved with their children improve the students' academic progress?

3) Will teachers' encouragement for using an online program to check progress improve the academic progress of students?

4) Will the administration support students, parents, and teachers to improve student academic progress?

Research Design and Procedures

Action Research Group

The members of the action research group were six sixth-grade teachers, one computer teacher, and one principal all from Sturgis Williams Middle School. All of the sixth grade teachers and one computer teacher were responsible for organizing the lab time for sixth grade students to check their grades, attendance, and comments from teachers on a regular basis. This group was also in charge of the surveys, interviews, electronic communication, and personal memos of the students and parents. The computer teacher was in charge of setting up the lab times for the sixth grade teachers. The principal approved the surveys and interview questions. The computer teacher accessed the school management program for vital statistics that included GPAs and number of times students and parents accessed the program. Permission forms were given out during the "Back to School" night for parents and students to sign and return.

Population and Sample

The population used in this research was comprised of the sixth grade students and their parents from a middle school in the upper Midwest. This middle school houses six hundred eighty-six students in fifth through eighth grades. Of the one hundred thirty-seven sixth graders, two are Hispanic, one hundred thirty-four are Caucasian, and one is unclassified. Only students with parental permission comprised the sample group, which was 56% of the sixth grade students. These seventy-seven students were grouped into three performance levels. Thirty-two

students (42%) comprised the high GPA group, thirty-seven students (48%) were included in the average GPA group, and eight students (10%) comprised the lower GPA group.

Timeline

Phase 1 (August – October) The action research group issued and collected permission forms from parents and students. In the first quarter, the GPAs of all students included in the research established the baseline. Parents and students were given their access codes and trained in program use on "Back to School" night. Parents were also asked to complete the first survey. The first parent-teacher conferences were mid-October, and interviews were held with parents at that time. Student interviews were held the first part of October. GPAs were recorded at the end of the first quarter grading period.

Phase 2 (November – January) The recording of GPAs continued during this second phase. At the end of phase two, the information gathered from the second student survey was compiled.

Phase 3 (January – March) The final recording of GPAs occurred after completion of the third nine weeks. Final observations were made and noted through surveys received from the parents.

Data Collection Techniques

A general survey was handed out at various times throughout the school year to determine if the students and parents had Internet access at home, how often each group accessed the web-based program, if checking grades helped the students to improve, and if the students viewed their grades with their parents. The initial surveys were distributed to students and parents at the beginning of the school year. A second survey was disseminated to students at the end of second quarter. Students delivered the final survey for the parents to complete at the end of the third nine weeks.

Both formal and informal interviews for students and parents were conducted to determine how they liked the program, if they experienced problems, and if they found it informative. Formal interviews for students were held during the school day. Formal interviews for parents were held during parent-teacher conferences. Informal interviews were held with both parents and students via e-mail and personal memos and provided researchers the majority of the feedback.

A feature in the school administration program allowed recording the GPA statistics of all participants at the end of each quarter. The statistics feature also allowed for recording the number of times students and parents accessed the software.

Results

Student Progress

Student GPAs were analyzed following the first, second, and third quarters of the 2001-2002 school year. The results of averaged GPAs are shown in Figure 1. Based on a 4.0 grading scale, first quarter GPAs averaged 2.18, while second quarter dropped to 1.83, and third quarter

increased to 2.33. Outside factors that may have influenced first quarter grades include students' adjustment to new teachers and schedules and review of content material. Throughout the first quarter, students were becoming acquainted with the new online grading program.

Lack of weekly mandated visits during the second quarter resulted in a drop in student and teacher communication concerning grades. A drop in GPAs was also noted. The students were not taken to the computer lab on weekly visits; however, if a student wanted to view his/her grades using the classroom computer, access was not denied. The number of hits from both students and parents decreased during the second quarter.

Third quarter found students enthusiastic and more comfortable using the online grading program. This was accompanied by an increase in GPAs. Figures 2, 3, and 4 show the GPA fluctuation by performance groups. The most noteworthy increase was evident in Figure 2. The immense fluctuation in the low GPA group was enough to skew the results in Figure 1.

Students were taken to the computer lab for weekly mandated visits promoted by the classroom teachers.

Figure 1. GPA Averages

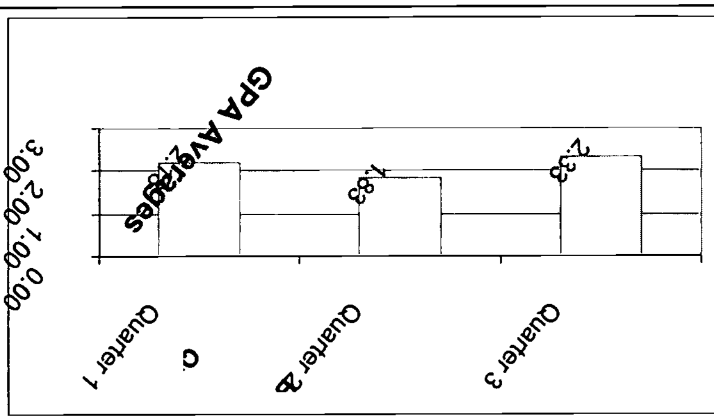


Figure 2. Low GPA Group

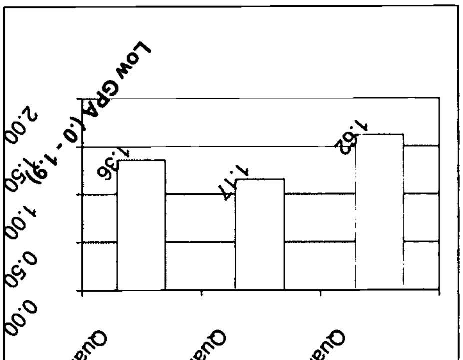


Figure 3. Average GPA Group

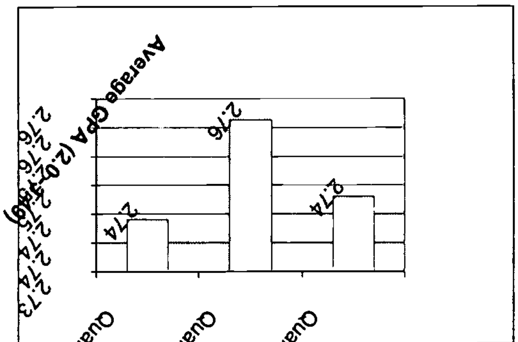
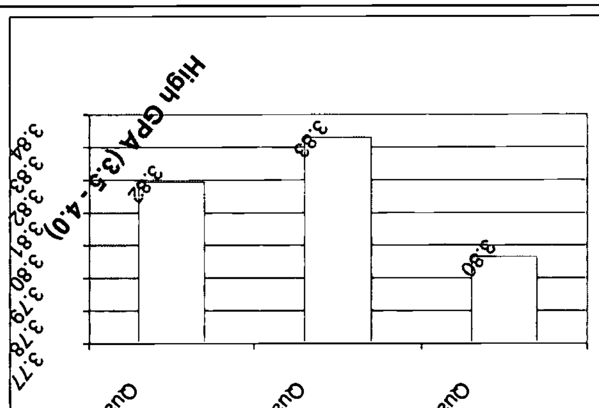


Figure 4. High GPA Group



Student Reflections

Students wrote a weekly memo to one of their teachers after viewing their grades online.

Students made supporting comments such as these:

> "I am really glad that my grade went up. My parents will be glad too."
> "All of my grades are good. In math, I thought I had a C, but I have a B."
> "I am surprised how my reading grade went up in just one day."
> "I like looking at my grades on the Internet."

> "I was not surprised at my grades, I was however glad to see that I brought English and social studies up."
> "Wow, I can't believe it. My grade is an A- in social studies… it is funny how it changed from a B+ to an A- in one day."
> "Getting my grades off the computer is fun. There is a lot of information about school, grades, lunch, and other stuff."

At the beginning of the research, 73% of the students surveyed reported having access to the Internet at home, library, friends' houses, or parents' workplace. Eighty percent of the students felt that checking the online grading program helped them to earn better grades. At the end of the second grading period, 56% of the surveyed students stated they had checked their grades online independently. Seventeen percent averaged weekly visits, while 13% averaged less than once a week, and the remaining 70% checked their grades only once a month.

Parental Involvement

Table 1 represents the total number of hits to the PowerSchool system during each of the quarters. These hits are district wide, which means they are inclusive of grades kindergarten through twelfth grade.

Table 1. District Wide Parental Access Statistics

	1st Quarter	2nd Quarter	3rd Quarter
Total accesses by parents to the online grading system	2848	2744	2901
Number of students whose records were accessed	456 (63.7%)	414 (57.9%)	452 (63.7%)
Average number of parent accesses per day	46.7	35.6	47.6
Number of parents signed up to receive progress reports via email	115 (16%)	115 (16%)	135 (19%)

Sixth-grade parents shared personal reflections in the surveys:

> "PowerSchool has allowed us to stay on top of grades, discuss assignments that were difficult…easy access to teachers…thanks for providing this service."

"It is the best thing that has happened for parents and students. It is a wonderful thing."
"PowerSchool is a great tool."
"I like getting the email progress report every week."
"I wish this was available years ago, thank you PowerSchool."
"I love it...wish we had it when I was in school...we would have done better."

Table 2. Parent Survey Results

Responses on Parent Survey	Percentage
Parents checked on the Internet and were aware of grades prior to distribution of report cards.	69%
Parents checked their child's grades on the Internet weekly.	44%
Child and parent who viewed grades together on the Internet.	43%
Parents believed a direct link between student academic achievement and Internet access to grades existed.	59%
Parents thought parent/child communication concerning school improved.	54%
Email/Internet access provided for better communication between parents and teachers.	37%
Parents viewed PowerSchool as beneficial.	69%

Teacher Interaction

The lab was reserved every week during the first and third quarters to allow student mandated access to the online grading program. During the first quarter, students required extensive teacher assistance to log-on and access their grades. By the third quarter, students could independently access their grades and complete their memos. The students looked forward to this designated time in the lab and showed disappointment when the research was completed. Outside the computer lab, the students requested time on classroom computers to check their grades. Teachers appreciated student independence to check grades rather than completing hand-written progress reports.

Administrative Impact

During the first and third quarters, the middle school principal gave this research project preferential scheduling in use of the computer lab. The principal approved the surveys given to parents and students. He provided extensive training to the staff in utilization of this web-based program. Under administrative direction, several training sessions were provided for parents to become acquainted with the online program. Through this program, the administration made online listing of the classes available for the following year.

Conclusion

The results of the 2001-2002 implementation of the web-based student information management program, PowerSchool, are consistently supportive of beneficial impacts on students, teachers, and parents. Overall student academic performance, as measured by GPA, increased by .15 with teacher mandated use of PowerSchool. This answered our first research question concerning student academic improvement due to regularly checking their grades. Research question number two can best be answered by noting the direct correlation between the students' access, parent hits on the web-based program, and student GPAs. The results of Table 1 also show the parents' involvement.

Table 3. PowerSchool Hits and GPAs

	1st Quarter	2nd Quarter	3rd Quarter
Student Hits	456	414	452
Parent Hits	2848	2744	2901
GPAs	2.18	1.83	2.33

As expected, higher-level students' academic progress did not fluctuate. Parents of higher-level students reported to the researchers that they were not concerned with their children's grades as the children were self-motivated and would maintain their usual average. The researchers were surprised, however, with the increased averages of the two top performance groups during the non-mandated second quarter. The low GPA achievers, as expected, made the most dramatic progress under teacher guidance. This helped clarify question three in determining improvement of student academic progress with teacher encouragement. Even though the low GPA students were the fewest in number, their progress had a profound bearing on the total results as shown in Figure 1. Certainly, there are many factors, including learner maturation, changes in pedagogy over time, and interest level in course content, which may have influenced GPA increases. However, the large jump in the grade point averages of our low achieving students who used the online system to track their grades is encouraging and warrants further study. The researchers learned an incredible amount through this research, but like any research they continue to have unanswered questions:

- Will students' utilization of the web-based program continue throughout the rest of their school years?
- Will use of online communication with teachers and parents increase?
- Will the enthusiasm from the sample group carry over to siblings and classmates?

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Appendix

Appendix A

Parent Survey
(NO NAMES PLEASE)

Please circle the answer that best applies to you or fill in the blank.

1. Do you log-on to the Internet?

   Yes No

2. If you do log-on, where do you access the Internet?
   Home
   Work
   Library
   Other ____________

3. When you know your child will be absent from school, do they get their assignments before they are absent or after they return to school?

   Before After

4. After a school absence, does your child complete and hand-in his/her assignments on time?

   Always Almost always Sometimes

5. Are your concerned about your child's schoolwork and how they do in school?

   Always Almost always Sometimes

6. Before you receive your child's report card, do you know what your child's grades will be?

   Always Almost always Sometimes Hardly ever

7. If you were aware of your child's report card grades, how did you know?

   Asked teacher Teacher told me Checked on Internet

8. If you checked your child's grades on the Internet, how often did you do this?

   Once a day Once a week Once a month

9. If you used the Internet to check your child's grades, did your child view their grades with you?

Yes No

10. By checking your child's grades on the Internet, did you think this helped them to earn better grades?

Yes No

11. By checking your child's grades on the Internet, do you think it helped your child be more aware of their assignments and grades?

Yes No

12. If you did not use the Internet to check your child's assignments and grades, do you think doing so would be helpful to you and your child?

Yes No

Appendix B

Initial Student Survey
(NO NAMES PLEASE)

Please circle the answer that best applies to you or fill in the blank

1. Other than at school, do you log-on to the Internet?
   Yes No

2. If you do log-on, where do you access the Internet?
   Home Library Other________________

3. When you know you will be absent from school, do you get your assignments before you are absent or after you return to school?
   Before After

4. After a school absence, do you complete and hand-in your assignments on time?
   Always Almost always Sometimes Hardly ever

5. Are your parents concerned about your schoolwork and how you do in school?
   Always Almost always Sometimes Not very much

6. Before you receive your report cards, do you know what your grades will be?
   Always Almost always Sometimes Hardly ever

7. If you were aware of your report card grades, how did you know?
   Asked teacher Teacher told me Checked on Internet

8. If you checked your grades on the Internet, how often did you do this?
   Once a day 2 or 3 times a week once a week other____________

9. If you used the Internet to check your grades, did your parent(s) view your grades with you?
   Yes No

10. By checking your grades on the Internet, did you think this helped you to earn better grades?
    Yes No

11. By checking your grades on the Internet, do you think it helped your parent(s) be more aware of your assignments and grades?
    Yes No

12. If you did not use the Internet to check your assignments and grades, do you think doing so would be helpful to you?
    Yes No

End of 2nd Quarter Student Survey

During this second nine weeks have you checked your grades using PowerSchool?

Yes No

If yes, how often do you check your grades?

Once a month Twice a month Once a week More than once a week

Environmental and Personal Factors Effecting K–12 Teacher Utilization of Technology

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Keywords: teachers, technology, adoption

ABSTRACT

The purpose of this study was to: (1) determine to what extent instructional technology was being utilized; (2) determine what was the descriptive profile of teacher use; and (3) to examine the environmental and personal factors that effected the decision to use instructional technology. The survey data was analyzed by cross tabulations and regression analysis to look for correlation or predictive factors between variables. The study results indicate that environmental factors such as access, the number of Internet connected computers, and the level of support and pressure are related to the focus and number of minutes of instructional technology use. Personal factors such as skill self-rating, and teacher beliefs were related to the focus, frequency, and number of minutes of instructional technology use. Teacher demographic characteristics of subject area taught, and years of computer experience were also indicated to be related to the number of minutes of instructional technology use.

INTRODUCTION

The current level of money, interest, and time being expended on technology based instruction in schools makes it a significant component of the educational process. Despite it's potential and the wealth of available information, many schools are still experiencing difficulty in implementing the use of technology in the classroom beyond drill and practice. Much of the research shows that in spite of current technology capabilities, instructional technology is primarily used in traditional ways to sustain existing curricula (Office of Technology Assessment, 1995) rather than to make major changes to reform education. But this is not new. Historically, education has really changed very little over the years despite technology and other reform efforts. Wide-scale adoption of many of these reform efforts failed for some of the same reasons computer technology has been slow to gain acceptance in schools today. Lack of funds, poor quality or unreliable equipment, poor planning, limited vision, insufficient time, and inadequate teacher training can all play a part in teacher disappointment and resistance to new technology (Snider, 1992).

The purpose of this study was to examine the level of utilization of instructional technology and the factors that predict its use. More specifically: (1) determine to what extent instructional technology was being utilized in selected public schools in southwest Louisiana, and (2) to examine the environmental and personal factors that effected the decision to use instructional technology. Areas of research that may be useful in explaining the phenomenon of teachers adopting instructional technology are: andragogy or adult learning theory, change theory, diffusion of innovations, Concerns-Based Adoption Model, and staff development concepts.

METHODS AND PROCEDURES

This study sample included four parish school districts in Louisiana. [The subdivisions for local government in Louisiana are referred to as parishes rather than counties. There are 64 parishes in the

state and each parish functions as a school district, as well as two additional city districts located in metropolitan areas. Although the student enrollment in the 66 school districts ranges from as few 1,285 students to as many as 82,187, approximately one-half of the districts have less than 6,000 students.]

The participants were 308 classroom teachers employed in unit (K-12) schools within this region. Total sample included the faculties of ten (10) schools. This was a non-random sample. As Table I, Socioeconomic and Demographic Information illustrates, there are variations in the demographic and socioeconomic characteristics of the sample school districts' host parish.

Table I. SOCIOECONOMIC AND DEMOGRAPHIC INFORMATION

Parish District	Parish Population [1]	% High School Graduates [2]	% College Graduates [2]	Median Income [3]
District A	24,218	57.1%	6.7%	$23,365
District B	180,607	70.3%	14.7%	$31,618
District C	8,969	61.1%	7.9%	$30,649
District D	31,423	59.9%	8.0%	$24,269
State Data	4,372,035	68.3%	16.1%	$27,265

U. S. Census Bureau Data [1]1999, [2]1990, [3]1995

District A has approximately 4,464 students, which rank it 41st statewide in student population. District D has approximately 6,000 students and ranks 32nd out of the 66 districts in student enrollment. District C would rank 61st in student enrollment with slightly more than 2,000 students. Districts A, C, and D are considered rural and are comprised of communities, relatively small towns and cities. In contrast, District B is the 5th largest district in the state with over 33,000 students. School district level characteristics are cited in Table II School District Sample Information.

It is important to study rural schools since 55% of the Louisiana public schools are located in either rural areas or small towns (Tompkins & Deloney, 1994). About one-half of the nation's public schools, and approximately 40% of public school students are in rural areas and small towns. That is,

of the approximately 80,700 public schools nationwide, 24% are in central cities, 27% are in urban fringe areas, and 49% are in rural areas. This also means that of the approximately 2.56 million public school teachers, about 41% are in rural and small town schools (NEA, 1998). Although this sample can not be considered representative of all public teachers, it does provide a snapshot of teachers in small rural schools.

Data collection utilized an anonymous survey developed to gather information in the areas of (1) Teacher Demographics, (2) Current Instructional Technology Use, (3) Environmental Factors, and (4) Personal Factors. The survey questions were developed based upon the literature in the field of

Table II. SCHOOL DISTRICT SAMPLE INFORMATION

School District	Total Number Schools/ Total Number Faculty	Number of Unit Schools/Number of Unit School Faculty*	% Poverty Level	% Minority	% Special Education
District A	11/ 335	3/80	31.2%	23.2%	9.6%
District B	57/2370	2/72	19.1%	23.8%	12.9%
District C	7/174	3/86	16.2%	6.2%	12.6%
District D	14/431	2/70	25.0%	19.5%	15.5%
Total 4	89/3310	10/308	--	--	--
State Data	1483/48,772	68/2,111	23.6% (58% F/R Lunch)	50.2%	--

Louisiana State Department of Education Progress Profile Reports 1998-99;*Principal Interview Data

educational technology and patterned after questions seeking data on similar criteria from other small studies and large-scale investigations. Other questions were developed based on research and theoretical constructs such as Roger's (1995) Perceived Attributes, Hall and Hord (1987) Stages of

Concern of the Concerns-Based Adoption Model, and the work of Michael Fullan (1991, 1996). The survey was designed to gather additional data in the area of teacher perceptions regarding pressure to adopt and utilize instructional technology.

Data was compiled in frequency counts and regression analysis by criteria being studied. Subgroups such as grade level, subject area, level of professional development participation, years of experience, etc. were reviewed in aggregate. The study design was a between-subjects correlational study. The independent variables were the specified personal and environmental factors. The dependent variable was the utilization of instructional technology. Data analysis included frequency tables, cross tabulation analysis, and analysis of variance (ANOVA) or regression analysis to look for differences between groups and correlation or predictive factors between variables.

Administrators from the selected schools participated in a brief interview prior to the distribution of the survey to the faculty. The questions developed for the Principal Interview were also grounded in the review of literature and aligned with the teacher survey. The Principal Interview questionnaire was utilized to clarify and validate teacher responses. A response was obtained from an administrator at each of the ten schools for the Principal Interview, or 100% response rate. The return rate for the teacher survey was 150 out of 308 or a 49% response rate.

SUMMARY OF FINDINGS

The teacher response sample included teachers across all grade levels (K-12), subject areas, years of teaching experience (one to more than twenty-six), degree levels (less than a bachelors to Education Specialists), and computer experience (less than one year to more than five years). It may be important to note that approximately 36% of the respondents indicated that they taught grades K-5, 15.3% middle school grades 6-8, 34.1% high school, and over 14% were multi-level special education or other. Over one-fourth (25.7%) of the teachers reported teaching in the core content subject areas of math, science, social studies, or English language arts, and 31.5% indicated elementary education as

their content area. Also over one-half (52%) of the sample indicated more than 15 years of teaching experience, and 34% had more than 20 years experience. It was also reported that 80% did have a home computer, and 69.9% of these were Internet connected.

Teacher responses were grouped for further analysis and comparison. Regarding the extent of technology use as addressed in the first research question, there were no real differences found in the average number of minutes engaged in Internet activities between elementary and core content teachers. There were slight differences in the average number of minutes students were engaged in technology based instruction, with more elementary teachers spending slightly more time per week. This was consistent with fewer elementary teachers reporting the frequency of use as rarely or never.

Cross tabulation analysis also indicated some differences between teachers with varying years of computer experience. Almost one-half (42%) of teachers indicating two years or less of computer experience, reported the weekly use of instructional technology for their average student was zero minutes, in contrast to only 17.5% of teachers indicating three or more years of experience with computers reporting at the same level of use. This is consistent with the responses for frequency of use with 52.2% of the less experienced teachers choosing the categories of rarely or never, compared to 27.1% of the more experienced teachers. There was a significant but weak relationship indicated through regression analysis between years of computer experience ($t=2.465$, $df=144$, $p<.05$) and the average number of minutes per week a student spent engaged in instructional technology. Hadley and Sheingold (1993) reported that most technology proficient teachers had five to nine years of computer experience.

Regarding the descriptive profile of teacher use, cross case analysis revealed classroom tasks, such as programming and graphics, although not very prevalent, were more predominant at the upper high school level and in the area of mathematics. The classroom task of utilizing instructional

software was most predominant at the elementary level, followed by educational games. The primary focus of technology based activities was drill and practice and whole-class instruction for the elementary educators. Other related studies resulted in similar findings. These include Ertmer, et al. (1999), who found in a small study of lower elementary teachers, the majority of use was for instructional games or drill and practice activities, and Cummings (1998), who reported that about 50% of the upper elementary teachers surveyed used technology for drill and practice.

There was a significant but weak relationship indicated through regression analysis between subject area taught and the average number of minutes per week a student spent engaged in instructional technology. English Language Arts and Reading teachers most often reported word processing tasks (57%) as the best description of instructional technology use in their classroom. Science teachers reported whole-class instruction (63%) as the primary focus, as did English Language Arts and Reading teachers (43%), whereas Social Studies teachers reported student-directed learning (44%). Most other subject areas were spread across the categories, with the exception of computer literacy skills, which was low or nonexistent. Core content teachers seemed to prefer whole-class instruction (43.1%) where elementary teachers cited drill and practice (38.3%) as the primary focus of instruction. Internet based activities appear to increase with grade level, and educational game activities seem to decrease.

Some differences were noted between teachers with a Bachelors degree or less, and teachers with advanced degrees. Many teachers with advanced degrees (38.9%), indicated whole-class instruction as the primary focus of instruction, compared to the teachers with a Bachelors degree or less (26.9%). Teachers with advanced degrees also reported less use of drill and practice, and student-directed activities than did their counterparts.

The study results regarding how technology is used in the curriculum were further validated by principal interview responses. The first principal interview question asked: Do you think technology should (a) be an optional supplement, (b) support and enrich, or (c) drive and shape the curriculum? Nine out of ten administrators chose "(b) to support and enrich the curriculum" and one administrator responding "(c) to drive and shape the curriculum". These responses are also aligned with the teacher responses. A majority of teachers (84.4%) also indicated that the role of technology in the curriculum was (b) to support, enrich and enhance.

Environmental Factor Summary

Study results indicated that the teachers did have ample access to technology. Less than 5% of the respondents indicated that they did not have at least one computer in their classroom. Over 80% indicated that there was at least one Internet connected computer in their classroom. Over one-third of the teachers surveyed indicated the classroom as their primary location for access, with about one-fourth citing equal access between the classroom and a computer lab. Analysis indicated that access in terms of the number of computers, and the number of Internet connected computers was positively related to the number of minutes of technology based instruction.

Almost one-half of the respondents indicated spending less than six hours in technology related professional development activities in the last two years. Approximately one-third reported they had never completed a technology related college course, and one-third had completed at least one. Slightly over one-half of the respondents indicated frequency of opportunities to participate in school or district sponsored technology training to be regularly once or twice a semester, or more often. There were no statistically significant relationships indicated between professional development and use in this study.

More than one-half of the teachers indicated that teachers in their school or district had

opportunities to provide input in decision-making and network to share ideas. Teachers citing that there were opportunities for input and networking also indicated a greater level of technology use in terms of average minutes per week. There were no statistically significant relationships indicated between perceptions of input and networking to technology use.

Approximately one-half of the respondents felt they had adequate or better support, and one-third indicated support was available, but more would be helpful. Teachers citing higher levels of support also indicated greater student engagement in instructional technology in terms of average minutes per week and frequency of use. Analysis indicated that the level of support was positively related to the focus of technology use. Over one-half of the teachers receive the majority of support from other teachers or school level personnel.

Slightly more than one-fourth of the respondents reported feeling pressured to utilize technology, and most of these cited administrators or principals as the greatest source of pressure. Analysis indicated that pressure may be related to the focus of technology use.

Personal Factor Summary

Almost all teachers surveyed rated themselves in the mid range of technological ability. Less than 2% of the respondents described themselves as a 'nonuser'. Nearly one-half felt that they could use specific programs and help students with technology, nearly one-fourth felt that they could integrate technology into the curriculum, and less than 20% indicated that they were beginners with limited experience. The self-reported ability was found to be consistent with the reported number of minutes of technology use—the higher the rating, the higher the level of reported use.

More teachers cited limited access as the primary barrier to technology integration than any other area. In light of responses regarding the number of available computers and setting, and the reported levels of use, access barriers may be in terms of a desire for an increase in the number of

computers per classroom for lower student to computer ratios, or other issues not addressed in this study. Limited time was the second most frequently cited barrier.

The indicated Stage of Concern for responding teachers as a group was not consistent with other indicators of technology use. The relatively low Stage 3 management and Stage 5 collaboration concerns do not support that most teachers have adopted or accepted instructional technology. The Stages of Concern most frequently cited (informational and personal) would typically be associated with novices, or teachers just beginning to use technology. More data would need to be collected on individual teachers to develop a more accurate profile with regard to the Stages of Concern. Although regression analysis did indicate a weak, but significant relationship between teacher concern and the focus of use.

In general, teachers in this study seemed to have a relatively positive perception of technology as indicated by survey responses regarding beliefs. Analysis indicated there was a possible relationship found between specific belief statements and the perceived attributes of observability and relative advantage, and the focus and description of technology use.

SUMMARY

More personal factors, such as statements relating to beliefs, concerns, and the perceived attribute of observability were found to be related to the focus of technology use, as were the environmental factors of the perception of support and pressure. Personal factors such as statements pertaining to beliefs, and to the perceived attribute of relative advantage were found to be related to the frequency of use. A weak relationship was noted between the environmental factor of the number of Internet connected computers in the classroom and the average number of minutes that students spent engaged in Internet based activities per week. A relationship was also indicated between the personal factor of teacher self-rating of their technological ability and the average number of minutes per week

that students were engaged in technology based activities, as was the environmental factor of the number of computers in the classroom.

Findings from the frequency counts, cross tabulation analysis and statistical tests of regression analysis indicated significant relationships between specific environmental and personal factors and the use of instructional technology. Some more anticipated predictors for frequency in minutes, were the number of computers in classrooms; and for self-reported frequency level, teachers' belief that computer knowledge would help teachers be better instructors and technology offered advantages over other instructional strategies. Although there were no significant findings relating to instructional technology tasks, teacher beliefs that it can improve student performance and teacher perceptions of support and pressure were related to the focus of instruction.

This study did not address how teachers may adapt technology use in the classroom nor its effectiveness as an instructional strategy. This study also did not address the effects of teacher personal interest, teacher workload, prior teacher knowledge, teacher pedagogy, or differences in leadership. This study did provide a snapshot of the various aspects of technology utilization for teachers in rural K-12 unit schools. Thus, the results of this study may have limited generalizability to other school systems or faculty.

Although this was a small study involving ten public schools in four districts, many prior studies were also relatively small. Marcinkiewicz's 1993 study included 170 participants from four schools. Oliver's 1994 Australian study of beginning teachers had 122 respondents. Chiero (1999) utilized a 48-item survey to gather data from 36 K-12 teachers enrolled in one of three college courses. Cummings (1998) surveyed 30 K-5 teachers with a 60-item survey. The qualitative studies involved smaller samples of seven (Ertmer, 1999), and ten (Stuhlmann, 1998). Much of the information from frequency counts and cross tabulations was consistent with prior studies. Demographics such as years

of teaching experience was found to be significant in prior studies (Hadley & Sheingold, 1993; Maney, 1994; Becker, 1994; Harris & Grandgenett, 1999) as was years of computer experience, with the exception of Maney (1994). The results of this study also indicated that the years of computing experience and the subject area taught were related to the number of minutes of instructional technology use.

The only finding that may have been somewhat unexpected, was the relatively overall positive indicators toward instructional technology in beliefs, and a higher level of reported access and use. The study participants reported greater access to technology than many prior studies (Blankenship, 1998; Jaber, 1997; OTA, 1995). This increase in available technologies may be a result of increased state, federal, or local funding initiatives, or the natural expansion of technology in society. As demand increases and costs decrease, technology access and use is becoming more prevalent. Technology is changing so rapidly, it is difficult for research to stay abreast of the current trends.

Other environmental issues, such as support and pressure, were found to be related to use. These concepts were also discussed by prior researchers (Carter, 1998; Chiero,1997; Dirksen & Tharp, 2000; Dwyer, Ringstaff, & Sandholtz,1991; Ely,1990), as potential predictors or factors influencing technology use. Teacher self-rating of technology ability was also found to be related to technology use in this study, and was a strong predictor found in prior studies conducted by Becker (1999) and Chiero (1997). As students from this 'technological' generation enter the teaching profession, it could be expected that instructional technology use will increase.

The results indicate that most teachers are accepting technology in the classroom and want to learn more about it, as evidenced by the 85.7% affirmative response to intentions for future use. The study results indicate how environmental factors such as access, the number of Internet connected computers, and the level of support and pressure are related to the focus and number of minutes of

instructional technology use. The study results also indicated that personal factors such as the self-rating of technological skill and teacher beliefs were related to the focus, frequency, and number of minutes of instructional technology use. Teacher demographic characteristics of subject area taught and years of computer experience were also indicated to be related to the number of minutes of instructional technology use.

Results of this study indicated that training opportunities were available, at least at the district level for the majority of teachers. The finding of the relationship between computer experience and use further suggests the potential impact of quality training and inservice activities. The absence of relationships between other demographic variables indicates a limited impact on use, and should be less of a concern for technology coordinators and staff developers.

The study results also indicate that teachers' beliefs regarding the value of technology is related to the level of use. This finding suggests that for more effective inservices, technology leaders must make the crucial link between the technology and the desired educational outcome. Teachers need to see that utilizing the tools of technology will produce positive student gains before they will risk adopting its use. The costs of utilizing educational technology in terms of dollars, time, and sheer human effort are much too high, to not try to accomplish it as efficiently and effectively as possible. Study results indicate access alone, is not enough to ensure utilization of technology in terms of frequency (time) and variety of focus or tasks should be systematically encouraged.

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Total Operational Costs Report

By

George Harris

Index

Summary

Northern Valley Regional High School has been involved in implementing a technology strategy for over a decade. In 1993, there was a large infusion of capital and a continued Board of Education commitment to provide for the integration of technology into the school's curriculum. The path that the school district chose involved several false starts, but many successes. It is the goal of the Technology Coordinator and Network Engineer, through this document, to explain to the stakeholders in the school district the outstanding performance and value they have received through their commitment to technology.

This document outlines how the funding that the Board of Education has provided was spent and will be spent over the next three years. Included with this outline will be several industry models that are geared towards business and public facilities. Comparing Northern Valley to both types of models will help the reader understand how to interpret the findings from this analysis.

The findings of this analysis show that, in summary, Northern Valley Regional High School is approximately six times more efficient than the average business in operating technology. When comparing Northern

Valley to the public organization models, again, the school district surpasses the averages. The delivery of technology in Northern Valley is approximately three times more efficient than other public facilities.

Use of funds in an effective manner, while providing not only technology for the Northern Valley organization, but also including support mechanisms that meet the organization's demands is a critically challenging task. Over the past six years, the support structure and mechanics have been constantly revised. The continuing cycle of implement, review, improve, and re-implement has resulted in a technology support product that has vastly improved users expectations and confidence in the ongoing need for repairing and troubleshooting technology problems. This improved organization has provided the school district with the ability to support roughly three times the number of computers as an equally sized public institution and roughly six times the number of computers of an equally sized business.

Evolution

For more than a decade private companies, industry analysts and technology firms have been exploring and researching two items. The first is called Total Cost of Ownership. The second is called Total Cost of Operations. Both are very important litmus tests in understanding how an organization functions and delivers technology through the years. Due to the same acronym for both processes (TCO) the writers have decided to change Total Cost of Operations to Total Operational Costs. This will allow for better distinction and less confusion between the processes.

Total Cost of Ownership (TCO) is based on two factors: Budgeted Costs and Unbudgeted Costs. Purchase of hardware, depreciation of hardware over its life cycle, software, staffing, an Internet connection, training, upgrades, repairs, and disposal costs are all part of the Budgeted Costs component. Lost work time due to broken hardware, downed connections, poor training, or inefficient processes are all Unbudgeted Costs. By adding the annually budgeted and unbudgeted costs associated with a computer over its lifetime, an organization can find the Total Cost of Ownership for a computer's operation in their environment. All of the

organization's individual computer costs are then averaged together to give an average Total Cost of Ownership.

The industry numbers associated with Total Cost of Ownership are highly subjective. This is due to the addition of unbudgeted costs. Lost work is very difficult to quantify in any organization. The range of Total Cost of Ownership is from $8,000 to $16,000, depending on the values that companies associate for lost work.

Total Operational Costs (TOC) is based on a slightly different model. Structured on the understanding that technology is not stagnant and requires continual maintenance; Total Operational Costs are defined as the cost to maintain a piece of technology within an organization per year. By adding all of the real costs associated with technology and dividing by the number of computers, an organization can find their cost per computer per year. The reader should note that these numbers do not include lost work or organizational inefficiencies due to poor process implementation, such as with Total Cost of Ownership.

Operations Costs look at every facet, just like Ownership Costs, but are less subjective. By looking at only the financial obligations required to maintain technology, Operations Costs can be compared very easily across all types of associations, companies and organizations.

Organizations with similar budgets and structures can realistically compare their effectiveness and efficiency. It should be noted that Total Operational Cost numbers are significantly lower than Total Cost of Ownership numbers. As stated before, Ownership Costs range from $8,000 to $16,000 per computer, where Costs of Operation are typically under $6,000 per computer.

To understand what the Total Operational Costs mean to the Northern Valley School District, the Network Engineer and Technology Coordinator have gathered all of the components that pertain to the organization. With the help of the business office, the financial information that was required was extracted from the previous years' budget reports and extrapolations were made for the next three years.

Future projections were then made based on many factors. All of the same items that had to be researched from the previous budgets now have to be projected for three years. The list of items to take into consideration is quite long. All of the following factors are included in the analysis, but this is by no means the full list: (computer purchases, longevity of legacy equipment, construction, network wiring, research and developement projects, server upgrades, software upgrades, changes in classroom usage, changes in software used in curriculum, employee costs,

technology services provided to the community, repair and maintenance contracts, data processing costs, repair costs, disposal fees, office costs for technology, telephone services, training costs, peripherals such as printers, scanners, and projectors, and technology supplies).

The Total Operational Costs lifecycle begins with the understanding that the District must be committed to technology and its evolution. Based on the following chart, the district can self-test itself in six categories. This chart is provided by The Consortium for School Networking. They are a non-profit organization that helps schools organize and understand Total Operational Costs and Total Cost of Ownership objectives and responsibilities within the context of an academic setting.

Comparing the six TCO categories in Table A to Northern Valley's operating procedure, we can note the following items: Northern Valley spends about 17% of its budget on professional development. Support is an integral part of the Northern Valley technology model and there are eight full-time technical people supporting the district's technology initiatives. Software is centrally supported and upgrades are regularly planned, though not on an annual basis, but the choices for software are left to the individual departments and Office of Curriculum and

Instruction. Technology is replaced based on the district's six-year curriculum cycle. The district has continually explored the importance of facility planning and has done modifications to its electrical structure and plans for future growth both in the current buildings and in any new construction. The school completed a network infrastructure upgrade that will meet the current needs and provides the accommodations to grow to meet district's future requirements.

Over the past seven years, Northern Valley has done an excellent job of identifying the many items needed for supporting technology initiatives. Once identified, the district has committed the necessary structure to support all of the facets needed to maintain technology. Some of these items were proactively looked at and solved before problems occurred; others were continually modified over the past years to reach an appropriate solution. Regardless of the path chosen, all of these items have been and will continue to be adjusted to meet the needs of the district.

Table A: TCO Category Chart

	The "TCO-Savvy" District	The "Doing the Best We Can" District	The "Worry About It Tomorrow" District
Professional Development	Devotes 15-30% of its budget to staff development	Provides some staff training, but not at times that are convenient or when staff is ready to put the lessons to work	Assumes that teachers and staff "will learn on the job"
Support	Provides computer support at a ratio of at least one support person for every 50 to 70 computers or one person for every 500 computers in a	Relies on a patchwork of teachers, students and overworked district staff to maintain network and fix problems.	Relies on the "hey Joe" sort of informal support

	closely managed networked environment	Does not track the amount of time its network is down or computers are not in use	
Softwar e	Recognizes that the greater diversity of software packages and operating systems, the more the support that will be required. Makes provisions for regular upgrading of software packages	Utilizes centralized software purchasing, but choice of application and respective support left to individual schools and/or staff members	Expects support personnel to manage whatever software happens to be installed on a district computer
Replace ment Costs	Budgets to replace computers on a regular schedule, usually every five years, whether leased	Plans to replace computers when they no longer can be repaired	Assumes that when computers are purchased with 20-year bonds

	or purchased		that they will last forever
Retrofitting	Recognizes that many school buildings will require modifications of electrical, heating and cooling systems, as well as asbestos removal, to accommodate new technology, and budgets accordingly. When possible, makes these improvements when schools are being built or renovated.	Understands minimum and recommended requirements for electrical and other infrastructure improvements and incorporates them when funding is available	Pulls the wires and then blows the fuses
Connectivity	Plans its network to provide connections that provide enough	Has the bandwidth it needs today, but has no plan for	A phone and a modem, what more do you

	bandwidth to manage current--and future--needs, especially multimedia applications	scaling it upward as demand grows	need?

Cost Analysis

With a commitment to a Total Operational Costs process and its lifecycle, the district can look at the three phases that make up TOC. In the Analysis phase, all of the pertinent numbers are acquired. In the Improvement phase, alternatives are modeled and then selections are made to reduce TOC. In the Management Phase, implementation, trend analysis and validation processes are measured. This cycle should be done every six months, but in a public organization, the cycle is stretched out to accommodate the fiscal year.

The analysis of Northern Valley Regional High School's TOC can be found in Appendix A. The table shows the breakdown of all technology spending in the school district. Personnel Totals are the costs for all of the persons hired by the school district that are directly involved in technology. This includes staff development, data processing, technical support and secretarial support. The general computer fund is used to purchase any technology for the district. Repair/Maintenance is for fixing broken computers; where the services account is used for annual support contracts. The training account covers the staff development costs for outfitting the three support rooms in the district. Substitute costs are

paid for by the Office of Curriculum and Instruction. These are the fees associated with having a teacher attend a technology-training workshop. Telephone costs are only the telephone fees associated with technology. These are Internet access fees, T1 connection costs, and Dial-in access line fees. Data Processing contains all of the expenses associated with the student database system. Hardware, software, forms, supplies, training, and any other costs that are incurred by the department are taken from this account.

The Distant Learning Refund is money that the New Jersey Department of Education allocates to the school district. This money can only be used for certain types of technology expenditures. The current amount of the refund is based on $43.00 per enrolled student. In the 2000-2001 school year, the school district was able to carry-over part of the money from the previous fiscal year.

This carry-over coupled with the purchase of the new student database system (TENEX) has skewed some of the numbers between the 1999-2000 and 2000-2001 school years. Approximately $17,000 was moved into the 2000-2001 school year from the previous year. The TENEX purchase also inflated the 1999-2000 Data Processing element by an additional $50,000. These two factors caused an overall increase of

$100,000 to occur between the 1998-1999 and the 1999-2000 school budgets.

The 2000-2001 school year also had a large percentage increase in expenditures. This increase was due to the increased support commitment by the stakeholders. Several personnel additions were made to the support structure, which greatly increased this particular expense. Overall, this was the primary cause for the second large percentage increase in total expenditures. One should note that the average percentage increase over the past five years for technology expenditures in the school district is 4.23%.

Based on research done by the Gartner and Forrester Groups, the average technology budget is between 2% and 9% of the total operating budget. Percentages increase proportionately with the total size of an organization's budget. Based on this research, Northern Valley School District's targeted technology budget should be 4% of the total budget. The average technology percentage of the Northern Valley budget for the past five years is 3.69%. Including into this average the 2001-2004 school year projections, the average percentage will be 3.80%.

Based on similarly sized corporations the average Total Operational Costs are $4,950.00. Similar sized public organizations are expected to

expend half of this amount, or $2,475.00. The reduction in operation costs is based on public organizations inability to acquire appropriate commitments from federal, state, or local leaders when dealing with technology. As can be seen in Appendix A, The Total Operational Costs for the Northern Valley Regional High School has continually dropped, from a cost of $1,197 per computer down to $880 per computer.

In the three projected years (2001-2004), several factors will help drive these costs lower. First, a replacement of several departments' legacy technology will drive the repair costs down. Many of these components are out of warranty and require a great deal of maintenance to continue their operation. Before the full implementation of the school district's technology plan there will be computers in the district that are ten years old. Removal of these computers will greatly enhance the district's ability to manage repair costs. Second, the school district's highly fluctuating costs associated with Data Processing will be under control. The previously installed system was too cumbersome to adequately control costs and there was no consistent support structure to manage those costs. Finally, an overall structured technology implementation plan was used to layout six years of cost estimates. This plan has organized where and when technology expenditures will be made.

The structure, provided by the technology plan, has helped to normalize costs over future fiscal years without over-burdening any single year. Ultimately, the Total Operational Costs are estimated to drop to $842 per computer.

Results

This analysis shows that Northern Valley Regional High School has shown a great commitment to implementing technology in an effective manner. The school district is also able to drive Total Operational Costs well below the corporate and public institution averages. In fact, the district's TOC is almost one-third the cost of the public institution average and nearly one-sixth the corporate average.

In Appendix B, Technology Expenditures, it can be seen that the financial commitment for technology will continue to grow. The largest portion of the technology commitment will be towards personnel costs, accounting for 60% of the total technology budget. Data processing and the general computer fund will account for about 25% of the budget. The remaining 15% will be divided between the remaining accounts. The accounts that comprise the 15% section do not have the fluctuation or projected growth that can be seen in the General Computer Fund, Data Processing or Personnel accounts.

Appendix C, Total Operational Costs – TOC vs. Computers vs. Expenditures, shows a comparison between expenditures, the number of computers, and the actual Total Operational Costs. Even with the increase

in expenditures and the numbers of computers in the school district, the Total Operational Cost is being driven down.

As the school district's stakeholders look into the next three years, there will be a continued analysis of technology costs. By understanding all of the costs involved, the stakeholders can better manage the overall technology budget. As can be seen from the historical data, TOC has dropped from $1,197 to $880 per computer. This figure is expected to be lowered an additional $38, over the next three years, bringing TOC to $842 per computer.

Stakeholders should feel proud of their accomplishments with technology. The delivery of quality services at an economic price underscore the management, organization and dedication of all members involved in the process. A typical public organization would either have to spend three times more money to achieve the same results or make due with one third of the technology and services deployed at Northern Valley.

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Criteria for Evaluating Web-based Hypertext

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ABSTRACT

This study focuses on teachers as designers using constructive hypertext and their perspectives on evaluating Web-based hypertext projects. The research setting was a graduate level course focused on learning hypertext and designing hypertext projects in Web-based environments. The participants of this study were in-service teachers and graduate students majoring in education. There were eleven participants in this study. During the ten-week course, the participants learned how to design hypertext, studied different aspects of hypertext theories and discussed the criteria for evaluating hypertext projects.

This study describes and interprets the participants' learning process in applying hypertext theory in their Web design and evaluating Web-based hypertext. Writing hypertext is writing a story waiting to be unfolded differently for each reader. In hypertext, there are fewer conventional constraints on authors, and infinite possibilities for readers. This research captures some of the inspiring moments of how the participants learned hypertext theory, created hypertext projects and evaluated hypertext projects.

Introduction: What is Hypertext?

Hypertext refers to systems permitting electronic representation of text to take advantage of the random access capabilities of computers in order to overcome the strictly sequential medium of print on paper (Nelson, 1987; Marchionini, 1988; Bolter, 1991).

Michael Joyce (1997) defines hypertext as "reading and writing in an order you choose where your choices change the nature of what you read" (p. 580-1). Given the ever-changing nature of the World Wide Web and the enormous amount of information

on the Web, Joyce also describes hypertext on the Internet as "a representation of the text that escapes and surprises by turns" (1997, p. 580).

In *The Electronic Labyrinth*, a study of hypertext technology, Keep, McLaughlin, & Robin (1995) define hypertext in terms of the experiences of the authors and the readers rather than the technological features of hypertext. They view hypertext as a technology with the ability to offer multiple authorships, to blur the distinction between the author and reader functions, to provide different reading paths, and to enrich works with links to other works and media with expansive boundaries. Hypertext not only provides authors new ways of writing and interacting with readers, but also invites readers to explore new ways of reading, thus complicating the functions of the author and challenging the authority of the author.

Michael Joyce (1995) discusses the differences between exploratory and constructive hypertext. Exploratory hypertext lets a reader explore the text and build a path or a web of knowledge of her own. Constructive hypertext encourages a reader to construct her own learning paths, and has the capacity to visually represent the paths a reader creates. Snyder (1996) argues that constructive hypertext is meant for authors and designers to develop their ideas and creativity. Constructive hypertext is also a great means for students who learn by doing or constructing (Jonassen, Peck & Wilson, 1999). Constructive hypertext encourages the participants not only to be users of hypertext, but also designers of hypertext. The study describes the participants' experiences as designers and their thoughts on evaluating hypertext projects in Web-based environments.

Bolter (1994) states that electronic writing or writing in hypertext entails "the qualities of fluidity, multiplicity, and dispersed control" (p. 8). Odin (1997) describes hypertext aesthetics as "non-linear, multivocal, open, non-hierarchical aesthetic involving active encounters" (p. 599), as opposed to the linear, univocal, closed, authoritative aesthetic. Both Bolter and Odin see reading and writing in hypertext as fluid, free and interactive. Odin further states that, "Since hypertext reading/writing involves active encounter and traversal, the reader becomes an integral part of the topological space created by the interaction of multiple texts " (p. 604). Hypertext changes the conventional ways of reading and writing, the roles of the readers and writers and the way authors and readers interact with text.

Odin (1997) states that, "The fragmentation and discontinuity that define the hypertextual environment do not lead to a fractured reading experience. In fact, the links between the nodes promote multiple narrative trajectories" (p. 605). It is the links that connect the text together, not disperse the meanings of the text. She further describes that "The multiple readings of the text finally lie not so much in what the lexias say, but rather in the relationship they forge with one another. These relations come into existence and dissolve with each reading and unfold into different versions of the text" (p. 612). Hypertext provides a great flexibility in writing, and enables multiple readings of the text. In the hypertextual space, authors are able to write text with nonlinear or multilinear paths; readers are invited to interact with text from multiple perspectives, and weave together text and meanings in each reading of the text.

However, hypertext aesthetics can be fragmented and discontinuous. The hypertextual experience may be temporal, deferring and constantly changing. For some that are accustomed to linear text, and/or value linear, logical thinking, the hypertextual experience seems precarious and disrupting. Therefore, this research focuses in-depth on hypertext and its implications on reading and writing, the roles of author and reader and their relationship, their interactions with each other and the text, and evaluation criteria emerging from designing and reading hypertext.

Evaluating design requires a multidisciplinary range of the criteria (Kerne, 1998; Alben, 1996). Since hypertext is a multidisciplinary field (Unsworth, 1997), criteria for evaluating hypertext design requires considerations from multidisciplinary approaches/ perspectives, including interactivity (Kristof & Satran, 1995), aesthetics (Alben, 1996; Weiman, 1999), navigation (Harpold, 1991; Jacobson & Spiro, 1995; Lawless & Brown, 1997), human-computer interface (HCI) design (Shneiderman, 1998, 2000; Kerne, 1998) and usability (Alben, 1996; Nielsen, 1995, 2000). It also depends on the purpose of the design and the intended audience. Since the main focus of this research is the study of designing hypertext in Web-based environments, criteria for evaluating hypertext design focus on the applications of hypertext theory in Web design.

Data Sources

This research employed three different methods of data collection, including observation, interviews, and document analysis. The research setting was a graduate course on hypertext and the World Wide Web at a large Mid-Western University. The class met once a week for about four hours. The first two hours were devoted to discussions about hypertext-related readings, and design problems, both theoretical and technical. The last two hours were lab time for the participants to learn Web design and to share their projects. The researcher participated in both the discussion and lab sections as a participant observer. The researcher interviewed every member of the class and collected their hypertext design projects for document analysis. The interviews were transcribed, coded and analyzed.

At the beginning of the course, the researcher distributed a consent form and a Preliminary Questionnaire to collect background information and information about students' computer skills. The researcher also described the study and asked for volunteers for full participation. All eleven students agreed to participate in the study.

The students had different kinds and levels of computer skills and different levels of hypertext literacy. Some students had never browsed the Web, and some had designed Web pages before. Six of them were full-time graduate students, and five were either full time teachers or other professionals.

During the course, the participants were exposed to hypertext fiction and Web-based hypertext documents. The participants were also required to design three Web-based hypertext projects and share their projects with the class. The main sources for this study were interview transcripts and hypertext projects produced by the participants. This data analysis paid close attention to the participants' experience in designing hypertext, and their perspectives on evaluating hypertext.

The Hypertext Projects

The students in this course were required to design three hypertext projects. Each project assignment was designed with a unique purpose [and objectives]. The first project was to subvert a linear text. Since it was the first project, most of the students were still learning about hypertext, both theoretically and technically, so the nature of the first

project was experimental. The second project was to create hypertext. Most of the students created something that was either familiar to them or was their personal interest so most of these projects were either personal or educational. The third project was to find an existing text, critique its linearity and redesign the text into a hypertext document.

Discussions and Results

Learning about Hypertext

> …to understand hypertext, you must experience it. – Snyder (1996, p. xi)

For most of the participants, this was their first time designing web pages and learning hypertext theory. In the beginning of the course, they related the conception of hypertext mostly to hyperlinks on the World-Wide Web. Towards the end of the course, most of them said that studying and designing hypertext broadened their understanding of hypertext and made them rethink and even question some aspects of hypertext.

The participants talked about hypertext in different contexts and thought of hypertext in many different ways from their design experiences. For instance, one participant thought of hypertext as an aesthetic medium to tell stories, while another thought of hypertext as a different mode of writing and expressing self. In the beginning, some thought of hypertext in terms of Web pages with links. Throughout their learning process, most of them realized that there is more to hypertext than links. Hypertext challenges conventional ways of reading and writing, such as linearity, narrative and closure. Instead, hypertext supports non-linearity, multiple perspectives, decentering, randomness, openness, and intertextuality. Some participants used storytelling to explore the unique hypertextual narrative and interactivity. Some have become more aware of linearity in text in everyday life because of their hypertext reading and designing experiences. Most of them expressed opinions reflecting advantages and disadvantages of hypertext to traditional linear writing.

Some aspects of hypertext theory were more important and inspiring for some particular participants. In the following section, I will discuss some of the hypertext

aesthetics/characteristics the participants took on in their hypertext design and their reading of hypertext.

Hypertext Aesthetics: Writing Hypertext

In writing hypertext, non-linearity and/or multi-linearity is the essence of hypertext, and most participants' projects worked to subvert the linearity of text. With non-linearity or multi-linearity, multiple perspectives were fostered. Issues surrounding multiple voices and points of views were also raised.

Non-linearity

Hypertext is defined as non-linear, non-sequential writing (Nelson, 1980). Students of hypertext usually realize quickly that they can either really speak through non-linearity and find their voices, or they loathe the non-linearity and long for the clarity and the comfort of linear narrative.

Multiple Perspectives / Voices / Multi-linearity

Multiple perspectives and voices are one of the distinguishing characteristics of hypertext. Nonlinearity and/or multi-linearity of hypertext supports and encourages multiple perspective and voices. In constructing hypertext, there are always contesting voices and perspectives in the text. Authors can include different voices and perspectives through links, paths, multiple sequences, and juxtaposition.

Randomness

Randomness is another feature of hypertext. Hypertext provides readers with random access to information and enables authors to present text, information and stories in a random order.

Overall, the participants subverted linearity by disrupting the sequence to tell different kinds of stories, and/or adding forking paths to present either more in-depth or broader information.

The process of creating hypertext allowed the participants to construct their personal narratives. Although a purpose of hypertext is to subvert linearity, somehow, in these projects, the participants as hypertext authors were able to weave their personal experiences into hypertext narrative that was neither linear nor sequential, yet told stories that conveyed a sense of personal feelings. The participants as hypertext readers, on the other hand, also were able to read from nonlinear text and weave together stories and construct individual narrative from the hypertextual text.

In writing and reading hypertext, hypertext readers and writers invested themselves in the text and created their own individual narrative, even though it was not linear. Hypertext authors used non-linearity of the hypertext medium as an unconventional way for storytelling and created their own personal narrative. Hypertext readers followed the hypertextual narrative and constructed their own understanding of the stories.

Hypertext Aesthetics: Reading Hypertext

In reading hypertext, hypertext opens up possibilities and simultaneously poses challenges to readers. Writing hypertext is like trying to tell stories with many beginnings and endings. Reading hypertext is like trying to piece together thousands of puzzles or to find your favorite storyline to follow from countless threads. With hypertext, readers are presented with openness, intertextualiity, decentering and interactivity. Hypertext readers have more freedom as well as responsibility to explore and connect in order to understand nonlinear text.

Openness, Decentering and Intertextuality

Openness indicates text with open endings, or ever revolving, never-ending stories. On the World Wide Web, readers can click a link, jump to other sites, and never come back to the page where they start. Sometimes readers may not be aware that they have left one page and gone to pages that are made by different authors.

With hypertext narrative, each link could start another center, another story. Every time a reader reads a story and links the one story to another story, the center of the story and characters are recentered again. It is constant decentering and recentering.

Closure

Some participants argued that hypertext did not have to always be open-ended. Some did not expect hypertext with only one ending, but would prefer hypertext with some sort of ending, such as multiple endings or multiple ways to an ending. Just as different authors write different kinds of hypertext, different readers offer different kinds of readings. Different readers also look for different features. Some readers look for interactivity; some prefer hypertext narrative; some insist on having closure.

In this study, some of the participants as hypertext readers still look for narrative and coherence in hypertext. However, as hypertext authors, most of the participants are fond of non-linearity, and embrace hypertext narratives when it comes to writing without definitive beginnings or endings. Some of the participants even express that it is difficult for them to go back to writing linearly.

For the participants who seek for narrative and closure, reading hypertext fiction such as *its name was Penelope* is somehow frustrating. Most hypertext fiction contains pieces of story that are read randomly or multi-linearly. Some readers can't help feeling lost and frustrated because hypertext fiction discards the conventions of fiction and "narrative is how we explain the world to ourselves." (Gibson, 1996, p. 7)

Interactivity

Interactivity is another promise of hypertext. Hypertext is said to encourage interactivity. What is interactivity? Do authors and readers interact? How do readers interact with text? There are different levels of interactions between authors, readers and text. Some authors use links to add voices, possibilities and depth, some use network connectivity such as email to connect and/or interact with readers. Some authors hope to let readers interact with the text by having the ability to add and/or change the text / content freely. Some of the participants' expectations of interactivity from the readers are just as one of the participants stated "like the way any author would, to reflect upon or draw in personal experiences as they were reading and to connect to the text in a meaningful way." Interactions between readers, authors, and the text are highly expected, but hard to achieve. Jay Bolter (1991) argues "readers cannot avoid writing the text itself,

since every choice they make is an act of writing" (p. 144). While some authors agree with Bolter and think that while readers are making links, they are already (re)writing the text. Some authors and readers would only consider real time conversation in cyberspace as interactions.

Criteria for Evaluating Hypertext

The participants not only learned about hypertext theory, and designing hypertext, they also learned about evaluating hypertext. In addition to their roles as designers, the participants are readers, users and critics of other participants' projects.

In my interview, I'd ask my participants which project(s) from the class or on the Internet they liked best and what criteria they considered for good web design. They were asked to talk about their own projects and design processes as well.

At the end of the course, the participants created about 33 hypertext web-based projects. There were some projects that got mentioned more often by the participants, including *The Kent State project*, *The Quilt project*, Julia's *Untitled* projects, and *The 40-day project.*

The Kent State project was created by a middle school teacher. She talked about her college experience in Kent State in the 1970s and the shooting incident that happened on the campus. The project was done in black and white. She tried to mix different perspectives and voices in her project so her own voice wouldn't come out too strong, but she felt that the author's voice came out anyway.

The Quilt project was created by a Masters student. She created the project to teach her daughter about the history of Ohio by integrating stories about the Freedom Trail and quilt-making. It was also part of her Masters degree project.

Julia's *Untitled* projects were about her own experience on the day that she had the surgery to remove her liver cancer. She created a hypertext project that weaved together the experiences of her best friend's, her mother's, her doctor's and her own on that single day.

The 40-day project was created by a middle school teacher. She had spent 25 years in Sierra Leone. She returned to the state after her husband's death. Her project was about the ritual that people performed upon her husband's death in Sierra Leone.

When the participants were asked to create hypertext projects, some of them chose something that was really close to their heart. Some of the participants noted that the non-linearity of hypertext helped them sort through complex emotions about their theme, and the notion of creating something also invited / encouraged them to write about their emotions and personal experiences.

Some of the participants who read the projects were touched by the personal feelings as well. The projects were mentioned by the participants tend to have personal narratives in them. The participants also commented on the well-designed text, graphics and overall quality of these projects.

The participants were also asked to read a hypertext fiction titled *its name was Penelope* by Judy Malloy. It's about an artist, a photographer's life. The story is presented in snapshot fashion and is about the photographer's life. Readers will read different moments of her life randomly. Some of the participants were really inspired by the nonlinearity of the text, but some were really distraught by the randomness of the text and really longed for linear narrative, closures and endings.

In summary, different participants had different takes on hypertext aesthetics. Some participants were fond of hypertext narratives; some were still looking for closures and endings. The participants either really liked hypertext, or missed the traditional text with definitive openings and endings. When it comes to select their favorite projects, different participants had different favorite projects, but they tended to remember and/or choose the ones that had personal feelings and meanings in them, such as *The Quilt project, the Kent State project,* Julia's *Untitled project and The 40-day project.*

When the participants were asked about their criteria for evaluating hypertext Web projects in general, the following criteria were mentioned:

1. Well-designed navigation: simple and clear, not too much, too overpowering, easy to work with, easy to find things and download. The heart of hypertext is nonlinearity, but readers still try to piece together something that is nonlinear in order to understand the text. Therefore, well-designed navigation is very important to readers. Pure randomness is fun for experiments, but not as widely appreciated by the readers.

2. Visual presentation: aesthetically pleasing, and eye-catching design. Readers appreciate visually pleasing graphics and layouts, but not too much flashy multimedia.

Although graphics and multimedia can help authors to tell part of the story and/or present information, the practice of simplicity is still a virtue.

3. Personal, meaningful, mood-setting: The purpose of the project set the tone for its audience. In this study, there are some touching personal experiences and stories; readers appreciate and are moved by the sharing of experiences. As one of the participant stated: He was very moved by some of the authors and designers who created a very personal narrative by using an impersonal media.

4. Coherence, harmony: Some participants look for coherence within nonlinear and multi-linear text. Multi-linearity is part of non-linearity, but emphasizes the multiple-linear approaches and de-emphasizes the randomness in hypertext. It opens up the limits of linearity, and connects the randomness of hypertext with some coherence, and provides different possibilities and different perspectives. Some look for coherence and harmony in design, text and graphics. Hypertext offers readers different paths, however, the coherence of text, graphics, and interface is important to some participants.

5. Types of interactivity: There are different ways to interact with authors, other readers and the content. Links are perceived as common mechanism for interactivity. However, some readers expect to change and/or add to others' work and request real time author-reader interactivity; some are perfectly satisfactory just reading some profound text by a good writer.

6. Levels of difficulty: uses of advanced Web authoring techniques and multimedia.

When the participants were asked about their favorite projects and what their criteria are, for some, the criteria were drawn from their favorite projects, such as simple and easy, easy to use, visual, personal and meaningful, etc. For some participants, the criteria they gave were more general. They usually don't like the sites that are too

complex and too overpowering. They like to feel in control. Some were attracted to visual effects, but realized that they definitely would not want too much.

Overall, the ease of use, and simplicity were the most desired features of web design. Things that the participants didn't like were too much text, too much graphics, web sites that take too long to download, too overpowering, and the feeling of losing control. To novice designers, they tend not to be impressed by complicated interactive features and advanced levels of difficulty in Web authoring.

Hypertext narratives also play an important role in participants choosing their favorite projects. They like projects that blend text and graphics well and carry meaningful stories; stories are that either based on personal experience or are woven together by history and culture. Coherence and harmony were important to some as well.

However, interactivity is not a word that has definite meaning for every participant. Mostly, the participants pondered upon the degrees of interactivity that technology and hypertext would allow them as authors and readers. The participants as designers and readers thus look for different kinds of interactivity and redefined the concept of interactivity.

Levels of difficulty were also not most participants' top concern. Sometimes the sites that use too many advanced features, such as multimedia and complicated links get less appreciated. Some participants actually found sites that demonstrate a great deal of author control by using advanced web authoring techniques, irritable.

In conclusion, the participants had different takes on hypertext aesthetics. Some were fond of hypertext narratives; some were still looking for closures and endings. The participants seek different levels of interactivity. Some designed their project to express; some to invite interactions. The participants formed more situated criteria. For most participants reading each other's projects, the criteria were more situated. There were no universal criteria that would describe everyone's favorite project.

However, while the participants were asked for the criteria in general, they expressed that navigation plays an important role in hypertext design. Most participants appreciate well-designed navigation. Despite the importance of visual presentation, the practice of simplicity in design is a virtue that cannot be over-emphasized due to the

bandwidth on the Internet. Personal interests are crucial in reading and evaluating hypertext as well.

Importance of the Study

Working in hypertext fosters different kinds of creating as well as different kinds of reading and evaluating. Hypertext authors/designers create in order to connect with the readers, just as the reader would like to connect with the author/designer. For some of the participants that find hypertext as their creative and inspiring media, there is no linearity to subvert, and there is no closure to work against. It is the openness, intertexuality, and plurality in hypertext that invites authors and readers to walk in the world of possibilities, to explore and experience the fluid space that hypertext opens up to them. Criteria for evaluating hypertext thus reside in a more situated context that fosters creativity and understanding.

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Linking Multiple Databases: Term Project Using *Sentences* DBMS

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Abstract

This paper describes a methodology for use in teaching an introductory Database Management System course. Students master basic database concepts through the use of a multiple component project implemented in both relational and associative data models. The associative data model is a new approach for designing multi-user, web-enabled database operations. Unique capabilities of the associative data model include: omnicompetent programming, feature programming, instance schema processing, and schema aggregation. Potential applied research and application development as related to the associative data model and *Sentences* are also addressed.

Keywords

database design
associative data model
database course

1 Introduction

The database course can no longer concentrate solely on the relational data model. Clearly E-commerce is rapidly changing the whole realm of business. Information for E-commerce will come from data residing in a variety of internal and external sources, often accessed through the Web. At The University of Texas at Tyler, we teach an undergraduate DBMS class which focuses on the web as a front-end to a relational database and includes providing the details of the associative data model. Basically many of the guidelines in the course follow the recommendations set forth for the future of the first undergraduate database course [5] of a student's degree in information systems from computer science departments.

2 First Component of the Project

A term project involving merging databases and/or designing web-based databases is assigned to the students. A variation of the multiple-component project with associated reflection [4] is employed. In the first half of the course, databases are developed in ORACLE on a single server. Each student team (consisting of two to three students) is provided a secure tablespace on the server allowing access to tables directly or through Visual BASIC using ODBC drivers.

The database designed and implemented was for a mail-order business that purchases items from suppliers and fills orders from customers. Many active data features as well as some user-defined data types and functions were defined for a set of tables using constraints and triggers that encapsulated certain policies defining the operation of the business.

With these components in mind, the first component of the project was to create the latter database. Students were asked to create new customers and add a few orders. During this component, each team had to implement their database design plus generate query and report sessions to demonstrate the functionality of their designs.

3 Second Component of the Project

At the completion of component 1, the teams were informed that their representative companies had merged. Each team was to retain their own identity but all reports and queries were to contain a unified set of data representing the aggregate of all merged companies. Additionally, each team was held responsible for the integrity of their company's database. An important feature was to avoid all duplication in the integrated database.

4 Third Component of the Project

The teams were asked to replicate components 1 and 2 utilizing the associative data model. Specifically, students were required to investigate the schema integration and instance schema processing features of the associative data model. Lazy Software's *Sentences* DBMS [6] was the DBMS employed for this component. *Sentences* is a multi-user, web-enabled DBMS written in Java complete with a full set of development tools, interfaces and applications. The first general release (1.1 *Sentences*), of the product was in October 2000 and runs under SUN Solaris, Windows NT or Linux. The ancillary tools that provide the user interface, schema specification facilities and query support can make use of Microsoft, Apache, WebSphere and Tomcat Web servers, with Windows clients running either Microsoft or Netscape browsers. At The University of Texas at Tyler, we are running a beta version of Release 2.0 (scheduled release fall 2001) which includes XML support, allowing for stored procedures and triggers.

The relational data model has many disadvantages which can be overcome by the associative data model. For instance, when employing the relational data model, each time a new application is constructed, the applications programmer would have to construct or modify a new set of tables. The latter practice is both time consuming and complex. Omnicompetent programming, a feature of the associative data model, allows for a single set of programs to implement many different applications. Also, companies or businesses often want to record information that is relevant only to a particular customer. In the relational data model, the programmer or database designer would accomplish the latter task via text or through null values in the relevant table column. Neither of these two solutions is truly satisfactory. Through the instance schema feature, the *Sentences* DBMS enables schema and rules to apply to a single instance in the database with no overhead. Additionally many company databases are reflecting the mergers taking place worldwide. In *Sentences*, distinct databases can be viewed together or amalgamated at any time without special tools for data correlation and analysis through the Schema aggregation feature. *Sentences* also allows for feature programming whereby features can be made visible or invisible to individual users. This latter feature is ideally suited to the needs of today's Application Service Providers (ASPs).

Sentences employs a set of technologies based around the Java2 platform including Java Servlets, JSP, and JDBC (Java Database Connectivity). Java Servlets are Web-enabled Java classes that can run on a Web server. Remote users connect to servlets using the same protocol as Common Gateway Interface

(CGI) scripts, which makes it easy to integrate servlets into the chosen Web architecture. JSP allows for the embedded Java code to be inserted directly into web pages, and it supports components called Java-Beans that hide complicated functionality behind a simple interface. Instead of updating Web pages every time programming logic changes are made, simple updates to the bean are completed and a copy of the bean is sent to the Web server. There isn't even a need to restart the server! JDBC is a set of libraries that connect Java programs, including Java servlets and JSPs to SQL databases.

Tomcat, the official reference implementation of Java servlets, enables the Web/database interfacing. Tomcat is an open source Apache Foundation project available at [1]. The Java2 SDK (java.sun.com/js2e) is required by Tomcat which is available for many operating systems including AIX, Linux, Mac OS X, Windows, and Solaris. Reference can be made to [3] on Tomcat installation.

5 Fourth Component of the Project

During this final phase of the project, the student teams were required to perform a series of system tests related to implementation of database conversion [2]. These system tests included:

- *Volume testing:* to verify that the system can handle the amount of data indicated by the specifications.
- *Stress testing*: to prove that the system performs correctly under peak loads; i.e., that it can process large quantities of data over a short period of time (especially important for web-enabled databases).
- *Performance testing*: to demonstrate that the system is able to process data as quickly as the specifications said it would.
- *Unit testing*: testing that concentrates on each unit (i.e. component) of the software as implemented in source code.
- *Integration testing:* where requirements established as part of software requirements analysis are validated against the software that has been constructed.
- *System testing:* where the software and other system elements are tested as a whole.
- *Acceptance testing*: to demonstrate that the global/ local databases met the business functions that were specified.

A comparative analysis of these various tests for the associative data model versus the relational data model were made by each student team.

6 The Associative Data Model

In the associative data model, a database comprises two types of data: entities and associations. Entities are things, or objects, that have discrete, independent existence. Associations are things whose existence depends on one or more other things, such that if any of those things ceases to exist, then the original thing itself ceases to exist or becomes meaningless. Associations are allowed to depend upon other associations. In the associative model, all attributes are represented as links between things within the database, and the target of every attribute is another thing that is represented within the database in its own right. In contrast, the relational data model has tuples as the source of an attribute and the target is the value contained by the cell under the column heading in the tuple. Thus in the associative data model, attributes are represented as: links between the entity or association whose attribute that is being

recorded as the source, a verb to express the nature of the attribute, and an entity or association as the target.

The impact of the latter representation is that things and associations are no different from associations in general. At any time the database designer or programmer may decide to describe an attribute by giving it attributes of its own. In the relational data model this would require restructuring the database, replacing a value by a foreign key and adding a new relation. The associative data model can be viewed as a vertically defined model on variable length data whereas the relational data model processes fixed length tuples horizontally.

6.1 Example *Sentences* Database

Consider the following mail order database application. Suppose the database designer needed to store the following piece of information: "Bob ordered a recordable compact disk on July 7, 2001 from Alpha, Inc." This piece of information contains four entities: Bob, recordable compact disk, date (July 7, 2001) and company (Alpha, Inc.). Additionally this information incorporates three verbs: ordered, on and from. Three links are required to store the data, as represented in the *Sentences* DBMS, by:

Bob ordered **recordable compact disk**
… on **July 7, 2001**
… from **Alpha, Inc.**

or by using parentheses we have:

(((Bob ordered recordable compact disk)
on July 7, 2001) from Alpha, Inc.)

This information could be implemented with following tables:

Items	
Identifier	**Name**
23	Bob
14	recordable compact disk
77	July 7, 2001
81	Alpha, Inc
92	ordered
101	on
16	from

Links			
Identifier	**Source**	**Verb**	**Target**
19	23	92	14
21	19	101	77
36	21	16	81

6.2 Relational Data Model for the Example *Sentences* Database

A relational data model for the mail-order business could include the following tables:

Customers [CustNo, Cname, Caddr, Balance, CreditLimit]

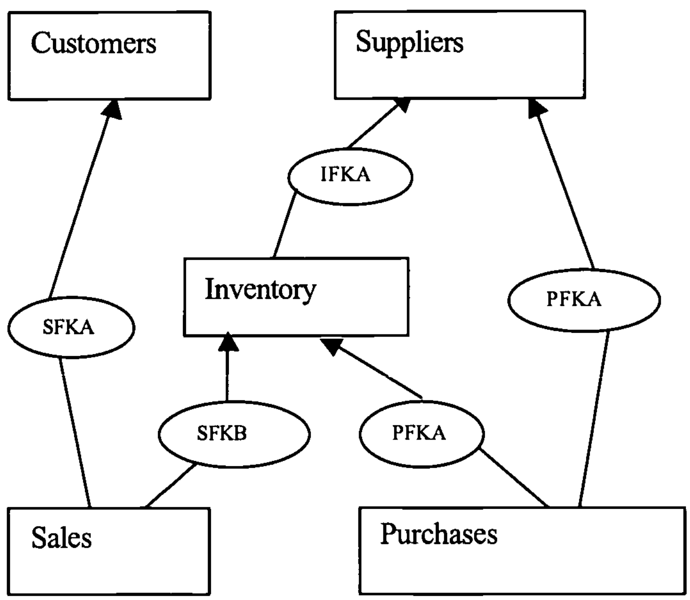
Suppliers [Sno, Sname, Saddr, AmtOwed]

Inventory [Ino, Iname, Sno, Qty-on-Hand, UnitPrice, Qty-on-Order, UnitOrderPrice, OrderThreshold, MinOrder]

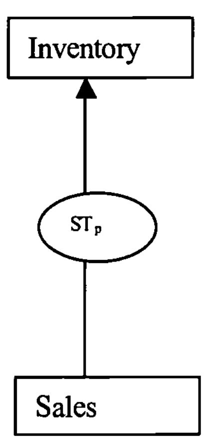
Purchases[OrderDate, OrdTime, Sno, Ino, QtyOrdered, DateRec, QtyRec, UnitPrice]

Sales[SaleDate, SaleTime, CustNo, Ino, QtySold, UnitPrice, TotalSale]

The following would represent a referential integrity diagram for this database where the notation XFKL is a foreign key from table X and L is a serial notation for all the foreign keys defined on table X.



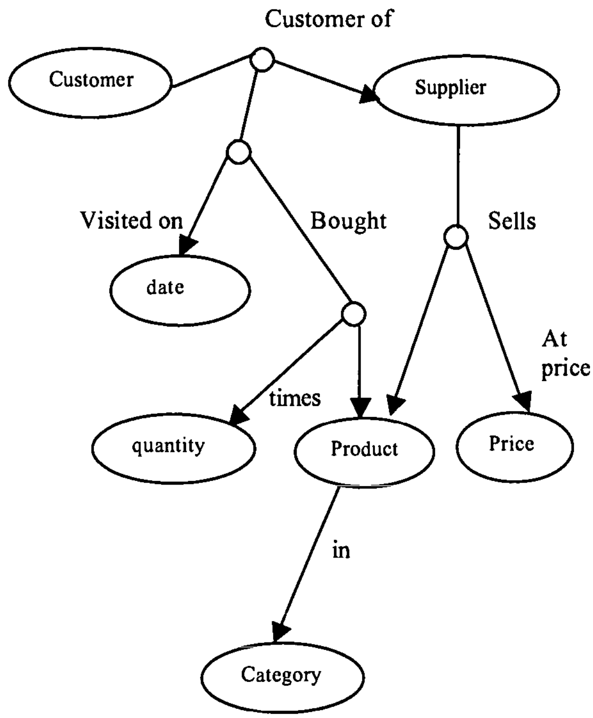
Finally various triggers can be defined on the latter database such as:



The pth trigger defined on Sales is ST_p. ST_p might be a trigger to increase the ordering threshold and possibly the minimum order quantity if the current value for the quantity sold for a given item in the last month is greater than the current threshold for that item. Triggers can be defined to maintain policy on: reordering supplies, what to do about customers who exceed their credit limit, cascading table inserts, maintaining audits, and other information deemed relevant.

6.3 Associative Data Model for the Example *Sentences* Database

A segment of a corresponding associative data model would involve items (ovals) and links (lines) in a semantic network diagram.



Next the semantic network is implemented in the *Sentences* DBMS. Every association has the following properties: a name, source type, target type, cardinality, inverse cardinality, being sequenced or sorted, and a default target. The associative data model permits an associative type that is specific to a single entity or association. Additionally, an entity or association type may be a subtype or supertype of another type. Besides subtypes and supertypes, the associative data model allows for the use of inferred subsets and supersets. For example:

Good Customer subset of **Customer**.

Basically there is a mapping between the relational and associative data models:

- A table with no foreign keys as primary keys is equivalent to an entity type that is the source of one or more association types.
- A domain is equivalent to an entity type that is the source of no association types.
- A table that has one or more foreign keys as primary keys is equivalent to an association type.
- The column heading of a type is equivalent to an association type's verb.

6.4 Query Language for the Associative Data Model

Associative algebra is the basis for query processing for the *Sentences* DBMS, which is derived directly from SQL. The following operators are available: union, intersection, difference, product, select, project, join, divide, extend, summarize, rename, and recursive closure. Only extend, summarize, and recursive closure differ from the traditional SQL operators. Extend forms the associative type that has the original type as source and a new type, instances of which are derived from the source as target. Summarize forms a type whose instances are formed by grouping instances of the original type that have the same sub-tree as source, and creating one instance of the new type for each subgroup, with the sub-tree as source and an instance aggregating corresponding sub-trees of the group as target. The recursive closure forms a relation by joining a self-referencing type with itself, taking the result and joining it again with the original type, as many times as necessary.

The schema for the latter associative data model for the mail-order business would be:

Customer customer of **Supplier**
    … visited on **date**
        … bought **Product**
            … time **Quantity**
Supplier sells **Product**
    … at **Price**
Product in **Category**

Sample data would include:

Bob customer of **Best Buy**
    … visited on **25-June-01**
        … bought **ink cartridge**
            … times **10**
        … bought **diskettes**
            … times **200**

Bill customer of **Ables Land**
    … visited on **6-July-01**
        … bought **office chair**
            … times **3**
        … bought **transparency**
            … times **10**
        … bought **file folders**
            … times **3**
        … bought **diskettes**
            … times **150**
Best Buy sells **ink cartridges**
    … price **$39**
Best Buy sells **diskettes**
    … price **$3**
Best Buy sells **big manila envelope**
    … price **$10**

Best Buy sells **correction pen**
… price **$2.75**
Ables Land sells **office chair**
… price **$70**
Ables Land sells **transparency**
… price **$10**
Ables Land sells **file folde r**
… price **$20.69**
file folder category **office supply**
office chair category **furniture**
ink cartridge category **computer accessory**
diskette category **computer accessory**
transparency category **film**
big manila envelope category **office supply**
correction pen category **office supply**

Example queries in the *Sentences* DBMS are:

"Who shops at Best Buy?"
Q: Select (**Customer** customer of **"Best Buy"**)
A: **Bob** customer of **Best Buy**

"What computer facilities has Bill bought?"
Q: Select (((**"Bill"** customer of **Supplier**) visited on **date**) bought **Product**) join (**Product** category **"computer facility"**))
A: (((**Bill** customer of **Ables Land**) visited on **6-July-01**) bought **diskettes**) join (**diskettes** category **computer facilities**))

7 Schema Integration

Database integration involves the process by which information from participating databases can be conceptually integrated to form a single cohesive definition of a multi-database. The design process in multi-database systems is bottom-up. In other words, the individual databases actually exist; this is followed by the design of the global conceptual schema integrating these component databases into a multi-database. Under phase one of the process, schema translation, the designer faces the task of mapping one schema to another. For n-ary relational databases the integrator must make trade-offs between the different local schemas to determine which representation should be given precedence when conflicts arise. This requires that the integrator have knowledge of all the various trade-offs that must be made among several different schemas and their semantics, which may be different. Phase two, schema integration, involves the process of: *identifying* the components of a database which are related to one another, *selecting* the best representation for the global conceptual schema, and finally, *integrating* the components of each intermediate schema. Foreign keys, preservation of the lossless-join property, and preservation of the functional dependency preserving property are among a short list of the constraints that make schema translation and schema integration for the n-ary relational data model difficult. Sentences implementation of the associative model of data with the concepts of profiles and chapters plus the surrogate links for representing entities and associations make schema integration efficient as well as simple.

8 Potential Applied Research and Application Development

Sentences, being the first commercial implementation of the associative model of data, needs many enhancements. These enhancements offer opportunities for applied research and application developments in the following areas:

- Methodologies for triggers and constraints to implement business policy
- How to enable concurrency
- Development of migration tools for moving between the n-ary relational data model and the associative model of data
- Establishing benchmarks
- Development of transaction processing algorithms
- Determination of whether or not *Sentences* will facilitate a "large" data warehouse
- How to implement temporal databases utilizing the associative model of data

Currently TPC (the Transaction Processing Council) benchmarks enable performance evaluations which are available for the n-ary relational and object-relational data models. Even a web-based version, TPC-W, is available. But these benchmarks are unacceptable for performance evaluations on the associative data model since transactions are not operationally defined in terms of atomic table operations such as joins, selections, and projections. The associative model of data implemented in *Sentences* is based upon query trees.

Migration studies could be realized through XML. *Sentences* allows for both importing and exporting the data in the database, the schema, and the query trees. The relational data model can be implemented by XML Schema, a data definition language for XML documents. Data for the relational model can be represented using XML. Since XPath views XML documents as trees and element attributes, comments, and text as nodes of those trees, the investigator would have the ability to develop mappings between the traditional SQL queries and the query trees of the associative model of data in *Sentences*.

XML Spy 3.5, an integrated visual development environment for XML, could be used to complete the migration study. The tool includes XML editing and validation, Schema/DTD editing and validation, and XML editing and transformation. A demonstration version of the software is available on the Web at xmlspy.com/xml-editor.html. A fully functional 30-day trial version is available for download. Turbo XML, a Java-based IDE for developing and managing XML assets, is also available as a free download on the Web from TIBCO Extensibility.

Triggers and constraints in version 2.0 of *Sentences* require the user to implement business policy in Java Jars and register them with the kernel of the database. A major contribution by an investigator would be to develop the windows event-driven triggers that would mirror the trigger capabilities similar to those found in products like ORACLE or DB2.

Concurrency control appears to be a major issue with *Sentences* since the model is implemented using only two pseudo-tables. *Sentences* allows for the source of an association to be another association. Therefore concurrency implementation for *Sentences* should be based upon the foundation of nested and multilevel transactions.

9 Conclusion

At The University of Texas at Tyler, the core material normally presented in an undergraduate database class is enhanced by having students provided with an extensive hands-on experience in database design, implementation, operations, and maintenance. By having the team project involve multi-user, web-enabled applications such as the integration of multiple databases into a single large database, students are exposed to a firm foundation for further studies and participate in an experience which is invaluable in the *real-world* environment.

The *Sentences* DBMS has been very well received by students in the undergraduate course at The University of Texas at Tyler. *Sentences* is easy to use, simple in design features yet contains most of the features that a database instructor would want to illustrate as limitations of relational and object-relational DBMSs.

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Learning Geometry Dynamically: Teacher Structure or Facilitation?

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Key Words: Mathematics education, geometry, instructors role, secondary math curriculum, project-based learning

Abstract

This study examined the effects of level of instructional scaffolding on students' use of Geometer's Sketchpad and other software tools in a technology-integrated geometry curriculum. In order to revitalize education at the secondary level and in particular in the mathematics curriculum, educational reformers have advocated the incorporation of appropriate technologies to support learner-centered environments. The goal was to determine the relative effectiveness of a teacher directed approach compared to a student-directed approach of utilizing Sketchpad to complete a project-based learning task. . In general, in the short term, the instructional model where the teacher provided structure and directed the problem solving activities of the students resulted in learner outcomes characterized by greater understanding of the concepts and less frustration with the process of using Sketchpad. However, many students in the self-directed group expressed a sense of self–confidence and pleasure with their accomplishments.

Perspectives

Mathematics education is frequently characterized by instruction that is shallow in nature and requires students to remember an assortment of facts (Stigler & Hiebert, 1997). A number of

documents emerging from efforts to improve the mathematics achievement of our students offer recommendations for instructional reform (NCTM, 1989; National Research Council, 1989). It is generally agreed that to facilitate the problem solving capacity of the learner, teachers must provide them with authentic classroom activities where they are required to apply knowledge as well acquire it (Brown, Collins, & Duguid, 1989). A recent report to the President's Committee of Advisors on Science and Technology (PCAST, 1997) recommended that allocations of funding for computers and information technology be increased in the K-12 schools. The report urged that these allocations be used for instructional applications that are designed to support the active constructions of knowledge and expressed optimism that these applications would have a positive impact on student learning outcomes. In response to these mandates pre-service and professional development programs have been designed to facilitate new teaching strategies that incorporate technologies that support learner constructions of knowledge.

A fundamental question in the design of learner-centered instruction is how much structure as well as learning control to give to students (i.e., learner control) so that learning is optimized. This structure versus learner control continuum can range from complete learner control of everything, which Snow (1980) describes as the 'Adult Scholar Model' to one where the learning task is highly structured and the learner has virtually no control, which Snow refers to as 'Child Robot Model'. Increased structure has the advantages of increasing learners' perception of guidance, where they are directed through the task completion process step-by-step, and there is more uniformity of learning outcomes with specific outcome expectations. Less structure, on the other hand, intends to promote more learner choices, more learner control and self-regulation, thereby encouraging more creativity and better meta-cognitive skills.

There is general agreement (Battista, 1999; Greeno, Collins, & Resnick, 1996; Schoenfeld, 1994) that for optimal learning of mathematics, ideas must be constructed by the learner. NCTM Standards (2000) suggest that students should be engaged in inquiry and problem solving while they solve complex and interesting problems. Technology environments to support the mathematics curriculum have evolved such that there are powerful programs available to support inquiry, reasoning, and problem solving in conducting mathematics tasks (Wiest, 2001). One program, which fits these criteria, is Geometer's Sketchpad (1993), a dynamic geometry program, which can be used to support a constructivist approach to instruction. Teachers can implement this program by providing various levels of structure and it has been suggested that further inquiry be conducted to establish the benefits of different instructional approaches (Hannafin & Scott, 2001). The present research extends previous studies that investigated the process of using this software (Hannafin & Scott, 2001). It also was initiated in response to recommendations to conduct research under conditions that are typical classroom contexts.

Research Questions

The specific questions that guided this research were:

1. Does the instructional approach influence students' conceptual understanding of geometry and in particular, transformations?
2. What were the students' perceptions of the support provided by the instructor, challenges, frustrations, and successes while working on the project-based learning activities?

Methods

The mixed method design of this study incorporated both quantitative and qualitative research strategies. Quantitative measures of achievement were obtained to provide an evaluation of students' knowledge of and their ability to apply geometric concepts. Qualitative methodologies including observation and content analysis were utilized to provide insights to the learning process and perceptions of the students.

Participants

The participants were 82 primarily tenth-grade students from four geometry classes that met daily for 50-minute sessions. The setting for this study was an all-female secondary private parochial academy that is nationally recognized for its academic excellence and innovations in the integration and immersion of technology into the curriculum. Gender differences on mathematics achievement tests have been noted and indicate that males do better on items with algebraic content, applied real life-type items and items classified at higher levels of cognitive complexity (Bielinski & Davison, 1998). An important goal in the mission of this school is to provide females with rich learning environments in mathematics and science to enhance their opportunities to develop expertise in those curricular areas. Students, teachers, and administrators are expected to be proficient at using technology for academic purposes. All students were equipped with their own personal laptop computers that were connected to both an Intranet and the Internet via wireless technologies available throughout the campus.

Instructional Context

The instructor for this course implemented a mathematics learning environment that was enriched through the technologies available to the students. Students were provided with

Geometer's Sketchpad (1993), a program that provides a way to construct geometric figures much like the traditional tools of geometry: the ruler, protractor, straightedge, and compass. Students were required to use word processing tools to take notes, record their observations, to prepare reports about their discoveries and to complete all exercises. This "electronic notebook" takes the place of traditional spiral and three ring binders and requires that students become proficient at using word processing tools, particularly the inclusion of equations and mathematical symbols, the insertion of graphics, and the inclusion of OLE embedded items. Blackboard, an online course management system, provided students access to course announcements, assignments and activities, course documents, collaboration tools (communication and digital file exchange), and an online assessment feature.

Project-Based Learning Activity

Student projects offer an ideal situation to provide problem solving opportunities that present real world problems that are scaled back so that they are doable in the confines of the classroom.. Project-based learning can be thought of as learning through a series of theme related activities that are based in authentic, real-world problems in which the learner has a certain amount of control over the learning environment and the design of the learning activities (Slavin, 1995). The goal of this project was to design and determine the cost of setting up a low maintenance garden to be located somewhere on the grounds of the school's campus. The project was conducted over a period of 4 weeks during which students worked collaboratively to complete the project tasks. Student groups were requested to tour the campus, identify the location for their garden, lay out the perimeter, and using yard sticks identify the measurements of the garden perimeter. The groups were required to identify a theme for the garden, design the

garden, develop a scale drawing depicting the garden's dimensions, design garden areas for paths, seating, flowers, shrubs, and trees. Geometer's Sketchpad was to be utilized to draw the garden plan with its various sections. Sketchpad options that could be used to facilitate the design process include transformations, constructions, and graphing. Subsequent activities included the selection of types and quantity of plants, soil and fertilizer, edging and path materials, and ground covers.

Geometer's Sketchpad

This dynamic geometry program (Key Curriculum Press, 1993) is a tool that can be used to support a constructivist learning environment. It contains no instructional agenda and its use depends on the way that the teacher decides to utilize it. A distinction between just providing the tool to students and how the teacher actually integrates the use of the tool in the instructional process has been made (Pea, 1993). Sketchpad is a dynamic tool, allowing students to not only construct geometric figures, but provides a way for these figures to be manipulated giving students an opportunity to explore and discover principles of geometry. Students can construct an object and then explore its mathematical properties by dragging the object with the mouse. It is recommended that students work collaboratively with this tool to visualize, analyze problems, and make conjectures. Some of the tools available in this environment include drawing tools which allow students to create Euclidean constructions using transformation commands to construct translations, reflections, rotations, dilations, and iterations by fixed, computed, and dynamic quantities.

Procedures

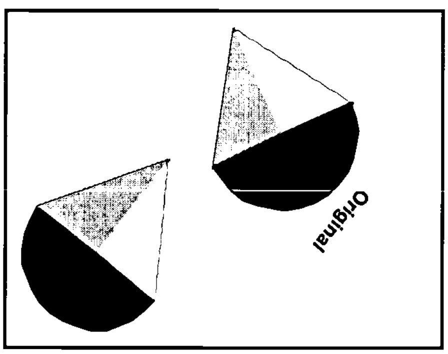
The four classes were randomly assigned to one of the two instructional models (structured problem solving or student-generated problems with teacher facilitation). In both models students were organized into groups of three to work collaboratively to complete class projects. Students were encouraged to share their ideas and to develop geometric thought through this collaboration. Students in all classes were given the project-based learning activity on designing a garden. In Model 1: Structured Problem Solving (SPS) students were provided with specific problems to solve and given a set of guidelines and strategies to follow in completing their problem-solving task. Specific tasks designed to facilitate the achievement of instructional objectives were presented in the Group section of Blackboard. At the beginning of each class the instructor demonstrated specific concepts related to transformation and discussed the application of these concepts to the project. In Model 2: Student-Generated, Teacher-Facilitated (SGTF) students were provided with the same problem-based learning activity, but were responsible for identifying the information and strategies they needed to solve the problem. They were directed to utilize their Group section of Blackboard to think through their problem and to request assistance from the teacher and other outside sources.

Students in both groups were requested to journal in their electronic diary and to write reflections in response to specific teacher generated questions.

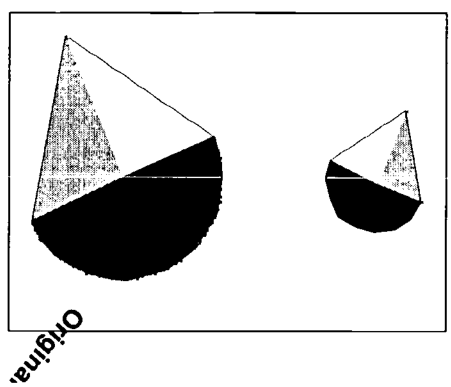
Results

To answer the first question related to whether the instructional approach influenced the students' conceptual understanding of transformations, the students' responses to an assessment created in Geometer's Sketchpad was analyzed. Five figure pairs were designed to focus the students' attention on aspects of transformation. Transformations of the translation, rotation,

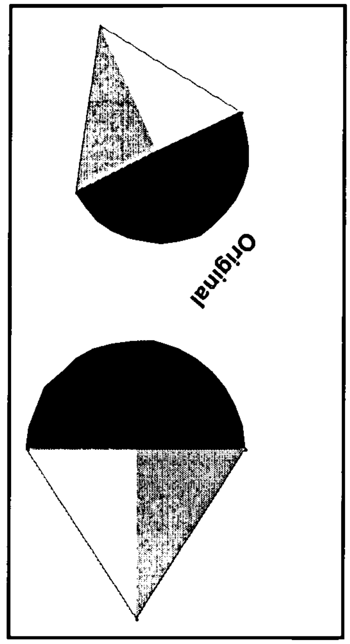
reflection, and dilation types were included. Figure 1 displays three of the object pairs presented to the students for the identification of transformations. Pair A was constructed using one transformation, Pair B was constructed using two transformations, and Pair C was constructed using three transformations. Students were requested to identify the transformations required to go from the first object in the pair to the second. A score for each collaborative group was calculated to be the sum of the individual group members. The mean group score was 5.25 for the teacher-structured problem solving group and 3.75 for the student-directed problem solving group. This difference indicated that the students who were in the teacher-directed group seemed to have a better understanding of the transformation concepts.



Pair A. Rotation



Pair B. Reflection and



Pair C. Reflection, rotation, and

Figure 1. Transformation Assessment Pairs

A content analysis of the students' journals was conducted to assess the their perceptions of the support provided by the instructor, challenges, frustrations, and successes while working on the project-based learning activities. A constant-comparative method of analysis was applied to identify patterns and themes within and between the groups. The journal entries generated by students in the self-directed groups were compared with those of the students in the teacher-facilitated groups. The goal of this analysis was to explore the students' motivational states and experiences while they were engaged in the use of Geometer's Sketchpad to complete a project-based learning activity. Motivation to succeed in mathematics and the sense of one's ability to do so was of interest in this study given the all-girls school population. It was believed that the girls' sense of self-efficacy could be derived from this data.

The prominent theme of their journals was the frustration they experienced while working with Sketchpad. Students in the self-directed groups expressed higher levels of frustration when trying to develop strategies to apply transformations to their constructions. The students in the teacher-directed groups had a better sense of what strategies should be used, but expressed frustration when errors in the process of applying transformation procedures. In their journaling related to the support provided by the instructor differences in their perceptions were revealed. The students in the teacher-directed groups often referred to specific help that they received, whereas the students in the self-directed group commented that their instructor gave them hints and guided them to self-discovered solutions to their problems. This sense of self efficacy was revealed in the following comment:

> The challenges I faced today were trying to figure out how I did what I did yesterday. We had some trouble but finally figured it out! YAY! And the best part is, IT ALL MOVES LIKE ITS SUPPOSED TO! I think I am the happiest girl alive. My new knowledge is that I know how to make a slider work. My success is that WE GOT THE SCALE TO WORK! You helped us figure out what we were doing wrong.

Another journal entry by a student in the self-directed group expressed the following thought:

> Today was very annoying. My computer crashed yesterday and it didn't allow me to back up, so therefore, my group and I had to start from scratch. However, it did not take long to catch back up. We knew exactly what we had to do and we got it done. We worked hard and didn't even ask Mr. Thomas for help. I believe this shows that we know what we are doing to the point that we are comfortable enough with our project that we can do it on our own. I'm feeling good about this project!

Additionally, while one of the researchers was the instructor for the course the other researcher conducted observations during the class sessions. The observations revealed distinct differences between the two groups in the process of task completion. In the unstructured model, distinct roles of group members were observed. Usually, one girl assumed the role of "Sketchpad expert" and worked independently to complete the geometric design. The other

group members assumed other roles and worked independently to complete their tasks. In contrast in the teacher-facilitated model, the students collaborated to complete task activities. An example of a scaled construction representing a garden design is displayed in Figure 2.

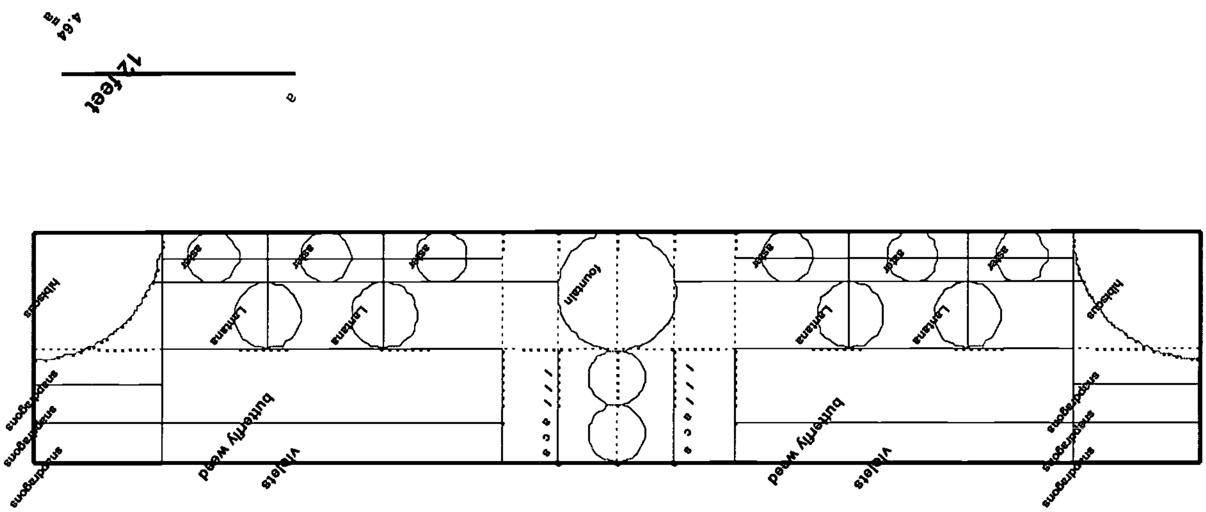


Figure 2. Scaled Construction

Discussion

Examining the effect of varying levels of instructional guidance and the role that the teacher plays when implementing these instructional strategies provides information to teachers who are current or potential users of this type of learning environment. In general, in the short term, the instructional model where the teacher provided structure and directed the problem solving activities of the students resulted in learner outcomes characterized by greater understanding of the concepts and less frustration with the process of using Sketchpad. However, many students in the self-directed group expressed a sense of self–confidence and pleasure with their accomplishments. At the presentation, samples of the scaled constructions created by the students in both groups will be demonstrated. Additionally, insights about how young women respond to the various instructional strategies will be provided. The National

Council of Teachers of Mathematics' (2000) equity principle holds that "excellence in mathematics education requires equity-high expectations and strong support for all students" (p. 12). Given that there still remain substantial gender inequities in the success that is achieved in mathematics (Bielinski & Davison, 1998), another important result derived from this research is how models of instruction support the achievement of women in mathematics.

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IT and The Attitudes of Middle School Girls: A Follow-up Study

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Key words: girls, technology, attitudes, computer science

Abstract: Research has reported various explanations for the disinterest of girls with certain matters such as computer science, mathematics and science. Researchers have included factor such as, the societal views of an appropriate female career, the lack of female role models in these areas, gender bias in the classroom setting at this critical time in the female life, and gender stereotyping in computer software (2)&(3). The two-year NSF-funded Girls Research Opportunities in Computing (Girls R.O.C.) project was designed to address these issues by conducting an intense three-week residential program that would encourage and motivate seventh and eighth grade female students to pursue the study of computer science with emphasis on Information Technology (IT). Forty-eight girls were selected to participate in the program during the two-year span. These female participants were selected from rural and urban school districts in northeast Louisiana.

Each year of the program a cohort of 24 girls participated in a three-week residential program on the campus of The University of Louisiana at Monroe (ULM) followed by 3 follow-up Saturdays during the fall. To assess the attitudes toward IT, the Computer Attitude Questionnaire (CAQ) (7) was used to measure the attitudes of the participants with a pre, post and a ten-week follow-up evaluation. The changes in attitudes were compared in terms of the program effectiveness. While these initiatives were targeted to core factors affecting the low female participation in IT, this research also examined if the findings for females also applied to other underrepresented groups in information technology. The analysis measured the effects of training on attitudes in the

following categories: Computer Importance, Computer Enjoyment, Study Habits, Motivation/Persistence, Empathy, Creative Tendencies, Attitudes Toward School, Computer Anxiety, Self Concept, E-Mail, the WWW, Integrated Applications, and Graphics in respect to grade level and ethnic group.

Introduction: Supporting Women in InFormation Technology (SWIFT) has identified several factors that they consider as the core factors that contribute to the lack of female participation in IT careers (3). These core items stem from several factors: the effect of societal labeling computer science as a hard-core male activity; lack of female role-models such as, IT teachers and females in IT industry; the tendency for boys to dominate computers at school and home along with the lack of computers used as teaching tools in the classroom results in less experience in computer usage for girls. This in turn contributes to computer anxiety and lower levels of self-perceived ability in computer science among female students (3)(6)&(10).

In the workplace one of the most dramatic changes has been the increased dependence on computers and computer-related technologies. In 1998 The Bureau of Labor Statistics reported that the top three fastest growing occupations from 1996-2006 are in the field of computer science (1). Yet recent studies indicate that women are significantly underrepresented in computer science degrees programs (8)&(2). Myers (1999) reported that only 14.4 percent of employees in IT are female (3). Many researchers have sought answers to the question of why girls do not pursue computer science degrees and careers in the computer related fields.

Research has shown that design and delivery of technological knowledge through educational software, web designed sites, and computer games appeal more to boys than girls (10). Computer use in schools has traditionally been linked to 'masculine' subjects such as science and mathematics rather than traditionally 'female' subjects such as liberal

art and literature (5). Shoffner (2001) reported that half of all teachers who have access to technology in their schools do not make use of it in their instruction (9). Janese Swanson, senior vice president of the Girl Tech Web site, states, "Shying away from technology not only restricts girls from certain life choices and successes, but also limits the potential for their future products, inventions, and discoveries – a disservice to the entire society" (10). In general the above research has reported various explanations for the disinterest of girls with certain subject matters such as computer science, mathematics and science.

The NSF-funded Girls Research Opportunities in Computing (Girls R.O.C) project was designed to address these issues by conducting an intense three-week summer program that would encourage enthusiasm for computers by providing female role models such as, ULM computer science faculty and majors, a non-competitive environment, and group research. The program provided both formal and informal activities for the girls in areas of computer applications, Internet research, email activities, graphics, and simulations along with a variety of classroom and hands-on activities that exposed them to ways that computers are used in research, business, and the home (4).

Participants: The 48 female participants were recruited from eighth and ninth grade girls from predominantly rural school districts in northeast Louisiana. These educational communities have high proportions of underrepresented students in IT career tracks. The girls were selected using several criteria that included a written essay, transcript of grades, and a recommendation from a counselor or teacher. Special consideration was given to minorities and students with disabilities.

This study consisted of the pre, post and follow-up survey results of 36 of the 48 girls who participated in the summer resident program. Twelve of the girls did not return for the follow-up visits and, thus, were excluded form this study.

Objectives:

1. Mentoring/Role Modeling: Using Big Sisters to encourage IT as a career choice.
2. To foster a better understand of IT career opportunities:
    a. Invited Female Scientists and Educators as guest speakers and online chat sessions.
    b. Field trips to facilities where participants can see IT and computer professionals at work.
3. Classroom & Group activity:
    a. To experience classroom activities which are free of gender-bias and male competition.
    b. Research Groups to study and develop group oriented research projects.
4. Follow-up Visits: To encourage the participants to work on and complete a science fair project.

Activities: Program activities for Years 1 and 2 of Girls R.O.C. were essentially the same; however, there were two major differences. For Year 2 students, Space Science replaced word processing and spreadsheets, which proved to be an exciting change that dovetailed well with the MicroWorlds activities leading to the research projects. Secondly, the project director led all research projects, not the individual instructors as was done in the previous year. This focused approach for the Year 2 group appeared to be a more successful than the individual approach for the Year 1 group where the girls were divided into three different research project groups.

During both years the participants in Girls R.O.C. lived on campus for three weeks and then returned for three Saturdays in the fall. During the residential portion of the program, the participants (Little Sisters) were supervised in the dormitory by five female science majors (Big Sisters). The Big Sisters also assisted with daytime activities when they were not attending class thus reinforcing the role model exhibited by the instructor for the participants. Events for daily activity included Girl Talk a time for the project director to preview plans for the day and receive feedback from the participants.

Using Frontpage and Netscape Composer to create individual girl's web pages and to produce a weekly electronic newspaper. A daily Space Science activity from The Science Out of This World site at Northwestern State University (NSU) to encourage interest in mathematics and science related subjects. MicroWorlds was used to teach the girls about graphics and to create simulations for their research projects. Field trips included visits to the U.S. Corps of Engineers Waterways Experimental Station in Vicksburg Mississippi, to Black Bayou National Wildlife Refuge outside of Monroe Louisiana, and to the Space Camp at NSU. Computer Lab time was used for email, browsing and searching, and completing computer activities begun earlier in the day.

The activities that the girls enjoyed the most were those that allowed them to be creative. They thoroughly enjoyed creating their web pages and writing stories for the newspaper. They also enjoyed writing and illustrating stories with MicroWorlds. Writing fairy tales was by far the most successful single activity of the summer. Experimental activity such as a bubble experiment was designed to teach the girls about the scientific method. This project divided the girls into groups of four and asked to formulate hypotheses about the best way to create bubbles. They were then given supplies to test their hypotheses. The most successful space science activities were those that allowed the girls to play games and create things. They did not like activities that simply made them read and do research. However, if the reading and research were combined with a creative activity, they did not mind. For example, they had to do research to create a moon phase calculator, an activity that they really enjoyed. They then used this research to create a moon phase simulation during research project time. Likewise, they enjoyed doing research about the environments of planets of the Solar System in order to design

an alien, who could live on a specific planet. They followed each activity with a simulation program that was the product of a MicroWorlds project. In contrast, they did not enjoy researching and answering questions about solar cookers since this activity did not include a creative project.

The Survey Instrument

The Computer Attitude Questionnaire, CAQ version 5.27 (7), a self reporting instrument for measuring middle school and high school students' attitudes on all Young Children's Computer Inventory (YCCI) subscales along with Computer Anxiety and Self Concept, was used as the tool or instrument for assessing the attitudes of the middle school girls who participated in the Girls R.O.C. The CAQ is composed of seven (7) YCCI subscales – Computer Importance, Computer Enjoyment, Study Habits, Motivation/Persistence, Empathy, Creative Tendencies and Attitudes Toward School – plus additional subscales that assess Computer Anxiety and Self Concept, a General Computer Skill Level and a modified Technology Proficiency Self Assessment (TPSA). The TPSA subscales assess attitudes toward E-Mail, the WWW, Integrated Applications, and Graphics. The General Skill Level is a measure of a student's typical use of computers in school. The subscales of E-Mail, the WWW, Integrated Applications, and Graphics measure the student's proficiency level in using these four (4) areas of technology. (See Appendix)

Evaluation Procedures

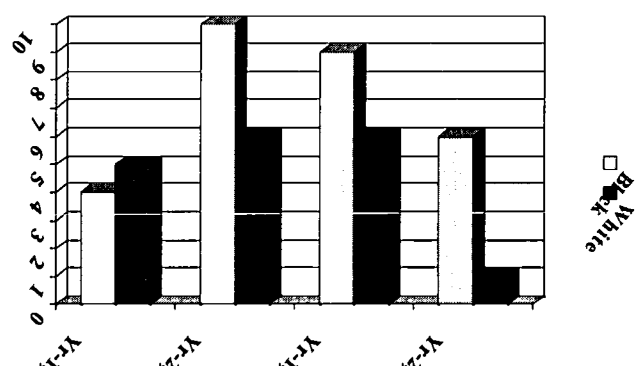
The CAQ was administered Year 1 and 2 to the participants during three periods: at the outset of the 3-week program (pre-survey), at the end of the 3-week program (post-survey) and 10 weeks after the completion of the program (follow-up survey). The Year 1

and 2 participants grade level and race distributions are given in Table 1 and displayed in Figure 1 below. In this study, there were twenty-five 7th graders, twenty-two 8th graders while the two groups represented 18 Caucasians females and 29African-American..

Table 1
Grade and Race Distributions

Year	**Grade**	**Total**	**Caucasian**	**African-American**
Year 1	7th	9	5	4
Year 2	7th	16	6	10
Total 7th		25	11	14
Year 1	8th	15	6	9
Year 2	8th	7	1	6
Total 8th		22	7	15

Figure 1
Grade and Race Distributions



The initial analysis of the attitudinal assessment data for the participants representing the two groups -- Year 1 and Year 2 -- were measured for each of the thirteen subscales of the CAQ and averaged over the three time periods producing six evaluation clusters. Friedman's analysis of variance by ranks was used to delineate any and all differences among the clusters in question. The first level of analysis compares the six groups by time clusters. The mean ranks for each of these clusters is shown in Table 2 and depicted in Figure 2. Friedman's ANOVA indicates that differences among the six clusters is present ($\chi^2 = 34.231$, $p = 0.0000$, $df = 5$).

Table 2
Group by Time
Average Ranks over CAQ Subscales

	Group	
Time	1	2
Pre	1.46	2.23
Post	3.77	4.15
Follow-up	4.46	4.92

Figure 2
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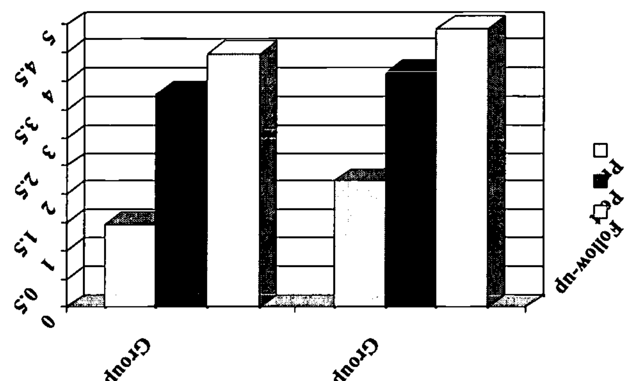
Average Ranks over CAQ Subscales



The second approach to the analysis was to consider differences among the attitudes attributed to grade level. The average ranks of the CAQ subscale data for the 7th grade girls was 1.62; whereas, the average rank for the 8th grade girls was 1.38. Friedman's ANOVA indicated no differences in attitudinal assessment by grade (χ^2 = 0.692, p = 0.405, df = 1). A further comparison of grade by time cluster indicated that differences were present ((χ^2 = 41.849, p = 0.000, df = 11). Table 3 and Figure 3 display the average ranks for this classification.

Table 3
Average Ranks by Group, Grade and Testing Period

		Grade	
	Time	7th	8th
Year 1 Group	Pre	4.00	3.27
	Post	7.88	5.27
	Follow-up	8.04	7.19
Year 2 Group	Pre	4.50	5.62
	Post	6.81	7.77
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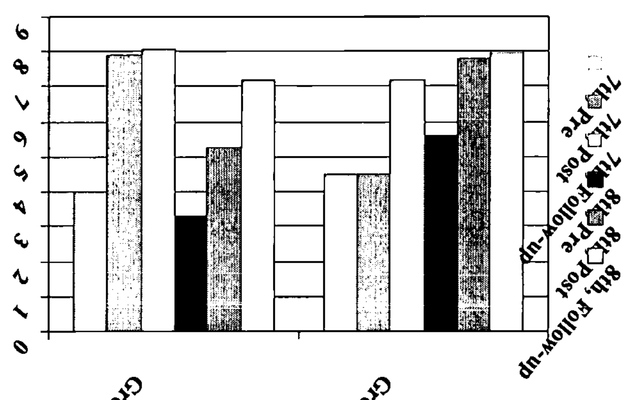
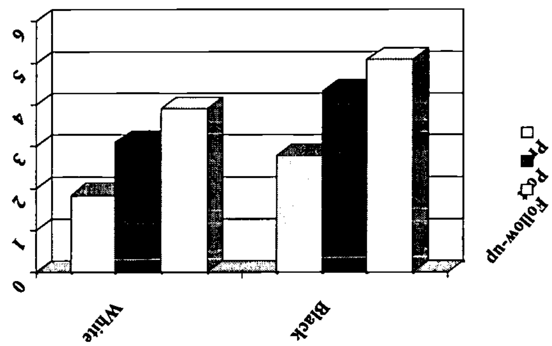


Where cluster the data by race, six groups appear representing average attitudinal assessment values by race and time. Table 4 and Figure 4 show the average ranks of these clusters. Friedman's ANOVA indicates that differences among the six groups are present ($\chi^2 = 25.132$, p = 0.0000, df = 5).

Table 4
Average Ranks by Race and Testing Period

	Race	
Time	White	Black
Pre	1.85	2.77
Post	3.08	4.31
Follow-up	3.92	5.08

Figure 4
Average Ranks by Race and Testing Period



Summary and Conclusions: A 1998 Association for Computing Machinery (ACM) report stated that women composed less than one-third of the computer scientists and programmers in the U.S. This figure was barely twice the number reported in 1988 and was still less than half a million women. A 1997 Global Strategy Group poll reported that 49 percent of the college-bound females that were interviewed indicated that the technology industry was too boring, too difficult, or too technical. According to Linda Sanford, General Manager of Global Industries at IBM (11), "if girls were taught at an early age that engineering and computer science are more about problem solving than about freckles and Coke-bottle glasses, we'd see a greater number of girls and women interested in technology."

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that changes in the participants' confidence in using E-Mail, the WWW, Integrated Applications and Graphics was greatly improved as a result of the three-week residential program for each of the two groups of girls. Additionally, the improvements in attitudes observed during the first year of the project toward E-Mail, the WWW, Integrated Applications and Graphics were replicated during the second year of the project. This latter finding further supports the findings of earlier studies about the Girl's R.O.C. on the importance of introducing female students to technology at an earlier age.

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Appendix

Subscale to Item Number Conversions

Subscale	Part	Item Numbers
Computer Importance	1	3, 6, 7, 8, 10, 11
Computer Enjoyment	1	1, 2, 4, 5, 9, 12, 13, 15, 18
Study Habits	2	21, 24, 25, 26, 29, 30,31, 32, 33, 34
Motivation/Persistence	2	21, 22, 23, 25, 27, 28, 29, 34
Empathy	3	36, 37, 38, 39, 40, 41, 42, 43, 44, 45
Creative Tendencies	4	46, 47, 48, 49, 50, 51, 52, 53, 54, 55, 56, 57, 58
Attitudes Toward School	6	62, 63, 64, 65, 66, 67
Computer Anxiety	1	12, 13, 14, 15, 16, 17, 18, 19
Self Concept	7	68, 69, 70, 71, 72, 73, 74, 75, 76, 77
E-Mail	9	85, 86, 87
WWW	9	88, 89, 90, 91
Integrated Applications	9	92, 93, 94
Graphics	9	95

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Creating Technology Leaders through Professional Development

Wendy Martin, Center for Children and Technology, with Naomi Hupert, Carmen Gonzales

The Regional Educational Technology Assistance (RETA) program is a collaborative, teacher-driven professional development initiative that has been educating New Mexico teachers in the use of learning technologies for the past three years. In our paper, we will discuss the effects of RETA on the collegial behaviors and changing leadership roles of its participants and instructors. We will present findings that indicate that, as a result of their involvement in RETA's ongoing professional development workshops, participants and instructors (a) increase their collaboration in technology-related matters with other teachers in their schools and (b) assume leadership positions in their schools and communities.

Format: Research Paper (Roundtable)

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Teacher Change Processes and Student Products of Exemplary Technology Integration

Marilyn May, Brenau University

Qualitative study of Kansas exemplary technology-using teachers. Teacher-identified changes in teacher/student processes/products using ISTE standards, and others, provided critical frameworks.

Format: Research Paper (Lecture)

Findings from an Evaluation of the Intel Teach to the Future Professional Development Program

Katherine McMillan Culp, EDC/Center for Children and Technology, with Wendy Martin, Andy Gersick

This presentation reviews findings from two years of evaluation of Intel Teach to the Future, a major professional development program focused on improving classroom technology integration.

Format: Research Paper (Lecture)

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Intel Teach to the Future: A Partnership for Professional Development

Teri Metcalf, Center for Distance Learning Research, with Deborah Jolly

Presenters provide an overview of the Teach to the Future program. We share findings on how teacher participants are integrating technology into the curriculum and how partners are learning to collaborate.

Format: Research Paper (Lecture)

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IT and The Attitudes of Middle School Girls: A Follow-up Study

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Key words: girls, technology, attitudes, computer science

Abstract: Research has reported various explanations for the disinterest of girls with certain matters such as computer science, mathematics and science. Researchers have included factor such as, the societal views of an appropriate female career, the lack of female role models in these areas, gender bias in the classroom setting at this critical time in the female life, and gender stereotyping in computer software (2)&(3). The two-year NSF-funded Girls Research Opportunities in Computing (Girls R.O.C.) project was designed to address these issues by conducting an intense three-week residential program that would encourage and motivate seventh and eighth grade female students to pursue the study of computer science with emphasis on Information Technology (IT). Forty-eight girls were selected to participate in the program during the two-year span. These female participants were selected from rural and urban school districts in northeast Louisiana.

Each year of the program a cohort of 24 girls participated in a three-week residential program on the campus of The University of Louisiana at Monroe (ULM) followed by 3 follow-up Saturdays during the fall. To assess the attitudes toward IT, the Computer Attitude Questionnaire (CAQ) (7) was used to measure the attitudes of the participants with a pre, post and a ten-week follow-up evaluation. The changes in attitudes were compared in terms of the program effectiveness. While these initiatives were targeted to core factors affecting the low female participation in IT, this research also examined if the findings for females also applied to other underrepresented groups in information technology. The analysis measured the effects of training on attitudes in the

following categories: Computer Importance, Computer Enjoyment, Study Habits, Motivation/Persistence, Empathy, Creative Tendencies, Attitudes Toward School, Computer Anxiety, Self Concept, E-Mail, the WWW, Integrated Applications, and Graphics in respect to grade level and ethnic group.

Introduction: Supporting Women in InFormation Technology (SWIFT) has identified several factors that they consider as the core factors that contribute to the lack of female participation in IT careers (3). These core items stem from several factors: the effect of societal labeling computer science as a hard-core male activity; lack of female role-models such as, IT teachers and females in IT industry; the tendency for boys to dominate computers at school and home along with the lack of computers used as teaching tools in the classroom results in less experience in computer usage for girls. This in turn contributes to computer anxiety and lower levels of self-perceived ability in computer science among female students (3)(6)&(10).

In the workplace one of the most dramatic changes has been the increased dependence on computers and computer-related technologies. In 1998 The Bureau of Labor Statistics reported that the top three fastest growing occupations from 1996-2006 are in the field of computer science (1). Yet recent studies indicate that women are significantly underrepresented in computer science degrees programs (8)&(2). Myers (1999) reported that only 14.4 percent of employees in IT are female (3). Many researchers have sought answers to the question of why girls do not pursue computer science degrees and careers in the computer related fields.

Research has shown that design and delivery of technological knowledge through educational software, web designed sites, and computer games appeal more to boys than girls (10). Computer use in schools has traditionally been linked to 'masculine' subjects such as science and mathematics rather than traditionally 'female' subjects such as liberal

art and literature (5). Shoffner (2001) reported that half of all teachers who have access to technology in their schools do not make use of it in their instruction (9). Janese Swanson, senior vice president of the Girl Tech Web site, states, "Shying away from technology not only restricts girls from certain life choices and successes, but also limits the potential for their future products, inventions, and discoveries – a disservice to the entire society" (10). In general the above research has reported various explanations for the disinterest of girls with certain subject matters such as computer science, mathematics and science.

The NSF-funded Girls Research Opportunities in Computing (Girls R.O.C) project was designed to address these issues by conducting an intense three-week summer program that would encourage enthusiasm for computers by providing female role models such as, ULM computer science faculty and majors, a non-competitive environment, and group research. The program provided both formal and informal activities for the girls in areas of computer applications, Internet research, email activities, graphics, and simulations along with a variety of classroom and hands-on activities that exposed them to ways that computers are used in research, business, and the home (4).

Participants: The 48 female participants were recruited from eighth and ninth grade girls from predominantly rural school districts in northeast Louisiana. These educational communities have high proportions of underrepresented students in IT career tracks. The girls were selected using several criteria that included a written essay, transcript of grades, and a recommendation from a counselor or teacher. Special consideration was given to minorities and students with disabilities.

This study consisted of the pre, post and follow-up survey results of 36 of the 48 girls who participated in the summer resident program. Twelve of the girls did not return for the follow-up visits and, thus, were excluded form this study.

Objectives:

1. Mentoring/Role Modeling: Using Big Sisters to encourage IT as a career choice.
2. To foster a better understand of IT career opportunities:
   a. Invited Female Scientists and Educators as guest speakers and online chat sessions.
   b. Field trips to facilities where participants can see IT and computer professionals at work.
3. Classroom & Group activity:
   a. To experience classroom activities which are free of gender-bias and male competition.
   b. Research Groups to study and develop group oriented research projects.
4. Follow-up Visits: To encourage the participants to work on and complete a science fair project.

Activities: Program activities for Years 1 and 2 of Girls R.O.C. were essentially the same; however, there were two major differences. For Year 2 students, Space Science replaced word processing and spreadsheets, which proved to be an exciting change that dovetailed well with the MicroWorlds activities leading to the research projects. Secondly, the project director led all research projects, not the individual instructors as was done in the previous year. This focused approach for the Year 2 group appeared to be a more successful than the individual approach for the Year 1 group where the girls were divided into three different research project groups.

During both years the participants in Girls R.O.C. lived on campus for three weeks and then returned for three Saturdays in the fall. During the residential portion of the program, the participants (Little Sisters) were supervised in the dormitory by five female science majors (Big Sisters). The Big Sisters also assisted with daytime activities when they were not attending class thus reinforcing the role model exhibited by the instructor for the participants. Events for daily activity included Girl Talk a time for the project director to preview plans for the day and receive feedback from the participants. .

Using Frontpage and Netscape Composer to create individual girl's web pages and to produce a weekly electronic newspaper. A daily Space Science activity from The Science Out of This World site at Northwestern State University (NSU) to encourage interest in mathematics and science related subjects. MicroWorlds was used to teach the girls about graphics and to create simulations for their research projects. Field trips included visits to the U.S. Corps of Engineers Waterways Experimental Station in Vicksburg Mississippi, to Black Bayou National Wildlife Refuge outside of Monroe Louisiana, and to the Space Camp at NSU. Computer Lab time was used for email, browsing and searching, and completing computer activities begun earlier in the day.

The activities that the girls enjoyed the most were those that allowed them to be creative. They thoroughly enjoyed creating their web pages and writing stories for the newspaper. They also enjoyed writing and illustrating stories with MicroWorlds. Writing fairy tales was by far the most successful single activity of the summer. Experimental activity such as a bubble experiment was designed to teach the girls about the scientific method. This project divided the girls into groups of four and asked to formulate hypotheses about the best way to create bubbles. They were then given supplies to test their hypotheses. The most successful space science activities were those that allowed the girls to play games and create things. They did not like activities that simply made them read and do research. However, if the reading and research were combined with a creative activity, they did not mind. For example, they had to do research to create a moon phase calculator, an activity that they really enjoyed. They then used this research to create a moon phase simulation during research project time. Likewise, they enjoyed doing research about the environments of planets of the Solar System in order to design

an alien, who could live on a specific planet. They followed each activity with a simulation program that was the product of a MicroWorlds project. In contrast, they did not enjoy researching and answering questions about solar cookers since this activity did not include a creative project.

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Table 1
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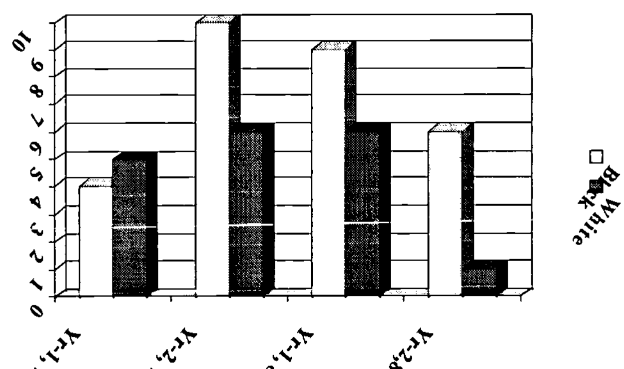

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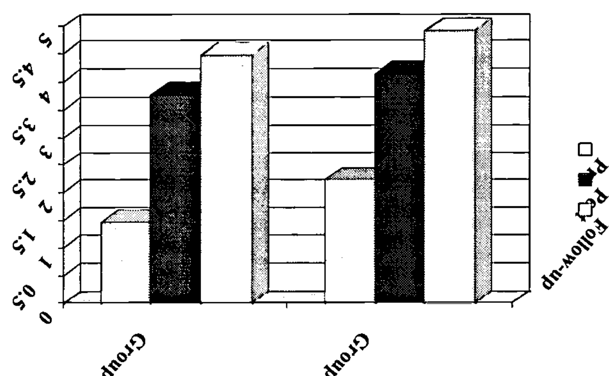

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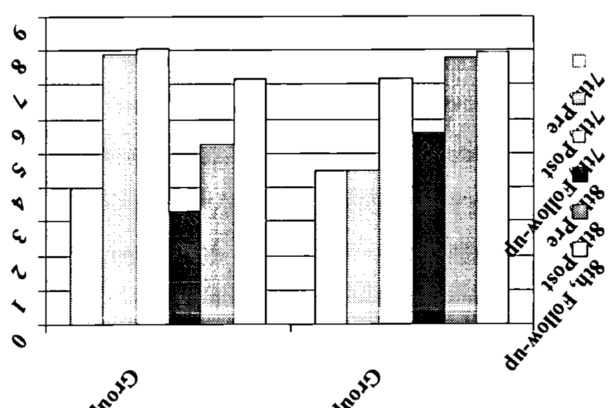

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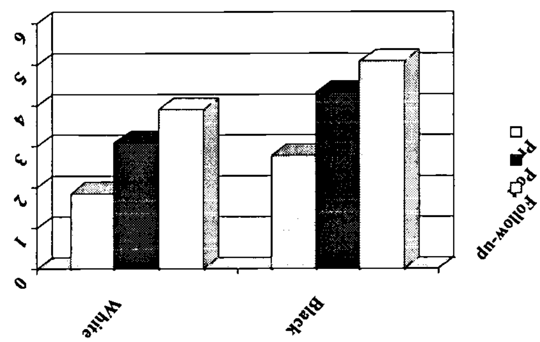

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Graphics	9	95

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Abstract

The Regional Educational Technology Assistance (RETA) program is a teacher-driven professional development initiative that has been educating New Mexico teachers in the use of learning technologies for the past four years. Since its inception the RETA project has directly served thousands of teachers in New Mexico. An important characteristic of the RETA program is its use of teachers to train other teachers. Since teacher-instructors understand classroom culture and the demands of teaching, their guidance is often more relevant and credible to teacher-participants. In this paper, we discuss the impact of the RETA model on the collegial behaviors and changing leadership roles of its participants and instructors. We will present findings which indicate that, as a result of their involvement in RETA's ongoing professional development workshops, participants and instructors: a) increase their collaboration in technology-related matters with other teachers in their schools and, b) assume leadership positions in their schools and communities.

Keywords

Professional Development, Technology, Leadership, Collaboration

Introduction

The Regional Educational Assistance (RETA) program provides professional development in technology for teachers and administrators in all public, private and federally funded schools in New Mexico, focusing particularly on the needs of teachers and students in high poverty schools. The student population in New Mexico presents a unique set of educational challenges, with a 44% high school dropout rate, 28% of all students living in poverty, and 48% of students at the 4th grade level scoring below the basic reading level (Kids Count, 2001). In addition, New Mexico schools serve a diverse linguistic population that includes a large percentage of Spanish speaking students as well as students from many Native American pueblos and communities for whom English is a second language. New Mexico children are in great need of an education that prepares them to fulfill their potential and, ultimately, secure and maintain productive employment in the 21st century. In order for this to occur, professional development, access to current information and resources, and practical hands-on training in how to use new and available resources is essential.

The teachers involved in the RETA program represent over two-thirds of the state's public school districts and a number of Bureau of Indian Affairs schools, including Northern and Southern Pueblo schools and Eastern and Western Navajo schools. The program, however, is not only concerned with reaching a diverse group of teachers, it is also seeks to build technical capacity and leadership among educators across the state. The professional development literature suggests that sustained change in teacher practice is most likely to occur when teachers create support networks with peers (Norton & Gonzales,

1998; McKenzie, 1999). Building communities of learners and allowing teachers to network and share ideas with their peers helps teachers to open their isolated classrooms and try out new teaching models (Reil & Fulton, 1998). The major thrust of the RETA project is to combine an exemplary, technology-rich, standards-based curriculum with model pedagogy and a supportive learning network to positively impact the skills and abilities of teacher participants. RETA employs a proven professional development model (Norton and Gonzales, 1998) to ensure that schools have the ongoing capacity to sustain and support the full integration of technology into classroom practice.

Methods

In order to evaluate RETA's progress in providing professional development opportunities to educators around the state, we employed multiple methods for gathering information about RETA participants and instructors. The information provided here analyzes the evaluation findings during the 2000/01 academic year for the RETA program. The RETA evaluation methods include:

Pre- and Post-Surveys: Teacher participants and workshop instructors completed surveys posted on the RETA Web site during the first RETA workshop they attended and then again at the final workshop, near the end of the school year. The data were automatically compiled in an electronic database. The instruments collect demographic data from participants as well as information about computer use, classroom practices, and attitudes toward technology. Open-ended questions on the post-survey asked about the aspects of RETA workshops that participants find most useful, the things that teachers do in their classes as a

result of what they learned in RETA, and participants' recommendations for improving the program. Seven-hundred and four people completed at least one of the two surveys.

Participant Workshop Evaluation: This questionnaire was mailed directly to participants' homes following the final RETA workshop. Teachers were provided with a self-addressed, stamped envelope and instructed to return the evaluation form. Eight hundred and fifty–six surveys were mailed out and 253 were returned. We believe that two factors contributed to this low return rate. First, teachers were asked to complete this survey just as the school year was ending and many teachers state that this is not a good time to do additional work. The second reason is that RETA teachers are asked to complete a participant evaluation at the close of each workshop in addition to the pre- and post-evaluation, and many teachers felt that this was too much paperwork.

The instrument collected data on participant demographics and asked participants to give feedback on the quality of instruction and workshop content. Participants were also asked whether they provided technology instruction for teachers, administrators or parents in their schools, communities or outside of their communities, and if so, how many people received instruction from them. The sample of participants who responded to this questionnaire differed somewhat from the sample who completed the pre- and post-survey.

Instructor Self-Assessments: This instrument was administered through the RETA Web site. An email message was sent to instructors on the RETA listserv

asking them to complete the questionnaire. This instrument, which parallels the Participant Workshop Evaluation, asks instructors to assess their own skills and knowledge, comment on their workshop implementation and suggest ways to improve the project. Instructors are also asked to identify other technology activities with which they are affiliated as instructors or trainers as a result of their experience with RETA.

Workshop Observations: During the 2000/01 school year, evaluators from CCT attended and observed four workshops led by four different RETA instructor teams. These workshops were held in different regions of the state—southern, western, central and northern New Mexico. Observations focused on both instructor and participant behaviors. For instance, we noted how the instructors organized the session, how they adapted the RETA curriculum to fit the needs of their participants, and how they interacted with the participants and each other.

Classroom Observations: During the fall and spring of 2000/01, researchers from CCT visited and observed activities in the classrooms of five RETA instructors. Classroom observations focused on student demographics, students' and teachers' activities with technology, and general teaching practices. For instance, researchers recorded if and how students collaborated in the classroom as well as how they interacted with computers. There was a particular focus on recording how technology was integrated into the overall lesson plan, whether the use of technology was a means to an educational end or simply an end in itself.

RETA Instructor Interviews: Weconducted a variety of interviews with RETA instructors. First, after observing RETA workshops, we held structured debriefing sessions with the instructor pairs in which we asked them to comment on the workshop—how they chose the topic, how they prepared for the session, the feedback they received from participants. Because both instructors participated each was able to feed off what the other was saying, and they could clarify or expand upon the other's statements. Second, we conducted individual interviews with instructors at their schools either before or after the classroom observations. In these interviews we asked instructors to talk more generally about their experience in RETA, and describe the impact their involvement with RETA has had on their professional lives. Third, we interviewed a number of both new and long-term instructors at the 2001 instructor orientation. Again, instructors were asked to describe their experience with RETA and its impact on their professional lives.

Leadership of RETA Participants

RETA is helping to establish a cadre of technology leaders throughout the state of New Mexico. The data gathered over the 2000/01 academic year indicated that teachers who participate in RETA become active in their school and district technology committees, help the districts make decisions about technology purchases, help write grant proposals to acquire equipment and networking services, and provide technology instruction to their colleagues, administrators and parents. These efforts are especially valuable in schools and communities in remote areas of the state, where technical expertise and leadership are sorely lacking.

When asked in the participant evaluation whether they provided technology instruction to members of their communities, 54% of participants responded that they had. Of those who took on professional development activities, 78% provided training to peers in their schools, 12% offered training to parents, 11% offered training to school administrators. In total this sample of participants alone provided technology instruction for close to 1,000 additional people. If the same rate of outreach holds true for the entire group of RETA workshop participants (890), then it's possible that, through the actions of workshop participants, the RETA program was able to reach an additional 3,500 people in the state of New Mexico.

Participants who had taken RETA at least once before were more likely to offer technology instruction to other teachers, administrators or parents than those who had taken RETA for the first time this year. Seventy percent of repeat participants said they gave technology instruction to others, while 47% of first-time RETA participants offered instruction. This finding suggests that the more involved participants become with RETA the more they assume responsibility for taking technology leadership positions in their schools and communities.

In addition to providing formal instruction to colleagues and others in their schools and districts, we also asked teachers in the pre- and post-surveys to tell us about how their involvement with technology affected the kind of informal technology support and encouragement they provide to their peers in their daily lives at schools (See Tables 24-27). A matched pair analysis of the pre- and post-

survey data show that, after participating in RETA, teachers provide technology assistance to their colleagues more frequently (n=345).

How often RETA participants assist other teachers with:

Table 24: Hardware problems

	Percent (Pre) Post
Daily or Weekly	(25.4) 28.0
Monthly	(10.2) 21.2
2-3 times per year	(29.7) 27.9
Never	(34.7) 22.9

Table 25: Software problems

	Percent (Pre) Post
Daily or Weekly	(26.6) 29.0
Monthly	(9.6) 14.7
2-3 times per year	(30.7) 35.8
Never	(33.0) 20.5

Table 26: Designing curriculum that uses computers

	Percent (Pre) Post
Daily or Weekly	(13.5) 17.3

Monthly	(17.0) 23.7
2-3 times per year	(27.6) 31.0
Never	(41.9) 28.1

Table 27: Discussing issues related to computers

	Percent (Pre) Post
Daily or Weekly	(44.2) 57.3
Monthly	(19.4) 22.1
2-3 times per year	(19.6) 13.8
Never	(16.7) 6.8

Comments offered by participants in their post-surveys also indicate that RETA participants are sharing what they are learning with their peers and school communities. "I taught other teachers how to use different programs," stated one participant. "I have shared many of my ideas with other teachers and they have used them in their classrooms," wrote another. A third participant engaged in more formal instruction at her school. "I have taught a Saturday class to our staff," she said, "and I used Marco Polo [an educational web resource] and taught a session of that to our staff."

In our workshop observations we witnessed instructors encouraging participants to become instructors in their own schools. At one workshop in western New Mexico, instructors provided participants with notebooks that outline ideas for

giving workshops to their colleagues. During the morning sharing session, after the teachers talked about how they used technology in their classrooms, one of the instructors asked, "Did anyone plan ways to share what you learned with the staff at your school?" One participant replied, "I promised a kindergarten teacher I would help her figure out how to use her computer."

"As RETA participants you should be technology leaders in your schools," the instructor advised. Then she told the participants how intimidated she used to be by technology. "Now I know how to take a computer apart," she said. "I added memory to my computer last year. I wouldn't have felt competent to do this a few years ago, but now I can." And now, along with being a classroom teacher, she is also the technology coordinator for the school.

Leadership of RETA Instructors

One of the ways that many RETA participants have evolved into technology leaders is by becoming RETA instructors. The majority of the 110 RETA instructors were once workshop participants who were recruited by their own instructors. RETA instructors are a group of motivated individuals, many of whom may have already had an interest in, if not necessarily expertise in technology before they participated in RETA. However, in most cases RETA instructors did not hold leadership positions in their school before becoming involved with RETA. The RETA program has given these individuals an organized, effective way to channel their interests and make a significant impact on the educational landscape of New Mexico.

As a group, RETA instructors are now quite active within their schools with regard to technology assistance. During interviews and classroom observations, we noted that RETA instructors are often called on informally to assist with technical issues, or to serve on committees that assist in technology planning. The data below, which come from an analysis of the pre-survey data, support these observations (n=84).

How often RETA instructors assist other teachers with:

<u>Hardware problems</u>

Daily or Weekly: 56%

Monthly: 20%

Less than once a month: 12%

Never: 12%

<u>Software problems</u>

Daily or Weekly: 56%

Monthly: 17%

Less than once a month: 18%

Never: 9%

<u>Designing curriculum that uses computers</u>

Daily or Weekly: 34%

Monthly: 28%

Less than once a month: 21%

Never: 16%

Discussing issues related to computers

Daily or Weekly: 75%

Monthly: 16%

Less than once a month: 6%

Never: 3%

All of the RETA instructors who served as the subjects of our workshop and classroom observations have assumed some kind of technology leadership role in their schools or districts. One has become a technology coordinator in her building. She noted that in previous years she had acted as a de facto technology coordinator, but this was the first year she has gotten paid to take on these responsibilities, which include staying after school to work on the computers, and trouble-shooting for other teachers in the school. Along with being a classroom teacher, one of the other instructors we observed is also in charge of the computer lab in her school, which has 27 computers in it. She also provides technology professional development for staff members in her school district. Her partner instructor is on the technology committee in his school, and has written grants that have brought technology funding to his school. Another instructor runs a media program in her middle school. Her students make use of multiple kinds of technology, and even produce daily news broadcasts for the school. Other instructors spoke to us about trouble-shooting for colleagues.

People we spoke to at the Professional Development for RETA Instructors in

June 2001 talked about the impact they have been able to have in their schools and districts since becoming involved with RETA. "My administration asks for my advice on things like software purchases," one instructor informed us. "Because I brought so much from what I've learned through RETA, they see the effort I'm making has had a positive effect." Another instructor noted, "It's allowed me to help my school find a better way of utilizing all of the technology we have, which has prompted me to learn more about the software applications and networking."

Other instructors spoke of new responsibilities they were assuming since taking part in RETA.

> "I'm now the library technology coordinator for my school. Because of RETA I've made contact with a lot of people, formed partnerships. That's brought a lot to my school that we wouldn't have had. I was the coordinator for other teachers at my school to attend RETA classes. We're in a BIA [Bureau of Indian Affairs] school, not a public school. We're not always as informed about programs that are available. So I was the link. Almost everyone in the school has attended the workshops."

> "We had consultants in school who wanted me to take over the role of technology and curriculum coordinator five years ago and I didn't feel I could, but now I'm more confident and have taken on that responsibility."

"My school put me in charge of the technology committee and the accreditation committee because I was the only teacher who could make graphs and use databases. I help with grants a little bit. I'm writing the technology plan and I ended up in charge of the GATE [Gifted and Talented Education] program. You can get yourself in trouble."

"My role in school has changed from computer instructor to technology coordinator because of RETA. It involves training teachers. I have trained teachers before but I'm much more efficient now because of the way RETA modules are structured, and because we can practice them."

"It's my responsibility to go out and share what I know. Administrators come to me and ask me to help out, especially with things that are networked. People come to me for trouble-shooting. Each school in the district has a technology representative and I will be that next year. I wanted to take that job when I felt prepared. Eventually what I would like to do is to be a consultant for the schools, teaching teachers how to use technology. The tech rep position may help me do that."

Professional Opportunities and Personal Growth

Along with moving into positions of leadership in their schools, RETA instructors also report that their involvement in the program has given them the confidence and knowledge to develop both professionally and personally. On the instructor self-assessment questionnaire, 74% of RETA instructors indicated that they gave non-RETA workshops over the year. These include Marco Polo (an

educational Web site developed by MCI/Worldcom Foundation), Intel's *Teach to the Future*, Cisco Systems Network training, workshops associated with RETA Regional Resource Centers, and workshops associated with consortia in which RETA is a participant.

"RETA has been like a career change for me," said one instructor. "I've been teaching for 20 years in social studies and I was ready to move on. I wanted something different. Now I'm getting my technology endorsement and looking to go full time into teaching technology classes." An instructor who left teaching to start his own business observed that RETA "allows me to still be involved in the education system in a peripheral role." Another instructor is pursuing a graduate degree. "RETA is opening doors for me. It encouraged me to enter into the master's program. The people are great to work with, no stinginess; everyone is willing to share."

Some instructors mentioned that their experience with RETA has made them better teachers. One of the workshop leaders we observed said that, since becoming a RETA instructor, she has gained more confidence as a teacher, because in the RETA workshops she gets more feedback on her lessons. Teachers are more willing than students to critique instructional methods. Another instructor argued that providing assistance has helped her learn more about technology. "I help teachers in my own school and in my district a lot, so now I know how to do a lot more. It's helped me with my skills. I used to help them out a little before but I do more now."

Not only has RETA enabled some instructors to advance professionally, but some of the instructors we interviewed also mentioned that RETA has had a positive impact on their personal lives. One instructor observed that his participation in RETA "makes my brain grow; it hurts the cobwebs." Another instructor stated, "I learn every day and I love that. I have a 7-year-old boy and I do a lot with him. He's on the Internet. It's personally rewarding." Still another instructor said that he welcomes the opportunity to pursue new interests. "Change helps, learning new stuff, new software, new ways to utilize software. I can take those back to students and can use them in the classroom. It helps me stay fresh. The personal growth is worth losing weekends. I'd rather be doing this than a lot of other things. RETA is my hobby."

Support of Instructors

One of RETA's main goals is to create a professional network of technology educators and advocates across the state. In order to create such a network, the RETA program understands that it needs to treat its participating teachers as professionals. This means providing them with the practical support that allows them to do their jobs. In fact, one of the main reasons instructors give for their dedication to RETA is the fact that they and their participants feel supported by the program staff. "If the participant experience hadn't been good I wouldn't have ended up being an instructor," said one man. "[The project director] is extremely supportive, and she has a dedicated staff. There is nothing we need that we can't get in terms of support."

One of the instructors whose workshop we observed mentioned that often teachers are not treated professionally by programs they become involved in. "[The RETA project director]," however, "treats her people well." Another instructor, who works in a Native American pueblo, contrasted RETA with another large professional development program that trains teachers to become master teachers who provide technology training to peers. This other program gives master teachers funding for equipment in their classrooms, but only if they train a certain number of teachers. "Teachers from Indian communities who do [the other program] don't get all the perks because we can't have as high participation. There's just not enough people. So they're trying to bring in Native Americans but they refuse to give them money and equipment, all because it's numbers driven. It's widening the technology gap."

The RETA program, on the other hand, provides support to all of its instructors, regardless of where they teach or how many participants they have. RETA instructors are "given software and tools, the lessons and handouts. RETA is great about providing that and giving instructors what they need—good pay, a laptop, equipment. The participants can really work if they have the tools to work with. That, combined with a highly competent program staff, [the RETA project director] manages that very well." One instructor said she will continue doing RETA as long as she can, because RETA pays better than other professional development programs she knows of, and she gets a laptop and software for doing it as well. "The fringe benefits with RETA are great," said another instructor. "The software, sharing with other teachers, the laptops. It's amazing."

Providing instructors with laptops and software helps them be better prepared to teach their workshops, which are often held in facilities that instructors are not familiar with and do not have access to before the day of the workshop. "It was a pain before (we got the laptops) because we had to load software on lab computers at the workshops. Now I can load it on my own computer so there's no surprises. I get to play with the software before I go."

In addition to equipment, software and pay, instructors mentioned that they felt supported by the instructor training that RETA provides, and the fact that the program staff listens to the feedback from instructors and makes improvements in the program in response to that feedback. "Part of RETA is top down and part is grass-roots. Having the debriefing as a part of the instructor orientations is great. A lot of programs wouldn't take time to find out what the problems are and if they did they wouldn't do anything about them. Things have changed because of debriefings and not just the formal ones but those that take place on a weekly basis." One of the changes that the RETA program made in response to instructor feedback was to give the instructors more time to practice the workshop modules at the annual Instructor Orientation. "The training is much better," said one instructor. Last year at the orientation we had to come up with workshop modules and then just go out and do them. This fall we took the time to go through every module." A number of instructors we interviewed agreed that this format helped them to feel more confident teaching the workshops.

In order to create new curriculum modules and prepare RETA instructors to teach those modules, the RETA program holds two instructor training and development sessions each year. In the June Professional Development session, instructors are introduced to different kinds of software and resources in hands-on workshop sessions. Instructors also form groups to work on creating curriculum modules over the summer for use in RETA workshops during the coming year. In the Instructor Orientation meeting in September RETA instructors met again for more training on software applications and to learn about and practice using these new modules.

Not only do these professional development and orientation sessions help RETA instructors gain the skills and confidence to teach the workshops, they also offer instructors the opportunity to connect with their RETA colleagues across the state. Many RETA instructors mentioned that they appreciated this opportunity to get to know their peers and learn from them. In order to sustain these connections, RETA maintains a listserv for instructors so that they can continue to communicate with each other over the year. This listserv is actively used by many instructors for exchanging information about educational Internet resources, grant opportunities, RETA news and political advocacy opportunities. As one instructor noted, "RETA is about providing teachers with the knowledge that helps them integrate technology into curriculum, and building a network of educated technology people." By providing opportunities for instructors to meet, exchange ideas and communicate throughout the year, RETA has helped support the development of a network of informed technology education professionals across the state of New Mexico.

Conclusion

The RETA model of technology professional development, which not only has teachers teaching teachers, but which encourages both instructors and participants to become technology leaders in their local communities, is particularly useful for meeting the unique educational technology needs of in a state such as New Mexico. Many communities in New Mexico are quite rural and isolated, and there is no pool of technical expertise in the community from which schools can draw when they are in need of assistance. In such circumstances, schools must be resourceful and rely on their own faculty and staff for technical support and leadership. The RETA model encourages participants to share their skills as they learn them, to see that an integral part of learning about technology is learning how to provide technology support and advice to colleagues.

As the above qualitative and quantitative evidence indicate, both instructors and participants assume greater responsibility for technology support and guidance in their own schools and districts after their involvement in the RETA program. Because they are treated like professionals by the program director and staff, and because the culture of RETA is one that encourages sharing and community-building among peers, RETA participants and instructors learn to see themselves not simply as educators participating in a professional development program, but as part of a statewide network of technology education leaders.

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Selected Findings from the Evaluation of Intel® Teach to the Future

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Key words: professional development, technology

Abstract
This paper reviews findings from two years of evaluation of Intel Teach to the Future, a professional development program focused on improving classroom technology integration. Intel Teach to the Future is a three-year, international effort supported by the Intel Corporation. The program uses a train-the-trainer model to deliver a curriculum that emphasizes using commonly available software tools to support students in conducting original inquiries and creating multiple representations of what they learn.

The Center for Children and Technology, part of Education Development Center, Inc., is conducting an external evaluation of Intel Teach to the Future. The first year of the evaluation investigated teacher responses to the training, and strengths and weaknesses of the program delivery model as a mechanism for achieving both broad implementation and locally meaningful and sustained impact. Year Two research uses case studies to investigate the sustained impact of the program on teachers' instructional practices.

Introduction

This paper reviews selected findings from an evaluation of the Intel Teach to the Future professional development program. Intel Teach to the Future was designed to address the overarching goal of the Intel Innovation in Education initiatives: to improve math, science, technology and engineering education worldwide. To achieve this end, the program focuses on two of the four more specific goals of the Innovation in Education initiatives: promoting the effective use of technology in the classroom, and improving science and math education in K-12 schools. Our evaluation focuses on the U.S. implementation of this international program. The, first year of the evaluation (2000-2001) focused primarily on understanding the extent to which the program may be meeting the first of its goals: promoting the effective use of technology in the classroom. Methods employed included surveys, site visits to participating school districts, and interviews with teachers, program staff, and district personnel. During the second year of the evaluation, we are conducting case studies in several districts to investigate both of the goals.

The evaluation examines the challenges of disseminating a challenging, high-quality curriculum to a broad (both geographically dispersed and diverse in their teaching specialties) population of teachers. A range of research has demonstrated the importance of local ownership of educational innovations to their long-term effectiveness (McLoughlin, 1978; Sabelli & Dede, forthcoming) On the other hand, the need to identify promising programs and practices and bring them to scale is great. Can a highly structured delivery model, a train-the-trainer approach, and a well designed and extensively piloted curriculum cause meaningful impact at the classroom level for teachers across the country teaching in widely varying circumstances? To help answer this question, we have paid careful attention to two key topics in our evaluation: the efficacy of the implementation model of Intel Teach to the Future, and initial evidence of the impact of the program on teachers who have participated in the program.

We understand "efficacy" here to refer not just to a smooth implementation of Intel's prescribed sequence of trainings, but to a more site-specific ideal of program effectiveness. Because we know that large-scale educational innovations have the most lasting impact when they allow for local adaptation and tailoring of the innovation (Culp & Honey, 2001; Culp, Honey, & Spielvogel, forthcoming; Fishman, Best, Foster & Marx, 2000), we looked to see whether this program was being adapted to meet local needs; whether the local adaptations improved the delivery and impact of the program; and whether the administrative structures of the program supported that process of local adaptation.

To learn more about the content and structure of Intel Teach to the Future, visit http://www.intel.com/education.

Findings

Demographic Profile of Teachers

This summary is based on data collected as of June 2001, but subsequent analyses as the pool of participants has grown indicate that the overall profile of the population is remaining consistent.

Most teachers who responded to end-of-training surveys were women (80%, N=6385). The sample was also predominantly White/non-Hispanic (84%, N=6713). Hispanic or Latino(a) teachers constituted 8% of the training survey sample (N=663), while less than five percent of the sample was Black/non-Hispanic (3%, N=268) or Asian (2%, N=141). This distribution includes more Hispanic teachers than the U.S. teaching population as a whole: the national profile is 90.7% White/non-Hispanic, 7.3% Black/non-Hispanic, and 2.0% other racial/ethnic groups (U.S. Department of Education, National Center for Education Statistics, 2001).

Survey participants varied widely in the extent of their teaching experience. Some of

those receiving training were just beginning their teaching careers, while others reported almost 50 years of teaching experience. These teachers have an average of 13 years of teaching experience (SD=9). Most teachers (64%, N=5103) reported that less than 50% of the students in their schools were eligible for reduced or free lunch, which is consistent with the national range (68% of schools nationwide have less than half of their students eligible for reduced price/free lunch).

The greatest plurality of teachers who completed end-of-training surveys were Generalists (these are primarily elementary school teachers who address all subjects), who accounted for 27% of respondents to the end-of-training survey. These teachers and Language Arts/English teachers (19% of respondents) accounted for a near-majority of program participants, while all other teaching categories lagged significantly behind (e.g. Math – 7.7%; Science – 6.8%; ESL – 5.4%). About one-third (32%) of these teachers work in the early elementary grades (K-3); 16% teach upper elementary (grades 4-5), one-quarter teach middle school (grades 6-8), and 27% teach in high schools (grades 9-12).

Responses to the Program

Teachers reported their responses to the program through surveys conducted at the end of every Master and Participant Teacher training, as well as in interviews with the evaluation team. Teachers consistently reported a very high level of satisfaction with the training.

In their responses to the end-of-training survey, Participant Teachers were very positive about their experiences with Intel Teach to the Future.

- 97% of teachers participating in Intel Teach to the Future trainings reported that the ideas and skills they learned through the program would help them to successfully integrate technology into their students' activities.
- 94% of these teachers said that they would "definitely" recommend the Intel Teach to the Future training to a friend or colleague.
- 91% of these teachers reported that after completing their training, they felt "well prepared" to integrate educational technology into the grade or subject they teach.
- 91% of these teachers felt "well prepared" to support their students in using technology in their schoolwork.
- 90% of these teachers felt "well prepared" to evaluate the technology-based work their students produce.
- 76% of these teachers felt that their trainer was "very effective" in facilitating their training experience.

When asked to rate the helpfulness of various forms of professional development, participants tended to rate Intel Teach to the Future more positively than other forms professional development they had experienced in the past year. Eighty-six percent of participants surveyed felt that the Intel training was "somewhat" (33%) or "very" (55%) useful to them as they worked on improving their use of technology.

In interviews, LEA coordinators expressed satisfaction with the program thus far and offered rich anecdotal evidence that their teachers are pleased with the training. When asked if he had received any feedback from Master and Participant Teachers about the curriculum, a typical LEA coordinator replied:

> "I met with their principals the other day to see what the general reception has been on the campus, and the feedback has been excellent, excellent. The

principals said that exciting things are happening with those students [of Participant and Master teachers]."

Program Impact on Participating Teachers and Their Classrooms

Initial Evidence of Program Impact

As we noted above, one of the factors we used to determine the efficacy of the program was the extent to which teachers implemented the unit plans they created in the trainings. In the end-of-year survey 51% of the respondents reported that they had implemented their unit plan they developed in their Intel Teach to the Future training (this includes 78% of Master Teachers and 48% of Participant Teachers). Over half of those teachers who implemented a unit plan reported being "very satisfied" with the experience (53%), and three-quarters were at least "somewhat satisfied"(33%).

Teachers who had implemented their unit plans felt very strongly that their unit had been effective in helping them to meet their learning goals for their students. Specifically:

- 80% reported "student projects showed more in-depth understanding" than other, comparable work.
- 89% reported "student projects were more creative" than other, comparable work.
- 99% reported students were "motivated and involved in the lesson."
- 97% said they "received positive student feedback," on the unit.

Reasons for not implementing the unit plan

Over 75% of those who had not implemented their unit plan expected to do so in the next school year. The most common reasons for not implementing a unit plan were that the plan was created too late in the school year to be used (38.6%) or that the teacher planned to use the lesson later in the school year (19.7%).

Obstacles to effective unit plan implementation included not having enough time to complete the entire lesson (42% agreed or strongly agreed), and not having enough computers available (47% agreed or strongly agreed). Teachers surveyed did not generally feel that their students' or their own computer skills were an obstacle to implementation, or that they had technical problems that kept them from implementing the unit.

In addition to time constraints, prominent obstacles to unit plan implementation included the following:

- Technology access. Teachers who implemented their unit plans averaged significantly more computers in their classrooms (7.42) than those who did not (4.77). This is consistent with other research that has shown that a 1-to-4 ratio of computers to students is critical to support gains in the quality of students' use of technology (Becker, 2000). Teachers who implemented unit plans were also significantly more likely to have at least some of their classroom computers connected to the Internet than those teachers who did not implement their units.
- Time constraints. When teachers explained that they did not have enough time to make full use of their unit plans, they were referring to several different issues.
  - the amount of class time that would be required to cover a full unit.
  - getting their students adequate time on computers.
  - finding time for themselves to do further curriculum development to improve or complete their unit plan.
- Testing pressures. Teachers who did not implement unit plans were more likely than those who did to report that standardized testing has changed how and what they teach. Teachers

often referenced the project-oriented nature of the Intel Teach to the Future curriculum, and said that there is little opportunity to do this sort of open-ended and student-directed teaching when test preparation is a high priority in their school or district.

- Applicability of the unit plan. Teachers who did not implement their unit plans frequently described what they perceived to be a poor fit between the program's emphasis on student use of the technology and inquiry- and research-oriented projects, and their own existing curriculum and learning goals. Early elementary grade teachers, who were slightly less likely than teachers at other grade levels to implement a unit plan, made these comments most often.

  Among those early elementary teachers who did implement unit plans, it is evident that many modified those units to suit their perceptions of what would work for their students. These teachers were the least likely group to have their students actually use any of the relevant software in the course of teaching their unit. Instead, these teachers used the software themselves to, for example, create a PowerPoint presentation for the class.

Intel Teach to the Future as a Catalyst for Change

LEA liaisons and other district- and school-level administrators viewed participation in Intel Teach to the Future as both a major opportunity and a major challenge. This section of this paper reviews several areas in which program participation was often difficult, but ultimately productive for school districts.

Hardware Allocation

Participation in Intel Teach to the Future challenged districts to re-think their policies on technology distribution, and motivated teachers to push for better technology resources in their classrooms. The essential issue generating change was Participant Teachers' expectation that they would have a computer in their classroom once they completed their training, and more importantly, their desire to have that computer, and often their decision to push for more than one. These new levels of motivation often clashed with existing district-level planning. One frustrated school technology coordinator exclaimed, the "Intel Teach program is upsetting the district's plan for hardware allocation." He related that the district hardware rollout was supposed to proceed on a specific schedule. The elementary schools were supposed to be the last to get computers, yet many Intel Teach to the Future participants were from the elementary schools, and were pushing to get moved up on the allocation schedule.

In another district, the program had an opposite effect: teachers had already been promised computers for their classrooms without any expectation regarding training, but once they signed up for Intel Teach to the Future, they had to "earn" their hardware by completing the course, causing tension between Participant Teachers and the Master Teacher they perceived as withholding their hardware. One LEA liaison, who was relying on Intel Teach to the Future to provide basic technology training to the teachers in her small district, explained that although she was enthusiastic about the emphasis Intel Teach to the Future placed on student use of computers, it conflicted with her district's policy of placing only one computer in every classroom and reserving it exclusively for teacher use. The LEA liaison reflected, "I had to ask myself, 'what can I do to meet Intel's needs and live within the administration's restrictions?'"

Accessing Participant Teacher work outside class

Across all districts, LEAs and MTs had to figure out how to help Participant Teachers access their work from locations other than the labs where classes were being held. In many districts, this was the first time that teachers had asked to have this kind of access to online resources, and

the needs raised by this training caused new policies or new resources to be put in place that, if they are institutionalized, will improve the functionality and quality of school networks for all teachers in these districts.

<u>Cross-platform issues</u>

Intel Teach to the Future's exclusive focus on PC computer platforms raises issues for teachers who use Apple computers in their classrooms. This challenge is particularly prominent because Apple computers are most commonly used in early elementary classrooms, and early elementary teachers (K-3) constitute almost one-third of the teachers participating in the program.

In some districts, teachers dedicated to using Macintoshes simply did not participate in Intel Teach to the Future (this contributed to recruitment challenges in some districts, as K-6 teachers are the majority of the classroom-based teaching staff in K-12 districts). As one LEA liaison said, "I could [recruit enough teachers for my training] if elementary school teachers had the equipment, which they don't. Of course they are the majority of the teachers in the district."

However, some Macintosh-using elementary grade teachers have been able to bridge the gap and apply the Intel Teach to the Future curriculum in their Macintosh-based classrooms. While they are obviously unable to follow the curriculum to the letter, they are able to use the same software packages used in the curriculum. A challenge to this approach is gaining access to copies of Microsoft Office for Macintosh, since the program does not provide it and it may be too expensive for the district to buy. Some teachers simply plan to apply the general lessons of the curriculum to other applications they already use with their students. These teachers are able to think beyond the technical issues involved in the training and to focus on the larger principles being communicated by the Intel Teach to the Future curriculum.

<u>Concluding analysis</u>

The vast majority of Participant Teachers we spoke with saw Intel Teach to the Future through the lens of their pre-existing perceptions of and experiences with their district administration and their previous professional development experiences. In many cases, this was beneficial – teachers with positive relationships with their districts took it on faith that the program had been chosen with an eye to their needs. However, when Participant Teachers had reason to be doubtful about the usefulness of training sponsored by their district, or about their district's ability to support them in making use of what they learned in professional development sessions, it was difficult for even the most skilled Master Teacher to make the Intel Teach to the Future a highly valued experience.

Different districts provide different sets of preconditions for teachers' reception of Intel Teach to the Future which have a real and tangible impact on what teachers take away from the training and, in turn, on what impact the training has on their teaching and their students' learning. Optimally, Intel Teach to the Future can act as a catalyst for positive change, encouraging administrators and teachers to re-examine their practices, policies or beliefs about technology use, and moving the entire district toward better access, more interesting ideas about student use of technology, and more collaboration and innovation by the teaching staff.

Across all contexts, a vital element was effective communication – between RTAs and districts, between administrators and teachers, and among teachers – about the scope and purpose of this training beyond earning computers or fulfilling professional development obligations. Especially in districts where constructive professional development opportunities are rare or where technology resources are scarce, it is crucial that teachers be invited to use Intel Teach to the Future as a chance to identify their own teaching goals, to reflect on their learning goals for their students, and to exploit the concrete curricular benefits of using technology in the

classroom.

Discussion of Year One Findings

What does it take to create a school in which students are frequent, comfortable users of technology tools, and teachers are able to make clearly considered connections between learning goals and the technologies they ask their students to use? Hank Becker (2000) suggests that no one factor can create this situation. His research indicates that a majority of teachers in a community will begin to use technology with their students for more than remediation, skill-building, or recreation only when adequate technical skill, a generally constructivist teaching philosophy, and convenient access to a cluster of at least five to eight computers are available in teachers' classrooms. Intel Teach to the Future seeks to help teachers build their technical skills, while also inviting them to pursue a more student-centered, research-oriented mode of teaching. The curriculum presents convincing images of how commonly available software tools can support this kind of learning. This bridging of technical training with opportunities to reflect on and practice student-centered, content-rich applications of technology tools is the key quality of this program. Its eventual impact on everyday teaching and learning depends on effectively moving teachers from understanding "technology" as a set of technical skills to master toward seeing various applications as distinct tools to support engaged and creative student learning.

Our research suggests that teachers who have participated in this program are extremely enthusiastic about the experience and have a high opinion of both their trainers and the curriculum. However, as this report has outlined, two major factors stand between the quality of the program and its ability to realize its intended impact at the classroom level. First, teachers' pre-existing beliefs and practices influence their engagement with the core concepts of the curriculum. Second, school- and district-level factors frequently militate against the kind of experimentation and innovation that teachers need permission to pursue if they are to build, over time, a real mastery with the technology and the kind of teaching and learning valued by this program.

Preliminary Findings from Year Two Case Study Research

Case studies being conducted in four school districts during the 2001-2002 school year are suggesting that Intel Teach to the Future can have a sustained impact on the character and quality of technology use in schools, and in science classrooms in particular. We are finding that many of the issues raised in our Year One findings continue to be prominent issues in the districts we are following this year. In our case study sites, raised teacher awareness and enthusiasm about using technology with students in instructionally rich ways is being sustained over time, and is creating a "push" on existing administrative and technical structures that have impeded teachers' ability to use technology well with their students. Intel Teach to the Future seems not only stimulate teachers to reshape their goals for technology use, but to stimulate changes in their environment that make it more possible for them to pursue and achieve these goals.

We conclude this report by briefly summarizing some of the issues we are following across our case study sites that illustrate this phenomenon.

<u>Common Goals in Schools with a Master Teacher and Many Participant Teachers</u>

Master Teachers frequently recruit many teachers from their own school to participate in Intel Teach to the Future. In these schools, where a large cohort of trained teachers has been established and a Master Teacher is providing leadership and sustained support, we are seeing

evidence of teachers beginning to act as a coordinated group, focused on similar goals for technology use. Examples of this kind of behavior include:

- Teachers pooling resources (including computers and instructional space) to make it possible for whole classes of students to work on the computers at once.
- Teachers making informed, shared decisions about technology policies in their schools, such as deciding what kinds of equipment they want to purchase for their grade levels/departments.
- Master Teachers seeking out teachers' feedback to inform purchasing and allocation decisions.

This kind of behavior is important because it suggests that these teachers are creating a distinctive social context for technology use in their schools. Rather than being a marginalized activity that most teachers do not engage with, instructionally-focused technology use is becoming one of the central, shared activities of the school as a whole. Further, teachers' goals for technology use are aligned with one another, and draw on a common vision of meaningful use of technology with students.

Shifts in Teachers' Instructional Strategies and Assessment Practices

We are seeing some evidence in our case study sites that teachers are beginning to place an increased emphasis on supporting and evaluating their students' work process, rather than focusing on the creation of finished products. For example, several teachers are re-designing lesson plans to help students set clear, content-focused priorities for their work process, such as completing content research before spending time on the design of a PowerPoint presentation. These shifts seem to arise initially as a response to the limited availability of both computers and time, which students need in order to engage in sustained research projects. The consequence of these shifts, though, can be an instructional environment that encourages students to focus on sustained inquiry and effective communication, rather than on more superficial aspects of the research process.

Teachers also seem to be making greater use of assessment rubrics after participating in Intel Teach to the Future. The training introduces rubrics as a way to articulate expectations for complex student work products and to evaluate students' accomplishments. Teachers are reporting that the experience of creating a rubric during their training helped them overcome their hesitations about using rubrics, and are finding that these tools provide a useful structure for assessing work products they are not entirely familiar with, such as student web pages and PowerPoint presentations.

These two findings suggest that Intel Teach to the Future can, with certain follow-up supports in place, have a lasting impact not only on the level of teachers' technology use, but in the quality of their instructional and assessment practices.

Impact of the Training Model on Other Professional Development

The approach and structure of the Intel Teach to the Future curriculum is also having an impact on districts' overall approach to professional development. For example, in one of our case study sites, the head of the district educational technology department has re-designed the district's Summer Institute for technology training. The Institute used to focus on building teachers' skills with various software programs. She describes this summer's redesigned institute in this way:

> "This year it's: 'Come and let's see where you are in your curriculum and in your standards-based use of technology, and let's see how we can help you use the

> *appropriate* technology to help you move forward in your use of technology.' I'm sure the Intel program was not the sole reason [for this change], but it really heightened our awareness and showed us that the emphasis needs to be on the curriculum, not just on the technology."

In another of our case study sites, teachers who have become Intel Teach to the Future Master Teachers are no longer willing to teach skill-building technology workshops that they used to lead for their district. They want to re-design the in-service technology training sessions their district offers throughout the school year to give the trainings a clear purpose that ties back to teachers' immediate classroom activities. These Master Teachers are hoping to influence district personnel to cause these kinds of changes across the districts' whole technology professional development program.

Changes like these are important because they suggest that Intel Teach to the Future can have an impact on a school district that reaches beyond the individual teachers who participate in this particular training program. Intel Teach to the Future models how technology-related professional development can maintain a core focus on curriculum and instructional issues, and can invite teachers to re-examine and re-design a portion of their curriculum. In districts with personnel in place who are able and willing to build on this model, it is possible for broad shifts to take place, refocusing the whole structure of technology-related professional development so that curriculum and instructional issues become central to the district's vision of technology use.

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Intel Teach to the Future: A Partnership for Professional Development

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This paper describes a public/private partnership program designed to provide staff development to help classroom teachers integrate technology in the curriculum by using the train-the-trainer model. The Intel Teach to the Future Project was developed by Intel in collaboration with other public and private sector partners, and has been implemented it in United States and in several other countries. Texas partners include the Telecommunications Infrastructure Fund Board (TIF), the Center for Distance Learning Research at Texas A&M University, and the Texas Center for Educational Technology at the University of North Texas.

Texas A&M University and the University of North Texas serve as regional training agencies (RTAs) for the Intel *Teach to the Future* Project. The program is designed to staff development to help classroom teachers integrate technology throughout the curriculum by using the train-the-trainer model. In 2000 and 2001, nearly 600 Master Teachers (MTs) participated in the training program in Texas. Each MT then provides training for approximately 20 participating teachers in their districts and regions each year for up to three years.

This research attempts to answer three key questions:
1) How well is this program increasing the effective use of technology in the curriculum?
2) How effective is such a public/private sector partnership in bringing about systemic educational change?
3) How are partners learning to collaborate?

Theoretical Framework

With the help of state and federal technology funding initiatives most K-12 classrooms now have computer technology and Internet access. According to the National Center for Education Statistics, ninety-eight percent of public schools were connected to the Internet by fall of 2000 (Cattagni and Westat, 2001). In their survey of Texas public schools, Denton,

Davis and Strader (2001) found that approximately 96 percent of public school classrooms in Texas now have Internet access.

In spite of increased access, only 20 percent of teachers feel prepared to use technology in instruction (National Center for Education Statistics, 1999). For example, Denton, Davis and Strader's survey (2001) found that only 18 percent of districts indicated that their teachers use online resources in instruction. The survey results showed that the greatest need for teachers was in curriculum integration of technology.

Although we have known for years that effective systemic initiatives require sustained, ongoing efforts with proper funding and ongoing support (Joyce and Showers, 1995; Metcalf, 1998; Martinez and Metcalf, 1998), we continue to disregard what research in best practices tells us. That is, as participants learn new skills (technology application) they become acquainted with problems of transfer to their own settings and must have ample opportunity to practice the skills in a controlled and safe environment until a certain degree of confidence and "executive control" is acquired. As they become more familiar with the skill and gain more and more executive control, they require coaching, sustained practice with total immersion in the technology in order to see things differently and change practice.

It is estimated that it takes up to five years to effectively implement technology into the schools and that teachers need to be trained and supported during that period (Office of Educational Technology, 1999). Technology training is often limited to the basics of how to make the equipment work. Training on basic skills is not enough to get teachers using technology in instruction. They need to understand how technology can be used as an integral teaching tool (Southern Regional Education Board, 1995; Metcalf, 1998; Martinez and Metcalf, 1998), and they need to have their concerns regarding technology addressed.

Methods and/or Techniques

Program Description: A staff development program designed to address these concerns is the Intel *Teach to the Future* Project, which was developed by Intel Corporation in collaboration with other public and private sector partners. Over a three-year period beginning in the year 2000, Intel is investing more than $100 million to train more than 400,000 classroom teachers in 20 countries throughout the world. Private sector partners include Microsoft, Hewlett-Packard, and the Bill and Melinda Gates Foundation. Intel has selected a regional training agency (RTA) for each of these regions to recruit teachers and manage program logistics. The RTAs in Texas are the Center for Distance Learning Research at Texas A&M University and the Texas Center for Educational Technology at the University of North Texas.

Program Objectives: There are three main program objectives of the Intel *Teach to the Future* Program (Intel, 2000).

1. Increase the effective use of technology resources in classroom instruction. This is being accomplished by providing training to classroom teachers on strategies for integrating technology resources in instruction. Curriculum modules include the following:
   - Locating resources for your unit.
   - Creating student multimedia presentations.

- Creating student publications.
- Creating teacher support materials.
- Creating student web sites.
- Putting unit plans together.
- Assessing unit plans.

2. Use the train-the-trainer model to reach more classroom teachers.
   - Each year for two years, 100 Master Teachers are selected by each RTA to participate in a five-day training session.
   - Each Master Teacher is to provide 40 hours of training for at least 20 participating teachers in their district, region or consortium each year for two to three years.
   - This curriculum is being aligned with state and national standards.
   - Each Master Teacher receives a stipend for training for participating teachers.

3. Ensure that each participating teacher has the technology equipment and software necessary to implement technology effectively in instruction.
   - Each Master Teacher receives a laptop computer.
   - Each Master Teacher and classroom teacher is authorized to use Microsoft Office and Microsoft Encarta Encyclopedia software.
   - Each district commits to providing a connected classroom PC for each trained classroom teacher. Districts have the opportunity to purchase highly discounted systems for each teacher trained.

Program expansion in Texas: In 2001, Texas A&M University and the University of North Texas obtained the support of the Texas Telecommunications Infrastructure Fund Board (TIF) to expand the program in Texas, which will potentially double the number of teachers participating to a total of nearly 40,000 Texas teachers by the year 2003. Intel agreed to provide senior trainers, curriculum materials, and other resources for the TIF expansion of the program. The TIF expansion also obtained limited support from Microsoft and other partners. The following table shows the approximate number of participating teachers each year in Texas for the original Intel project and the TIF supported expansion.

Year	Approx. number of Texas teachers in original Intel project	Approx. number of Texas teachers in TIF-Intel Project	Approximate total number of Texas teachers
2000	4,000		4,000
2001	8,000	4,000	12,000
2002	8,000	8,000	16,000
2003		8,000	8,000
Total teachers	20,000	20,000	40,000

Data Sources

Program evaluation is ongoing and is being conducted by the RTAs and by an external evaluator. Evaluation includes review of relevant documents, including application forms, selection criteria rubrics, electronic and surface mail correspondence, phone conversations, surveys, participation lists, equipment lists, curriculum documents and student projects. Evaluation also includes interviews with selected teachers, administrators and students, as well as other program partners.

Results/Conclusions

Satisfaction with the program: Evaluation findings of teacher satisfaction with the program are very encouraging, according to results of an online survey conducted by Education Development Center's Center for Children and Technology (CCT). By late October 2001, 1850 Participant Teachers from Texas have responded to the online survey upon completion of their workshops. According to their Likert scale responses:

- 99% would recommend the Intel *Teach to the Future* training to others.
- 98% said that the ideas and skills will help them successfully integrate technology into students' activities.
- 97% indicated that the training provided useful new ideas for teaching strategies to apply with students.
- 95% said that the training prepared them to align teaching and assessment with state learning standards.

Their comments on the online survey were full of superlatives. Many said that this was the best training they have had. Typical comments follow:

- *Awesome training! Every teacher could benefit from this program.*
- *Best technology workshop I have attended.*
- *Excellent! I recommend to every teacher.*
- *Great class! The best teacher workshop I've been to yet.*
- *Excellent training! Excellent trainer! Excellent ideas!*
- *I have attended many workshops and classes on technology. This class was the best taught, most practical, and has the best support notebook! I think all teachers would enjoy and benefit from this training.*
- *I have been teaching for 25 years and this has been by far the best workshop I have ever attended. It was a great learning experience as well as a great resource that I will definitely implement in my classroom immediately.*

The suggestions/criticisms of PTs were primarily in four areas:

1) Offer training in the summer.
   With the many constraints on a teacher's time, this course may be able to be completed in an all day format within a one-week period perhaps during the summer. I also feel that this would be more agreeable to our administrators.

2) Require prerequisite skills.

A prerequisite should be required....I learned so much but was initially frustrated because of my lack of knowledge of basic computer skills. PowerPoint training is a must....Students who don't have PP should not be allowed to take the class.

3) Offer ongoing support and follow-up classes.
I enjoyed the training and was a little sorry when it was over because I was just getting warmed up. There were things I was beginning to discover that I would like to explore more. Maybe there should be Intel Teach to the Future II.

4) Slow down.
I feel that the class was very useful, except it threw so much at you. Then it continued on to another project, which was hard at times to process and keep up.

Needs: We have found that ongoing communication between and among partners is the most overarching need in order to maximize success of the program.

1. The RTAs need to maintain communication with one another and with Intel, and work to bridge the gap between academic and corporate cultures.
2. Master Teachers need ongoing support.
3. The RTAs need to maintain communication with school district administrators to ensure their buy-in and ongoing district and campus level support for the project.
4. Long-term evaluation needs to be conducted to determine how and the extent to which Participant Teachers are actually implementing technology in instruction.

Bridging the gap between academic and corporate cultures: If the Intel *Teach to the Future* Project is to emerge as a successful and sustainable public/private sector partnership model, a number of issues still need to be addressed. The biggest problem areas seem to be defining the roles of the partners, and accommodating the differences between corporate and academic cultures. The negotiation of power has emerged as the major challenge. Power relations have also been found by other studies of collaborative efforts to be the central issue (Metcalf, 1994).

Intel made it clear at the start that Intel program managers would be closely involved at all phases of the project. A problem arose due to the different policies and approaches to hiring, promotions, and raises. The university hiring and promotion system is more cumbersome than in the private sector. It has been very frustrating for Intel that the Texas A&M hiring of full time project personnel has been slow, and that the university has relied heavily on assigning existing staff to the project. A related issue occurred when Intel "rewarded" Texas A&M University for the fine performance of the project coordinator during the first year, and was dismayed to learn that little of the money actually went toward a salary increase for the coordinator. Other ambiguities have resulted from the close working relationship between the university project coordinators and Intel program managers, such as the sense among some university coordinators that they work for Intel. This, in turn, has raised loyalty issues, and ultimately resulted in the resignation of a project coordinator.

There are also different views regarding curriculum materials for training. Intel program management initially required that it be followed faithfully in order to maintain program integrity. But educators tend to modify curriculum materials to suit different teaching and learning styles and meet changing needs. In fact, educators tend to treat curriculum materials as living documents. The integrity of the curriculum especially became an issue with faculty in our colleges of education, as Intel is also supporting program expansion to pre-service teacher education. Intel is loosening up some on their requirement of total adherence to the curriculum.

TIF expansion in Texas has led to more issues. Intel and the university partners initially attempted to make the program "seamless" between the original Intel project and the TIF expansion. However, financial constraints prevent the program from being seamless. TIF expansion has not received the same level of support from Microsoft. Furthermore, Microsoft has replaced MS Office 2000 with MS Office XP and Publisher 2002, which are significantly more expensive (Metcalf, Jolly & Poirot, 2001). This has caused unexpected additional expenses for the TIF expansion. This has also resulted in some discontent among TIF teachers, who have not received the software in the same manner or timeframe as teachers associated with the original Intel project. At the time of this writing, we continue to work through these issues.

Providing ongoing support for Master Teachers: Program staff members at the RTAs have done well in keeping up communication channels with MTs via email and phone conversations. Specifically, the RTAs have provided ongoing support for MTs in addressing challenges they face in their districts, such as scheduling training, recruiting participating teachers, etc. There have been delays in getting needed software to TIF districts, but the communication with MTs has at least reassured them that it is coming. The communication is working. Based on enthusiastic feedback from Texas teachers who participated in Master Teacher training in the year 2000, the program is effective in helping teachers integrate technology across the curriculum.

Another form of support has been extra benefits and recognition. Intel and other private sector partners have provided equipment, software, shirts and other gifts to recognize teachers for their participation in the program. The Gates Foundation sponsors a three-day leadership seminar for Master Teachers, and provides for their lodging and meals at major hotels. In Texas, Intel sponsored mid-year reception for Master Teachers at a hotel in Austin at the time of the annual meeting of the Texas Computer Education Association.

Communication with school district administrators: Sometimes there is a disconnect—especially in large districts—between the Master Teachers and their campus and district administrators. Although teachers and administrators have the some overall goals, their different (and sometimes competing) roles can contribute to the disconnect. Lack of understanding about the program among key administrators has led to lack of needed support for implementation. The communication problems in large districts have led us to believe that administrators need to be involved in all phases of the program in order for them to have ownership in it. The RTAs need to maintain communication with administrators beyond the

initial recruitment phase, and administrators need to participate in the training that occurs in their districts in order to better understand the program. In other words, school districts need to feel they are partners in this ongoing effort.

Long-term evaluation: The first two questions of this research are:
1) How well is this program increasing the effective use of technology in the curriculum?
2) How effective is such a public/private sector partnership in bringing about systemic educational change?

Although the satisfaction level with the Intel training is high among Master Teachers and Participant Teachers, these research questions can only be answered through long-term evaluation involving classroom observations and reports of teachers and students. We need to know how and how often teachers are using technology in instruction. We need to know whether their use of technology is enhancing teaching and learning.

Educational Importance

The Intel *Teach to the Future Project* is an important partnership that has promise for bringing about systemic change in education by combining the resources of public and private sector partners. It will be critical to reflect on and share the lessons learned if this kind of partnership is to be sustained and replicated. It is just as important to share how partners negotiated power relationships and learned to collaborate; as it is to share the lessons learned regarding staff development and technology implementation.

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BE THE TECHNOLOGY: REDEFINING TECHNOLOGY INTEGRATION IN CLASSROOMS

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ABSTRACT

We launched a technology professional development initiative in a school district with the goal of extending technology use in the classroom. For teachers to teach expertly we wanted them to "be the technology" by modeling technology use in the classroom, applying technology across the curriculum, applying technology to problem-solving and decision-making activities, and applying technology to facilitate collaboration and cooperation among learners. To implement this technology initiative, we established a set of technology standards and indicators to describe best practices for expert teaching and student learning using technology. We hypothesized teachers would experience several stages as they developed into expert technology integrators and that we could evaluate this technology initiative by tracking their progress through these stages. This study analyzed our developmental model for technology integration based on the stages, standards, and indicators of our technology professional development initiative and validated its use as a tool for use in the evaluation of technology integration.

KEY WORDS: Technology Integration, Technology Standards, Professional Development, Program Evaluation, Educational Change

For computer technology to recreate or reorganize the learning environment—what we call *technology integration*—computers and technology must be viewed in terms of function rather than application, process rather than approach (Becker, 1994; Hadley & Sheingold, 1993). Over a decade ago Sheingold (1990) pointed out that integrating technology in schools and classrooms is not so much about helping people to operate machines as it is about helping teachers integrate technology as a tool for learning. Our own evaluations of technology integration in classrooms have led us to conclude that technology integration in classrooms is more about teaching and learning than it is about technology. The potential for technology use in the classroom extends far beyond being a mere teaching tool—we could say that for teachers to teach expertly they must "be the technology!"

According to Sandholtz, Ringstaff, and Dwyer (1997), technology integration includes five stages: entry, adoption, adaptation, appropriation, and invention. Entry stage teachers use text-based materials and instruction to support teacher-directed activities. Adoption stage teachers use technology for keyboarding, word-processing, or drill-and-practice software. Adaptation phase teachers integrate new technologies into classroom practice and students use word processors, databases, graphic programs, and computer-assisted instruction. Appropriation stage teachers begin to understand the usefulness of technology and students work at computers frequently as project-based instruction begins to take place. In the invention stage learning becomes more student-centered as multi-disciplinary, project-based instruction, peer tutoring, and individually paced instruction occur.

Hadley and Sheingold (1993) analyzed patterns of technology used by teachers and proposed multiple profiles for technology integration based on five teacher segments: enthusiastic beginners, supported integrators, high school naturals, unsupported achievers, struggling aspirers. Using a national survey, Becker (1994) identified exemplary computer-using teachers and the characteristics that distinguished them from other computer-using teachers. Becker determined that exemplary computer-using teachers had no distinct advantages over other computer-using teachers as far as resources or student achievement or abilities were concerned, but they taught in an environment that helped them become better computer-using teachers. They had prepared themselves better to use computers in their teaching, and they had allowed technology to have an impact on how and what they taught.

We launched a technology professional development initiative in a school district with the goal of revolutionizing classroom teaching practices that create learning environments capable of preparing a new generation of learners for a 21st century workplace driven by the acquisition and manipulation of information. To implement our technology professional development initiative, we established a set of technology standards and indicators that clearly described a set of educational best practices for expert teaching and student learning with technology as the foundation and framework of this initiative. Since there is a high degree of variability in educational beliefs, technological availability, and state and community expectations, technology integration should be locally defined, using available research models and national standards as a foundation (Pierson, 2001; Hadley & Sheingold, 1993). Therefore, we formulated a set of standards for our own educational context by combining local, state, and national technology standards and then identifying educational best practices to support our standards.

The purpose of this study was to appraise the value of the technology professional development initiative by validating the technology integration standards and stages identified by our technology professional development model and by evaluating the progress of teachers through these stages. We hypothesized teachers would experience stages of development to become expert technology integrators. Therefore, we organized these standards into *phases* to reflect a developmental approach from novice technology operators, who use technology as a tool for professional productivity, to technology facilitators, who use technology as a tool for the delivery of instruction, to expert technology integrators, who are *being the technology*—augmenting student learning with technology. Furthermore, we postulated that if the phases of technology integration we devised reasonably reflected the reality of technology integration in classrooms, then the technology integration knowledge and skills of teachers could be identified and described in terms of these developmental stages. We could then measure their progress through the stages and use these measurements to gauge the relative effectiveness and value of the technology initiative.

A number of interventions were provided to support and reinforce this *be the technology* professional development model. We started by offering a summer technology institute, workshops, seminars, and college-credit courses. We devised a set of performance assessments whereby teachers could demonstrate their technology integration expertise for each of the developmental phases. Financial incentives and credentialing were provided to teachers who demonstrated technology integration knowledge and skills based on performance assessments. These performance assessments corresponded with each phase and required teachers to model the technology integration knowledge and skills promulgated by the technology professional development model. As the number of teachers certifying their knowledge and skills at each of

the phases increased, they teamed with peers and numerous informal small-group, mentoring, and tutoring sessions organized in schools, departments, and grade-levels throughout the district.

Technology Integration as a Model for Educational Change

The goal of transforming teaching and learning by increasing access to and use of technology in schools and classrooms has been near the top of most educational reform agendas since the early 1980s (Cuban, 2001). The integration of technology in classrooms and schools, however, is a complex process that entails supporting curriculum goals through the instructional use of computer technology to enhance student learning (Dockstader, 1999). To deal with this complexity, educational change models often attempt to assess and explain the change process in terms of dimensions or degrees of change.

Several models or strategies have been employed by educational researchers and practitioners to provide a systematic approach for determining the quality of innovation implementation. Since we perceived technology integration to be a developmental process, the Concerns-Based Adoption Model (Hall, Wallace & Dossett, 1973) fit our evaluation requirements because it emphasized change as a developmental process experienced by individuals implementing innovations within an organizational context. CBAM represents a comprehensive systemic change model that allows change investigators and facilitators to understand organizational change from the point of view of the persons affected by the change (Surry, 1997). CBAM is based on the assumption that change is best understood when it is expressed in functional terms—what persons actually do who are involved in the change. CBAM provides for the development of diagnostic tools based on the design of the innovation being evaluated. One of these diagnostic tools is the Innovation Configuration Matrix or Map (ICM), which represents an innovation in the form of a two-dimensional matrix with the various

configuration components along one dimension of the matrix and a scale that renders closer approximations of implementation or use along the other dimension of the matrix.

Since the ICM has a procedural rather than static definition, it accommodates the evaluation of innovations (such as technology integration) that are changeable or variable over time and across contexts while employing a fixed evaluation protocol. Therefore, we formulated an ICM, the *Technology Integration Standards Configuration Matrix* (*TISCM*), based on the developmental stages, standards, and indicators of our technology professional development model as a tool for use in the evaluation of technology integration among teachers in the district.

METHODS

Instrumentation

The *Technology Integration Standards Configuration Matrix* (*TISCM*) was formulated based on a consensus-building process that followed a procedure developed by Heck, Steigelbauer, Hall, and Loucks. (1981) and used previously by the researchers (Mills, 2001-2002; Mills & Ragan, 2000). Relevant national, state, and local technology standards were reviewed and evaluated by the researchers in conjunction with the district technology committee. The committee reached consensus on 18 technology integration standards that were appropriate for the school district.

Technology integration standards were organized into three skill sets or phases: *Phase 1—Using Technology as a Tool for Professional Productivity* (Standards 1-6), *Phase 2—Facilitating and Delivering Instruction Using Technology* (Standards 7-12), and *Phase 3—Integrating Technology into Student Learning* (Standards 13-18). Each successive phase was intended to identify a set of instructional strategies that exemplified a more appropriate use of technology for facilitating or enhancing student learning in the classroom along a continuum

from technology as a tool for professional productivity (Phase 1) to technology as a tool for the delivery of instruction (Phase 2) and ultimately to the establishment of learning environments where student learning is augmented by technology (Phase 3).

Each technology standard was designated to be a component for one dimension of the matrix. For the other dimension of the matrix, variations for each component or technology standard were identified. These variations described specific classroom teaching practices using technology. The variations for each component were organized along a continuum from unacceptable use to ideal use. For example, in determining variations for the component, *Use Software Productivity Tools*, creating a simple document using word processing was construed to be minimal use while merging word processing and spreadsheet objects to create a report was construed to be ideal use. The component variations were refined by the researchers in consultation with the technology committee to reflect actual practices of teachers integrating technology in classrooms.

The components and component variations were organized into a matrix comprised of four variations for each of the 18 components with each successive variation indicating a level of use representing a closer approximation of ideal use and/or technology integration. A checklist corresponding to the components and variations on the *TISCM* was devised as a self-report instrument to be completed by teachers using paper- or Web-based administration.

Subjects and Procedures

The school district used in this study was located in a small town in a Midwestern state. The school district had a total enrollment of almost 2,200 students in grades K-12 with 147 certified teachers. Computer technology was used in all the schools in the district. All schools, except the high school, had computer labs and all teachers had classroom computers.

The school district had made a substantial investment in computer technology and was beginning a district-wide technology professional development initiative.

To collect baseline data regarding technology integration occurring in classrooms, all teachers at all grade levels were provided with a paper version of the *TISCM* checklist and the option to complete a Web-based version of the *TISCM* checklist on the school district Web site. Only a Web-based version of the checklist was used for the end of year administration. The checklist was designed in a multiple-selection format in which respondents could select more than one response for each *TISCM* component. Data collection occurred at both the start and end of a school year. A usable *TISCM* checklist was completed by 70 teachers at the start of the school year and 78 teachers at the end of the school year and 46 teachers completed both the start and end of year administration of the *TISCM* checklist.

Several statistical methods were used to evaluate teacher responses to the start and end of year *TISCM* checklists. Discriminant analysis validated the classification of cases into different groups and determined which *TISCM* components discriminated among the groups. Frequency counts for the *TISCM* checklist responses for the start and end of year administrations were examined to determine the attributes of each configuration pattern group based on the *TISCM* components and phases. Results from the end of year *TISCM* checklist administration were compared with a matched set from the start of year administration using a paired-samples t-test in order to measure significant change in the development of technology integration expertise among the teachers in the school district.

RESULTS AND DISCUSSION

Descriptive statistics for the start and end of year data collections were computed and are provided in Table 1. Reliability statistics were computed on both the start and end of year data

collections to determine the internal consistency of the *TISCM* checklist. The final 18-item checklist allowed for a range of total scores from 0 to 72. The *TISCM* checklist yielded a coefficient alpha of .91 for the start of year administration and .89 for the end of year administration.

Table 1. Descriptive Statistics for Start/End of Year Administration of *TISCM* checklist.

	Start of Year (N=70)			End of Year (N=78)		
TECHNOLOGY STANDARD	SUM	MEAN	SD	SUM	MEAN	SD
1. Operate common technology input devices.	217	3.10	.82	313	3.73	.73
2. Perform basic file management tasks.	206	2.94	1.11	316	3.76	.63
3. Apply trouble-shooting strategies and install software.	226	3.23	.87	318	3.79	.70
4. Use software productivity tools.	182	2.60	1.34	297	3.54	1.01
5. Use technology to communicate and collaborate.	228	3.26	.72	316	3.76	.59
6. Use technology to collect data and perform research.	188	2.69	1.10	286	3.40	.95
7. Model responsible use of technology.	174	2.49	1.42	274	3.26	1.13
8. Facilitate regular student use of computer technology.	208	2.97	1.45	257	3.06	1.43
9. Conduct learning activities using computer technology.	187	2.67	1.43	234	2.79	1.46
10. Select appropriate technology resources for classroom use.	83	1.19	1.33	194	2.31	1.69
11. Evaluate the validity of data collected using technology.	22	.31	.91	93	1.11	1.69
12. Use technology to present classroom instruction.	154	2.20	1.16	235	2.80	1.23
13. Integrate technology-based learning experiences into classroom instruction.	138	1.97	1.43	207	2.46	1.48
14. Use computer technology for problem-solving and critical thinking.	118	1.69	1.48	199	2.37	1.48
15. Use technology to facilitate individualized/cooperative learning experiences.	94	1.34	1.39	157	1.87	1.40
16. Assess student use of technology using multiple methods of evaluation.	66	.94	1.57	91	1.08	1.53
17. Develop and maintain electronic student portfolios.	23	.33	.88	48	.57	1.01
18. Use computer technology to maintain and analyze student performance.	136	1.94	1.23	224	2.67	1.08

<u>Beginning of Year Data Collection</u>

Since the initial cluster centers and the number of dominant patterns were unknown, cluster analysis was performed on the first administration of the *TISCM* checklist using all 18 technology standards or components of the *TISCM* and incrementing the number of clusters until a reasonable model was obtained. The cluster analysis was run for 2, 3, 4, and 5 clusters before a reasonable model was selected. A reasonable model occurred with the number of clusters set at

3. When the number of clusters was set at 3, the number of cases in Group 1 was 21, Group 2 was 33, and Group 3 was 16. To make comparisons between the start and end of year data, the same grouping model (3 groups) was used for analysis of the end of year data collection.

The start of year configuration pattern groups were entered into a Discriminant Analysis (DA) to determine which *TISCM* components discriminated among the groups and to validate the classification of cases into different groups. Using this procedure enabled the researchers to better describe the characteristics and define the differences among the configuration pattern groups. The *TISCM* components were loaded into the DA as the independent variables using a model where they were all entered simultaneously to force the DA to consider the contribution of all components to the discrimination among groups. As a result of this procedure 96% of the cases or 67 of 70 cases were correctly classified. The DA predicted 1 case in Group 2 for Group 1, 1 case in Group 2 for Group 3, and 1 case in Group 3 for Group 2.

To derive substantive, meaningful constructs or labels for the discriminant functions, the factor structure matrix describing the correlations between the *TISCM* components and the discriminant functions was examined. The largest absolute correlations for Function 1 were mainly with most components in Phases 2 and 3; thus, Function 1 was labeled, *Delivering instruction and integrating technology with learning*. The largest absolute correlations for Function 2 were mainly with some components in Phase 1; thus Function 2 was labeled, *Using technology as a tool for professional productivity.*

Figure 1 provides a scatter plot of the discriminant functions for each of the *TISCM* groups. Group 1 is characterized by a high positive relationship to Function 2 and a high negative relationship to Function 1, Group 2 by low positive relationship with Function 1 and a low to

high negative relationship with Function 2, and Group 3 by high positive relationship to Function 1 and a low to high positive relationship with Function 2.

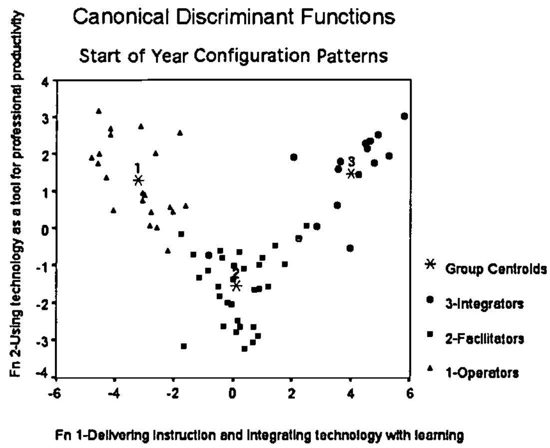

Figure 1. Scatter Plot of Discriminant Functions for Start of Year TISCM Configuration Patterns (N=70).

These configuration patterns indicated that using technology as a tool for professional productivity and operations of computer technology (Phase 1 Standards) was not necessarily a distinguishing characteristic of expertise in technology integration. In other words, there was pervasive use of computers by teachers in preparing for instruction, but limited use of computers by teachers for delivering instruction and integrating technology in the classroom. What discriminated between integrators and operators was integration skills, not operations skills.

This finding had relevance for the provision of technology professional development activities indicating to us that technology training activities needed to focus more on instructional strategies and methods to integrate technology into student learning than on activities to increase skills in using computer hardware and software applications. Although we could not ignore the novice skills associated with technology operations, our approach to training became one in which integration skills became embedded in operations training.

Frequency counts for *TISCM* checklist responses were analyzed to determine the attributes of each configuration pattern group based on the *TISCM* components and phases. When all the cases were summarized by group membership based on the overall technology integration rating, the classification of cases derived from the responses to the *TISCM* checklist allowed for a grouping similar to the developmental stages of the technology professional development model. Group 3 teachers demonstrated expertise in technology integration for all sub-scales; Group 2 demonstrated expertise in Phase 1 and Phase 2; and Group 1 demonstrated expertise in Phase 1 only (see Table 2).

Table 2. Descriptive Statistics of Groups by Sub-Scale/Total Scale Scores—Start of Year

GROUP		Overall Integration Score	Overall Integration Rating	Technology Operations Score	Technology Facilitation Score	Technology Integration Score
1	N	21				
	Mean	23.29	1.76	15.76	5.62	1.90
	Std. Deviation	6.54	.44	3.60	3.50	1.73
2	N	33				
	Mean	37.24	2.58	17.00	12.33	7.91
	Std. Deviation	6.09	.50	3.91	2.22	3.09
3	N	16				
	Mean	58.31	3.75	22.19	18.94	17.13
	Std. Deviation	5.62	.45	2.32	2.08	3.96
All	N	70				
	Mean	37.87	2.60	17.81	11.83	8.21
	Std. Deviation	14.08	.86	4.25	5.51	6.27

End of Year Data Collection

A cluster analysis was performed on the end of year data collection with the number of clusters set at 3 to compare with the patterns from the first of year data collection. With the number of clusters set at 3, the number of cases in Group 1 was 16, Group 2 was 34, and Group 3 was 28. The DA was repeated for the end of year data collection of the *TISCM* checklist and as a result of this procedure 95% of the cases or 74 of 78 cases were correctly classified. The DA predicted 4 cases in Group 3 for Group 2.

The factor structure matrix describing the correlations between the *TISCM* components and the discriminant functions was examined and the largest absolute correlations for Function 1 and Function 2 were similar in meaning to the Start of Year functions; thus Functions 1 and 2 were labeled the same as the Start of Year functions.

Figure 2 provides a scatter plot of the discriminant functions for each of the *TISCM* groups. When compared with the start of year data collection, the scatter plot indicated some dramatic movement among the participants in the development of technology integration expertise. This movement indicated changes in the substantive meaning of each group. Group 1 was characterized by a high negative relationship to Function 1 and a low negative relationship to Function 2, Group 2 by a low positive relation with Function 1 and high positive relationship to Function 2, and Group 3 by a high positive relationship to Function 1 and a relationship to Function 2 that was quite widespread from high negative to high positive.

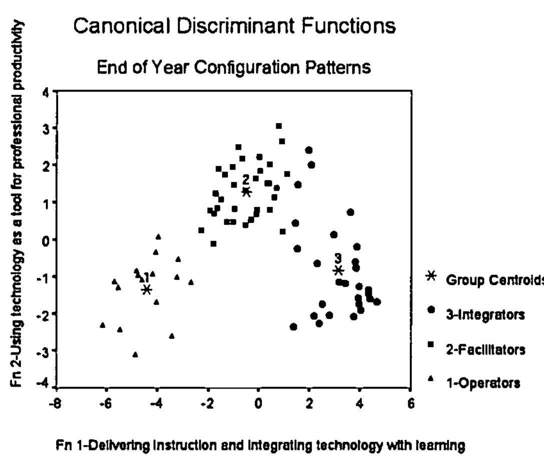

Figure 2. Scatter Plot of Discriminant Functions for End of Year TISCM Configuration Patterns (N=78).

The DA for the end of year configuration patterns demonstrated that the characteristics delineating differences among the teachers were more sharply defined by those who were novice users (or operators) and those who were facilitators and integrators of classroom technology.

Although the technology professional development initiative did not purport to make technology integrators out of all participants, the numbers of those who were facilitators and integrators were increased and their distinction from novice users was clearly indicated. Therefore, it was clear that teachers were progressing toward expertise in technology integration knowledge and skills.

When all the cases were summarized by group membership based on the overall technology integration rating, the cases of Group 1 consisted of ratings of 1's (2), 2's (13) and 3's (1); the cases of Group 2 consisted of ratings of 2's (2), 3's (27), and 4's (5); and, the cases of Group 3 consisted of ratings of 3's (3) and 4's (25). At the end of the year the classification of cases derived from the mean scores of the responses to the *TISCM* checklist strongly indicated a grouping similar to the developmental stages (phases) of the *TISCM* where Group 3 teachers demonstrated expertise in technology integration for all sub-scales, Group 2 demonstrated expertise in Phase 1 and Phase 2, and Group 1 demonstrated expertise in Phase 1 only (see Table 3).

Table 3. Descriptive Statistics of Groups by Sub-Scale/Total Scale Scores—End of Year

GROUP		Overall Integration Score	Overall Integration Rating	Technology Operations Score	Technology Facilitation Score	Technology Integration Score
1	N	16				
	Mean	28.63	1.97	19.88	5.69	3.06
	Std. Deviation	6.85	.44	4.32	3.36	2.32
2	N	34				
	Mean	47.56	3.09	22.38	14.44	10.74
	Std. Deviation	6.05	.45	2.50	3.15	2.85
3	N	28				
	Mean	60.46	3.89	22.64	21.89	15.93
	Std. Deviation	5.36	.31	2.26	2.06	4.11
All	N	78				
	Mean	48.31	3.14	21.96	15.32	11.03
	Std. Deviation	13.02	.82	3.04	6.58	5.69

Paired samples t-test for each of components (technology standards) of the *TISCM* were computed for matched cases (N=46) on the start and end of year administrations of the *TISCM*

checklist. All components of the *TISCM* indicated significant differences on the t-test ($p<.05$) between the start and end of year administrations of the *TISCM* checklist except for Component 8, Component 9, and Component 16 (see Technology Standards on Table 1). Additionally, paired samples t-tests were computed for matched cases ($N=46$) on the start and end of year administrations. When *TISCM* components were grouped by phase, significant differences on the t-test ($p<.05$) were indicated for all three phases. These comparisons indicated measurable progress in technology integration across components and through the developmental phases.

CONCLUSIONS

A fourth grade teacher reported that at the beginning of this initiative "teachers with little experience using technology were hesitant," but, as the initiative progressed, teachers "started to bond and complete phase projects together as a support for one another." A fifth grade teacher noted an increased level of comfort using technology in classroom lesson and a high level of support from other teachers. A middle school science teacher reported integrating new technology skills and knowledge in her science lab and modifying her classroom instructional strategies to the extent that technology now plays an important role in daily instruction. A kindergarten teacher developed a PowerPoint template that was adopted for use by all the district kindergarten teachers. A high school language arts teacher worked with another teacher's class to develop a Web page for their mock business.

The common thread in these reports is that teachers are attempting to "be the technology." As teachers advanced through the developmental stages of technology integration, they began to realize that technology is more than a teaching tool and start using technology to create learning environments that augment student learning.

The results of the data analysis confirmed our perception that technology integration is a developmental process. It also supported our view that this process starts with novice teachers using technology as a tool for professional productivity and expands from there. These results also suggest that when educational best practices for teaching and learning with technology are clearly defined and established, the professional skills of teachers will begin to exemplify the stated expectations.

The results of this evaluation may have implications for Colleges of Education and teacher preparation programs. This study suggests that developing technology integration expertise in teachers will not be achieved through the provision of a technology course or two built into the professional education curriculum. Preparing new teachers who are technology integrators will require a professional education curriculum that is infused with opportunities for teacher candidates to learn with technology and model technology use throughout their professional preparation.

Over time we have refined our technology integration professional development model to include more powerful technology integration strategies in classrooms beyond that of computer technology use and operations. We have learned that through the establishment of a well-defined set of pedagogical standards and indicators, higher levels of technology integration in classrooms can be identified and achieved. Consequently, when teachers know how to use and then actually use all the tools at their disposal, the potential for student learning is increased.

Recommendations for Future Research and Development

Research is now needed to show us not only how teachers are developing expert teaching practices, but also to show us if students are achieving the outcomes these practices are designed to produce. We recommend research that focuses on learner outcomes resulting from the

teaching practices and instructional strategies (student-centered, situated, cooperative, project-based, problem-solving, etc.) made possible by the expert technology integration practices described in this model.

This technology professional development model is an on-going initiative in this school district. At this writing the researchers are continuing to collect data in this school district by applying the *TISCM* model to interviewing and observational methodologies that will triangulate the results of our analyses as well as enhance our understanding of technology integration in classrooms. Additionally, the researchers are currently experimenting with phases of technology integration beyond those described in this article that will define school and district leadership in technology integration.

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Professional Development: Building Effective Virtual Communities through Cooperative Learning

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Abstract
A web site for an online graduate course in Earth systems science for middle school teachers was designed to affect teachers' knowledge about Earth systems science and resources and their use of constructivist teaching practices, particularly collaboration, rubrics and the use of journals. In the 16-week course 44 teachers experienced collaborative inquiry as they worked in groups to develop knowledge of individual spheres and create Earth systems diagrams as teams. Individually, they created Earth systems science lessons and local event analyses. Teachers were administered an exploratory pre course survey to guide ongoing development and formative assessment. A post course survey provided information on the validity of the design and its affect on the participant's attitude changes; knowledge gains, time spent and suggestions for further improvement. An archive analysis is currently underway. Revisions to the site design and content, the course methodology and assessment tools are discussed.

Introduction
Online courses consisting of communities of learners are experiencing increasing use and credibility (Duffy, Dueber and Hawley, in press; Hewitt and Scardamalia, 1997; Hewitt, Web and Rowley, 1994) due to their potential for increasing intentional learning through interpersonal interaction (Scardamalia and Bereiter, 1994). This paper outlines the design, development and implementation of an online middle school teachers' Earth systems science graduate course designed to use web-based interactions for learning. The themes of Earth system science (ESS) content and collaborative, inquiry-based science education mirror each other within an electronic environment where teacher participants take responsibility for their learning within a structure of clear expectations and a web of relationships.

Description of the course
This 16-week course was created to provide professional development in Earth system science for middle school teachers. The course was delivered through the World Wide Web (WWW) and used the jigsaw method of collaboration through threaded discussion areas. The course addressed the US National Research Council's standards for including inquiry-based approaches in science through explicitly modeling a collaborative, student-centered environment in which teachers relied on each other for input, knowledge-building and feedback.

Two sections of participants (middle-school teachers) enrolled in the course (N=44). Each section had two mentors, a master teacher and an Earth systems scientist. The role of the mentors was to answer Earth systems science questions, prime discussions, reply to journal entries, give feedback on Earth systems science thinking, connect course participants around interests and needs, provide administrative and technical assistance and track down people who did not post messages. Participants were chosen for the course based on access to the WWW and their stated interest in helping refine the course for future iterations.

Course activities consisted of online collaborative discussions to develop knowledge and exchange ideas, individual research for information concerning Earth systems science, team construction of Earth systems diagrams about major Earth events, and individual journal reflections.

Teacher Development: Building Effective Virtual Communities through Cooperative Learning
NASA ESSEA 5-8 Course

Inquiry in a Community of Learners

A primary concern during course design was to create an online learning environment of inquiry where interdependence among participants provided the glue necessary for a successful community of learners. To provide a framework for supporting inquiry, we looked to Bereiter's discussion of inquiry (1992) in which he describes the scientific approach to inquiry as the commitment to:

- work toward a common understanding satisfactory to all
- frame questions and propositions in terms of evidence
- expand the body of valid propositions
- subject any belief to examination

Davis's (1997) recipe for building a community includes shared goals, challenges that cause relationships to form through exchanges of ideas, regular reflection for metacognition, and a structure or place for the virtual community to form. One means of following this recipe is to have participants focus on information collection, then enter "virtual space" where they test ideas and ask questions of each other, and of mentors.

Rogers and Laws (1997) addressed the challenge of building an online community by supporting extensive discussions and providing opportunities for cooperative learning. Jigsaw cooperative learning structures (Grisham and Molinelli, 1995; Aronson, 1978) provide a useful method for creating interdependence by having team members form temporal ad hoc groups to become "experts" on a content area, then return to their original team to share their expertise. Cooperative learning like that required in the Jigsaw method requires interaction among students on learning tasks. The belief is that the interaction in itself will lead to students to construct knowledge (Damon, 1984; Murray, 1982; Wadsworth, 1984). "Students learn from one another because in their discussions of the content, cognitive conflicts arise, inadequate reasoning be exposed, disequilibrium will occur, and higher-quality understandings will emerge" (Slavin, 1995b).

Electronic Tools for Building a Community of Learners

Web design goals to support inquiry in an electronic distributed environment have been developed by Duffy, Dueber and Hawley (in press):

- focus the user on problem solving
- promote attention to and reflection on the argument and goals
- provide appropriate structures for the communication need
- support coaching

These design goals led to the construction of the ACT tool (Asynchronous Collaboration Tool) with two discussion spaces: conversational and issues-based. Using a PBL model, learners generate questions in conversational space (chronologically organized) and then develop full arguments in issue-based discussions (organized with topical threads.) The notion of different spaces for different functions defines the task and protocol for contribution, providing both focus and comfort to the participants to encourage participation.

Establishing intention and protocols for discussions is paramount in Scardamalia and Bereiter's (1991) CSILE (Computer Supported Intentional Learning Environment) system. Learners label their entries in the database in terms of thinking, such as "what I need to know" or "my theory" or "new experiment" (Oshima, 1994). Recent research (Hewitt, Web, and Rowley, 1994) suggests that considerable face-to-face interaction may be necessary to the successful use of CSILE for rigorous inquiry. The Collaboratory Notebook (CoVis, Edelson and O'Neill, 1994) represents another electronic distributed learning tool for collaborative inquiry in which students label their entries as "information" "commentary" "question" and "conjecture" etc. The labels are intended to scaffold the discussion, and

invite connections and feedback. It is possible that their use eliminates one level of interpretation for the reader, so that responses are more forthcoming, connected and useful.

The challenge of creating and sustaining knowledge-building conversations using technology in face-to-face situations has been addressed by Brown and Campione (1994). Different groups are established to build individual and collective expertise, groups reform to address specific tasks as they are identified. Technology serves as a tool for managing information, but more importantly for establishing a growing base of knowledge applied to a task or problem.

In considering the core of virtual learning, Mitchell, writes, in City of Bits (1997), "no matter how extensive a virtual environment or how it is presented, it has an underlying structure of places where you meet people and find things and links connecting those places. This is the organizing framework from which all else grows. In cyberspace, the hyperplan is the generator."

Goals

The challenge presented for the design team of the Earth system science course was to create a collaborative learning environment exclusively online. It required integrating the research on collaborative learning in face-to-face situations, online environments, and emerging web systems such as ACT.

Two questions guided the development team in creating the course and the mentor team in implementing it:

- How do we create a community of learners to address how to teach Earth systems science through inquiry?
- What structures and tools will support a collaborative online learning environment?

The design had to accommodate the belief that experiencing collaborative inquiry is essential to being an effective Earth systems science teacher, within the context of no face-to-face interaction - an exclusively web-based environment. The following design elements were deemed critical to collaboration and knowledge-building:

- Complex tasks
- Differentiated roles
- Designated spaces for specific activities
- Reflection by learners
- Feedback learner-to-learner, mentor-to-learner
- Expanding information sources
- Clearly defined criteria for success (rubrics)

Teacher Development: Building Effective Virtual Communities through Cooperative Learning NASA ESSEA 5-8 Course

Design

The development team consisted of instructional designers, Earth systems scientists, a graphics artist, a web master, and an expert in creating online collaborative environments. The design goals led to decisions about the methodology, site design and tool selection. Discussion of each goal provided perspective and generated possibilities that were woven into the final design.

Collaborative structures in an online environment

An online environment supports the development and maintenance of a learning community in some interesting ways. Commitment and involvement are intensified by the public nature of the text-based environment. Reflection is facilitated by the asynchronous threaded public discussions and an online private journal. Self-regulation comes through the feedback from other members in developing "expert packets" and preparing systems diagrams according to criteria. A collaborative inquiry method supports the flow of energy toward new levels of understanding as members "jigsaw" between expert groups and event teams. Content and resources are provided in the week-by-week course outline, and a resource space grows with participants' suggestions.

Five main areas of the site greet course participants on the home page (Figure 1):

- Course Description
- Overview of Activities and Grading
- Library of Ideas and Resources
- Students' Guide to the Virtual Learning Community
- Weekly Course Outline (pull down menu with 16 weeks)

The *Course Description* briefly summarizes the collaborative methodology, goals, expectations for participation, and provides "getting started" resources on Earth systems science, inquiry and other topics. This section is designed to provide a common understanding of the "operating procedures" of the course, so participants have a structure to begin with which requires participation and rigorous thinking.

The *Overview of Activities and Grading* is listed on the home page to make the criteria for success clear and accessible. It was hypothesized that objective criteria would scaffold student-to-student and mentor-to-student feedback and collaboration in discussions (Figure 2).

The *Library of Ideas and Resources* is the entryway to the knowledge-building discussion areas, the reflective journal spaces and the evolving resource guide. Seven archival spaces in the *Classroom* (Figure 3) were created for specific purposes:

Whole Class Discussion Space
- Course Space - a general, administrative area for discussion

Whole Class Collection Spaces
- Classroom Application Space - individually developed activities
- Local Event Space - individually developed ESS diagrams
- Resource Space - for collecting resources for all course activities

Small Group Discussion Spaces
- Sphere Space - knowledge-building by sphere groups
- Event Space - ESS diagrams for the four events by event teams

Individual Reflection Space - Private
- Journal Space - weekly reflections on content/process of learning

The design incorporates "issue" and "conversational" spaces as proposed by Duffy et al (in press). In The Great Good Place (1989), Ray Oldenburg writes about the need for "third" places in modern community where an informal public life can develop, the mood is playful and there are "regulars." Virtual environments make good third places because people can come and go, recording their thoughts asynchronously, but connecting them with other people's ideas through the threaded discussions.

The site also incorporates public and private spaces for different size groups. Public spaces create a sense of belonging to a community that has its own life. The Course Space is a kind of bulletin board where messages are posted for everyone to see, while Sphere Space and Event Spaces are for small group teams to be productive together. They are public, but since everyone belongs to a group which is task or issue driven, they may not take the time to go to the other groups to drop in, pick up on the conversation or "lurk" so they are semi-private functionally. Private spaces support ongoing reflection about learning. In this case the Journal Space is a continuous record of self-reflection on what and how each person is learning and a way to communicate with mentors.

The designation of different spaces also supports differentiated roles, since each space has a particular task associated with it. The rubrics provide the scaffolding for the kind of thinking which needs occur for knowledge-building.

The *Students' Guide to the Virtual Learning Community* was written to scaffold the social interaction so essential to collaboration. There are also strategies to support the individual success of participants. Tips are given on how to write messages that get responses and how to give constructive feedback. As participants build ideas and knowledge in the Sphere and Event Spaces, many different kinds of interactions will occur. Gerdau (1998) suggests that group members engaged in collaborative inquiry develop more of an appreciation of the value of the group over time, as they develop listening, clarifying and piggybacking skills. The mentors will also coach participants in supportive feedback language, such as summarizing ideas, quoting sources, suggesting ideas and asking questions.

The *Weekly Course Outline* provides activities, resources and information. The importance of a clearly stated, challenging and complex task is described by Cohen (1986, pp. 69-70), who states "if the task is challenging and interesting, and if students are sufficiently prepared for skills in group process, students will experience the process of group work itself as highly rewarding."

The complex task is provided by the very nature of the Earth systems science content. By viewing Earth as a system, in which the land, water, air and living things are interdependent and co-evolving, students learn each of the areas in the context of the others, as well as applied to familiar settings and events. Event teams are asked to create an Earth systems diagram supported by a description for each of four events.

The Earth systems scientists on the team posited that Earth's systems are most clearly seen when they are under stress during anomalies, such as hurricanes, tornadoes, and flooding. By focusing on events such as these, as well as human induced stresses, such as deforestation, learners are able to identify the relationships among the spheres in light of the event. Four events were identified for the course which stress Earth systems and can benefit from the use of NASA resources such as satellite imagery: volcanoes, sea ice, hurricanes and deforestation.

Resources

The online environment was viewed as a place for collaboration and knowledge building, rather than a repository for Earth systems content. With this principle in mind, participants were mailed necessary background reading materials, CD-ROMs, and other supporting materials. The weekly instructions incorporate those resources. An abundance of resources encourages both independence and interdependence. Participants can choose the resources to fit their style and interests and contribute

information and reflections from those sources as well as their own experience. Interdependence is encouraged because it is difficult for one person to use all the resources, and so a team might organize to "divide and conquer" the readings. With an abundance of resources, individuals are more likely to be providing new information or complementary information from a different source, making it more valuable to the group in developing their ideas.

Course Methodology

The three goals of the course are: Earth Systems thinking; Event analysis and Classroom Applications. The event analysis is a common goal of each team and leads to the formation of the jigsaw expert groups and is followed by the development of a classroom application. Being part of two groups invites multiple perspectives, interdependence in data gathering from individual expertise and expert groups, and negotiation in developing a rigorous analysis. The implications for course methodology are to:

- define the team task
- provide a model of an Earth systems science analysis of an event
- plan repeated experiences for teams to do Earth systems science analyses
- plan to provide feedback on analyses
- develop guidelines for evaluating Earth systems science diagrams (rubrics)

Method

A post course survey was completed by 29 of the participants -14 in the Wheeling section and 15 in the Idaho section. Participants were asked to reflect on the importance of various skills to effective Earth systems science teaching, changes in their knowledge, attitudes and practice as a result of the course, and the effectiveness of the elements of the design. Data is presented in graph form to show simple averages or relative average ratings. T-tests for paired samples were used to test for significant difference between means where it was appropriate. The p values are reported in the narrative. This self-report data will be reexamined in light of the results of a subsequent study of the archival discussions and products of the participants.

Results

Thinking about science from an integrated, coordinated and thematic perspective requires a shift from the traditional discipline-based approach, a "reform of thought." The "right" answers are those that have the most support by the members of the group, given the current knowledge base.

As learners construct the systems diagrams, they build on each other's thinking, challenge it and support it, depending on what knowledge they bring from their sphere groups AND the connections they make in the process of thinking about all the effects within the system. In constructing the systems diagram, participants can build off each other's ideas and make sense of the emerging patterns of meaning in response to the challenge.

Perhaps the best test of the efficacy of an experience is whether or not you would recommend it to your friends. 24 of the 29 people responding said definitely "yes" to the question, "Would you recommend this course to a friend?" for reasons like these:

> "An excellent way to learn earth science from a new perspective, improve your Internet capabilities, great materials, learn to use a new research tool (the web)."
>
> "I would tell my friends that I learned a lot. That when the group works well together, you learn so much more than working alone... that I got some really wonderful free materials, and leads to some cool web sites...that I met a group of new friends and resources for new ideas."
>
> "I learned more from this course than I have learned in a long time."

A few teachers who found the course disjointed or too time consuming offered an opposing opinion:

> "Although I learned a lot, the course takes way too much time. I spent far more time that I would for most 3 credit courses."

Many participants had good ideas for how to prepare their friends for taking a "cutting edge" course as one person called it, including: stay involved with your group; ask lots of questions; set aside time to do it at least three days a week for a couple of hours and more on the weekends; be prepared to love it and spend a lot of time exploring ideas and resources.

What were participants' expectations? Did the course meet them? The responses were fairly evenly divided between: 1) wanting to learn more about Earth systems science and how to teach it; 2) wanting to improve in using the internet or computer for learning and teaching; and 3) no expectations. Approximately 90% of the people who finished the course had their expectations fulfilled and more. The remainder felt they had not invested enough time, or they did not enjoy the emphasis on group interaction. The range is represented by the comments below:

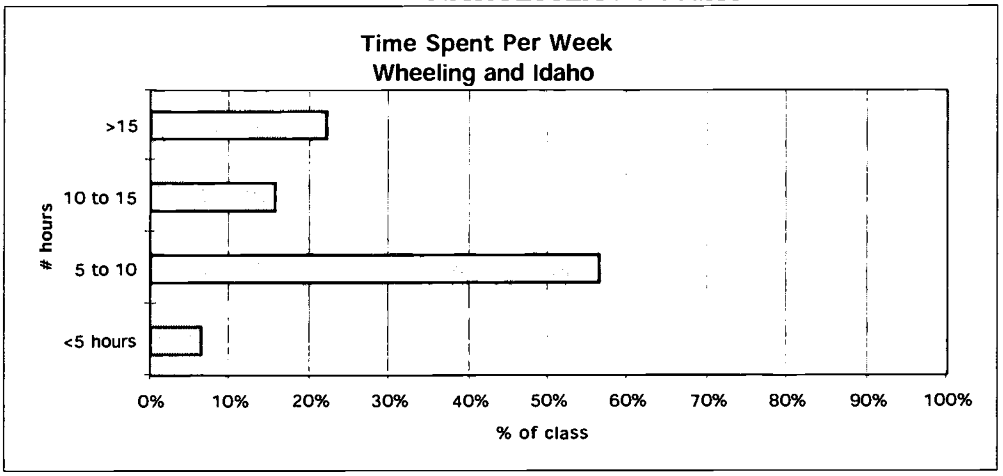
"That I would learn a new way of thinking about earth science concepts, and I would communicate via the web with other teachers around the state. I would also receive materials that I could use in my classroom. Class far surpassed my expectations."

"I guess I expected a more linear approach to the course and a clearer picture of what was required. I would have preferred to work on my own more."

Time Spent in the Course

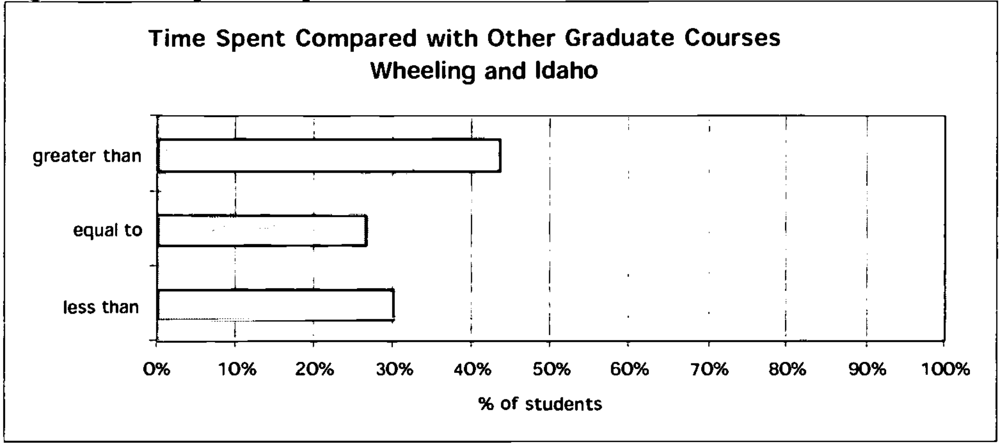
How much time did the participants spend in the course? Participants were asked how much time they spent per week in the course. The majority (94%) reported spending 5-10 hours per week or more due to depth and variety of resources (see Figure 4). Those who reported spending less than 5 hours per week (6%) most frequently commented that they could or should have spent more time, but did not have it available. Most people (56%) reported spending 5-10 hours a week.

Figure 4: Time Spent per Week



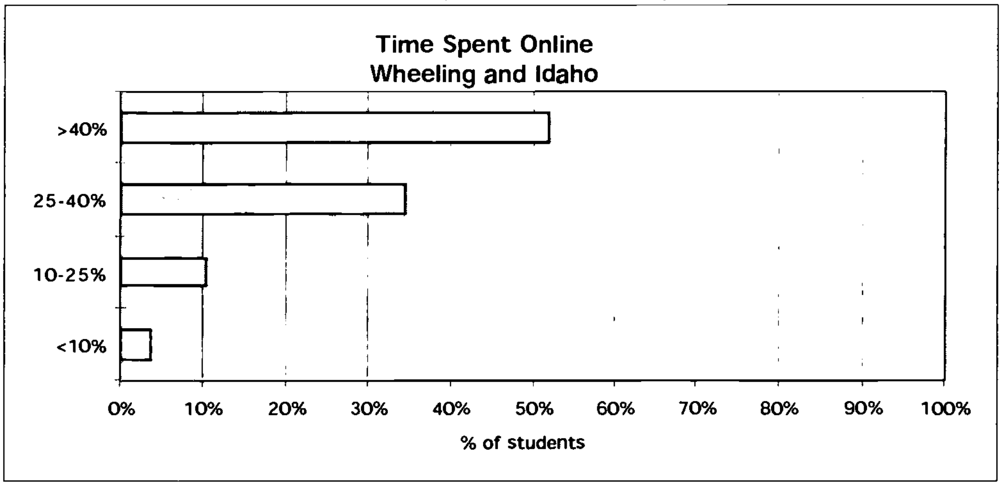
Relative to time spent on other graduate courses, 43% of the participants reported spending more time, 27% reported equal time, and 30% spent less time. For some participants, connectivity limited their time. See Figure 5.

Figure 5: Time Spent Compared with other Graduate Courses



How much time was spent online? 52% reported spending >40% of their time online using online resources and participating in the online discussions. See Figure 6.

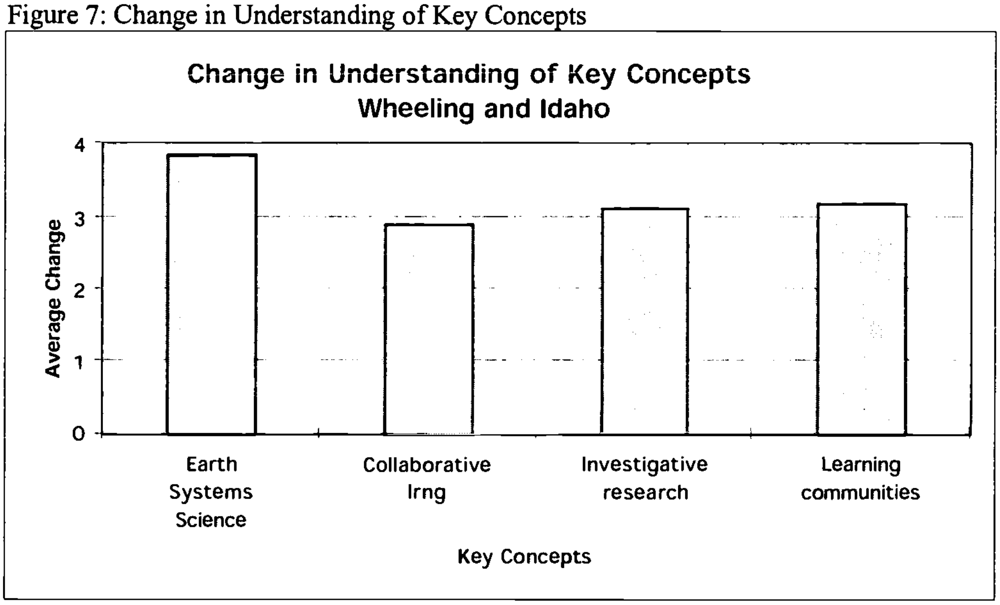
Figure 6: Time Spent Online



Change in understanding of key concepts

Participants were asked to rate the change in their understanding of Earth systems science, collaborative learning, investigative research and learning communities on a scale of 1 to 4 (highest). Average changes reported in Figure 7 indicate fairly substantial change. Participants reported the greatest change in their knowledge of Earth systems science (ratings ranged from 3-4). Several people reported a "rounding out" of their knowledge as a result of working in the sphere groups and having an opportunity to focus on one sphere at a time in relation to an event. Others reported that having to struggle with creating Earth systems diagrams for four different events showed them how much they had learned. Ratings for investigative research ranged from 2-4, and from 1-4 for collaborative learning and learning communities. Participants who rated no change in their understanding of collaborative learning also rated learning communities low (N=2) and commented on the lack of value in the group work.

Figure 7: Change in Understanding of Key Concepts



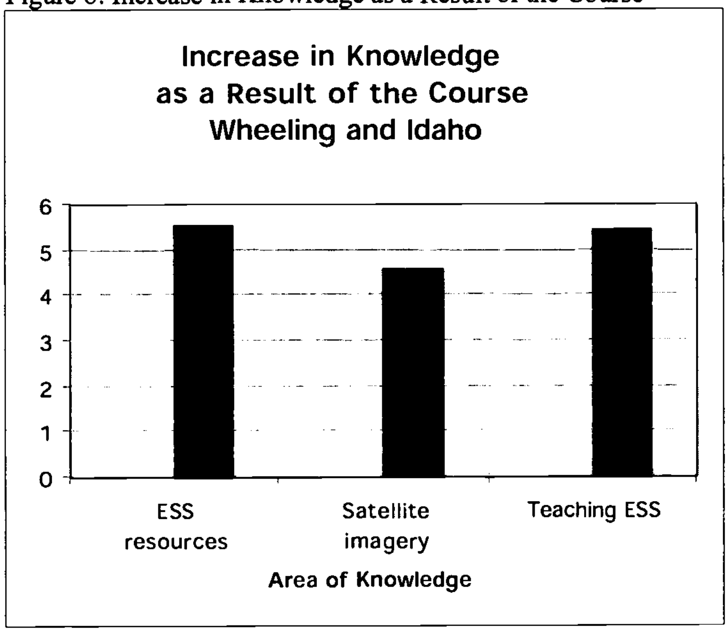
Increase in knowledge

A main goal of the course was to increase participants knowledge of Earth system science resources and teaching strategies, so they were asked to rate their change on a scale of 1-6 (highest). Comments

included: "I have binders full of great classroom activities and resources!" "It is absolutely amazing how many sites and resources are available. I am really excited about using these in my classroom next year."

Participants were also asked about the increase in their knowledge of satellite imagery since it was included in the course, but not extensively taught like it is in face-to-face sessions. The average rating for using satellite imagery was 4.58, lower than the other two areas. As expected, some participants felt they had only scratched the surface and wanted more in-depth instruction. Others had difficulty because of the slowness of a dial up connection. Others suggested more emphasis on this topic throughout the course.

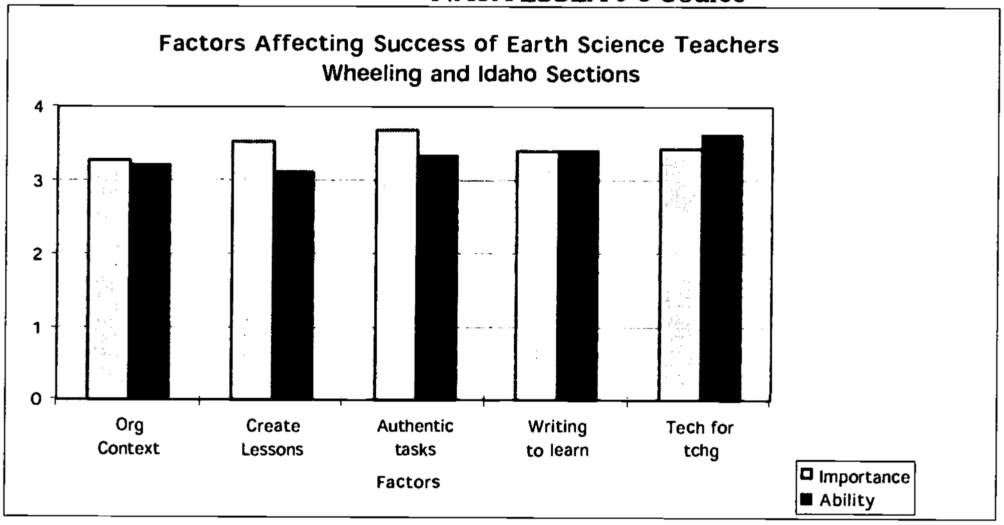
Figure 8: Increase in Knowledge as a Result of the Course



Factors Affecting Success of Earth Systems Science Teachers Participants were asked to rate the importance of five factors in the success of ESS teachers and then to rate their ability in each area as a result of the course (See Figure 9). On a scale of 1-4 (highest) all five factors had an average rating of 3 or better lending some support to the choice of these factors. Although the course did not directly address three of the five factors (organizational context, writing to learn, and using technology for teaching), it modeled them intensively.

When asked to rate their ability on the five factors as a result of the course, there was a significant difference (.05 level) between the importance and ability ratings in the areas of creating ESS lessons ($p=.005$) and authentic tasks ($p=.0226$), indicating participants still feel they need to improve in those areas relative to their perceived importance. No difference between importance and ability was found in the areas of organizational context ($p=.6253$), writing to learn ($p=.8513$) and using technology for teaching ($p=.2266$). This may indicate that there is adequate attention, support or learning in the course for these areas relative to their perceived importance. A separate analysis of the two sections of the course revealed no difference in importance and ability in the Wheeling section in creating ESS lessons ($p=.0454$), indicating greater comfort in this area for this section. A second study being conducted on archival transactions may shed some light on this difference between sections.

Figure 9: Factors affecting Earth systems science teachers



Participants were asked to respond to an open-ended question about their expectations for the course. Of the 33 participants who responded in the, 24 identified a key goal as gaining confidence and a better understanding in teaching ESS. Other goals included: improve in use of the Internet or technology (15); develop, locate lesson plans, activities and strategies I can use in my classroom/pedagogy (10). be made aware of ESS resources (5); and work/get to know others interested in ESS nationwide (5).

"I expected to learn about just the Earth's spheres. I didn't realize they would be connected to an event and they would affect each other during or after the event. My expectations were met many times over.

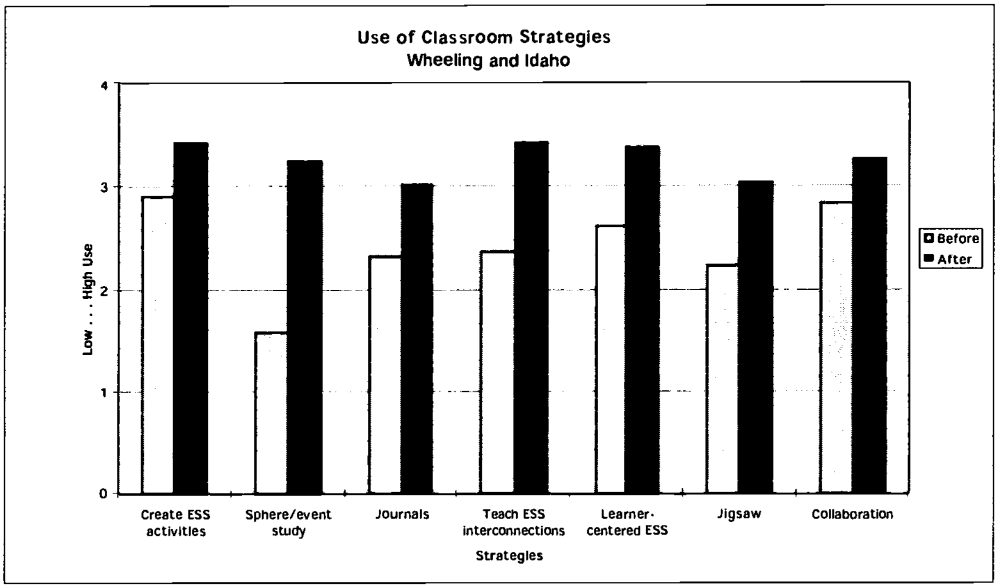
Use of Classroom Strategies

One of the goals of the course was to influence teachers to use strategies with their students that support learning Earth system science through immersing them in an environment that modeled those strategies. Criteria in the form of rubrics and sources of activities that use them were also provided.

Teachers were asked to rate their use of the strategies before and after course by responding to the question: "How likely were you to use this in your classroom prior to the course? After the course?" A significant difference (.05 level) was found in the entire sample for increased use of all the strategies associated with constructivism, including learner-centered activities ($p=.0032$), jigsaw ($p=.0064$), collaborative grouping ($p=.0002$), use of journals ($p=.0006$), teaching for connections ($p=.0001$), and sphere/event study groupings ($p=.0001$). Teachers reported greater intention to use all the strategies, especially the sphere/event strategy and teaching for Earth systems science interconnections.

As seen in Figure 10, teachers reported significant increases in the use of all strategies, especially in the area of sphere/event studies and in teaching for Earth systems science interconnections. This suggests an increased likelihood of use of these strategies as a result of the course. This is especially important, since few of the teachers reported using jigsaw learning groups before the course. One participant commented, "This course has provided a host of supportive contexts which I have internalized, enlarged upon, and will continue to expand upon."

Figure 10: Use of Classroom Strategies

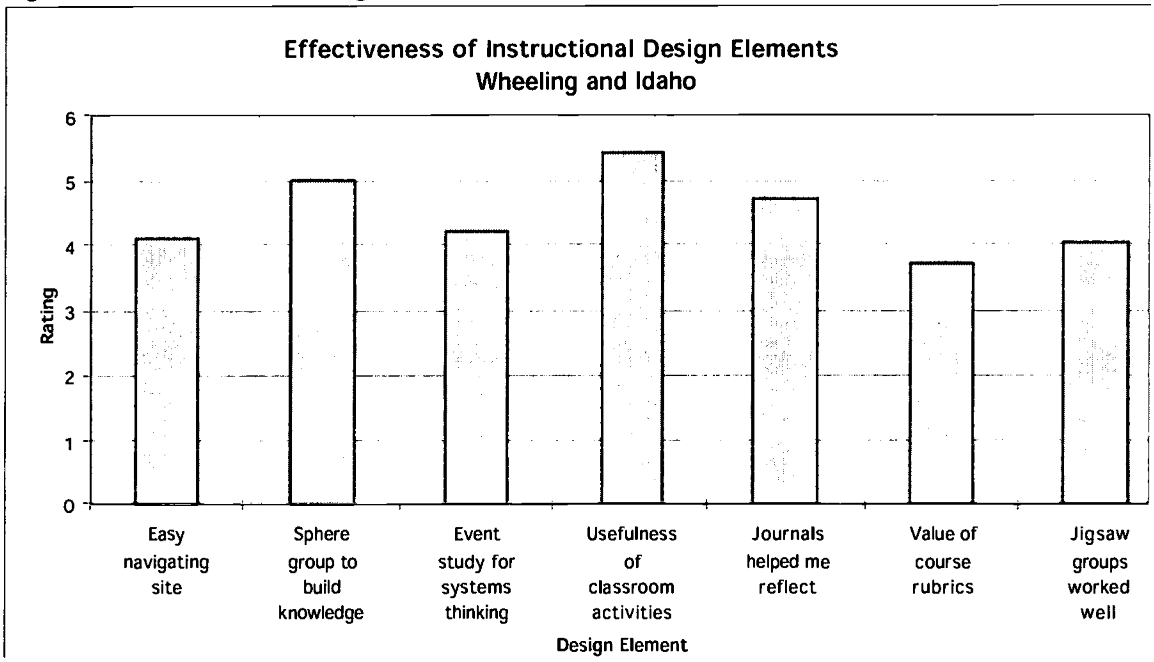


Effectiveness of Design

As discussed in the background section, the development of the web site environment for the course was guided by the design goals of particular spaces, functions, and flow to create a community of learners. Participants were asked to rate statements about the design elements from 1-6:

- I had no trouble navigating about the site itself. That is, material was presented in such a way that it was "obvious" as to how to make the "right choices."
- The sphere group exercises (jigsaw) helped the participants become knowledgeable in content area so that they could contribute to group discussions.
- The event study groups worked well for the participants. They helped in the development of the earth systems diagram.
- I plan to use the classroom activities I encountered during this course.
- The journals helped the participants reflect on what had taken place each week.
- The course rubrics were of great value.
- The jigsaw groups worked well for the participants.

Figure 11: Effectiveness of Design



As seen in Figure 11, average ratings ranged from 3.73 to 5.45, providing support for the effectiveness of the design elements in their desired roles. The rubrics were not posted in their final form until the third week, which may account for their lower rating. One participant commented, "The rubrics were great for guiding us on what exactly the course designers anticipated we would be doing in each space." Having specific expectations to meet increased the time commitment for some participants. One person commented, "It was just too time-consuming for me to put in the time to make the grade."

Participants almost universally appreciated the classroom activities and resources that pointed to them. The most popular ones included the volcano sites, Weather on other Planets, and the ETE modules, but the most frequent comment was, "so many were excellent."

The site design was fairly highly rated (4.15) for ease of navigation. Participants suggested embedding more directions in the weekly outline, making separate archives for the groups to work in, making the threads easier to read and browse, and checking in with every person within the first three days by phone, fax, or email) to make sure they are connected and have found all the parts of the site.

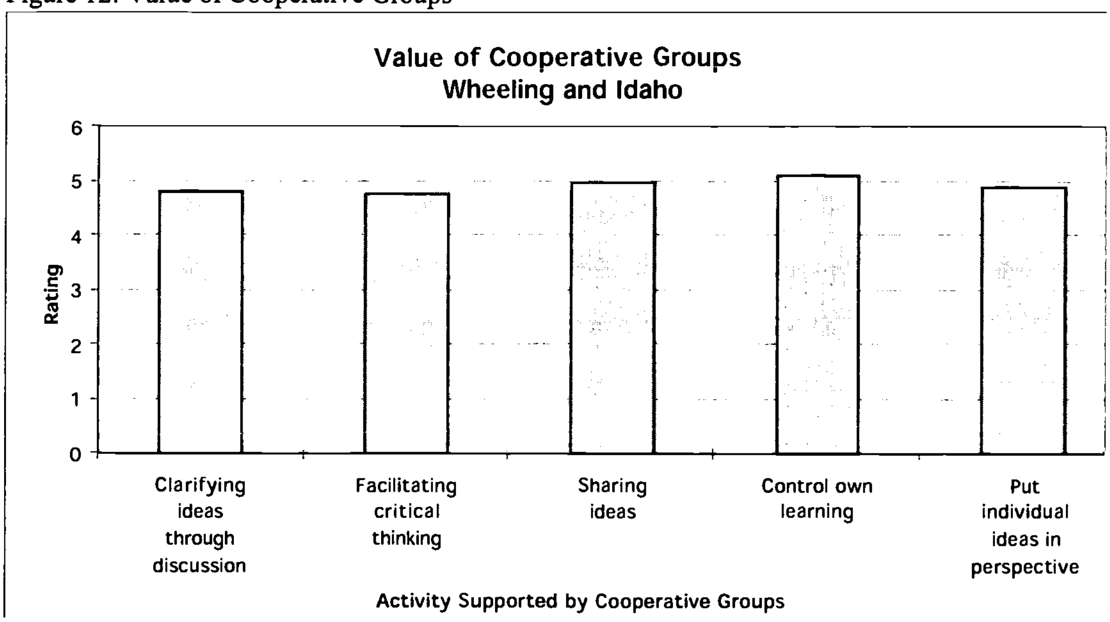
Function of the Cooperative Groups

Additional questions were asked about the use of cooperative groups to try to tease out what made them effective for participants. They were asked to respond to the following statements on a scale of 1-6, with 6=strongly agree:

- Cooperative learning in this course helped clarify ideas and concepts through discussions (both Sphere and Event Groups).
- Cooperative learning in this course facilitated critical thinking.
- Cooperative learning in this course provided opportunities for learners to share information and ideas.
- Cooperative learning in this course provided opportunities for us to take control of our own learning, in a social context.
- Cooperative learning in this course provided validation of individuals' ideas and ways of thinking through conversation, multiple perspectives, and argument.

As Figure 12 shows, the ratings ranged from 4.76 to 5.12, indicating fairly high value for all the functions of cooperative groups. Many participants commented on how nice it was to have so much choice about what to read, when and what and how to contribute to the groups. Those who did not find the cooperative groups as helpful made comments such as: "the groups I was in did not get to the conversation stage" or "I prefer working alone." As one person commented to a mentor, "It's hard to hide in a group in a face-to-face class, and almost impossible in an online course." The typical challenges of uneven participation of group members, lack of direct communication about individual needs, and different pacing needs of participants were dealt with in various ways. One person commented, "I am not sure the labor was evenly divided, but that happens in the classroom too." Experiencing both the power and challenges of collaborative learning were valuable to many people, as one person remarked, "It was important for me to be a student and experience this first hand."

Figure 12: Value of Cooperative Groups

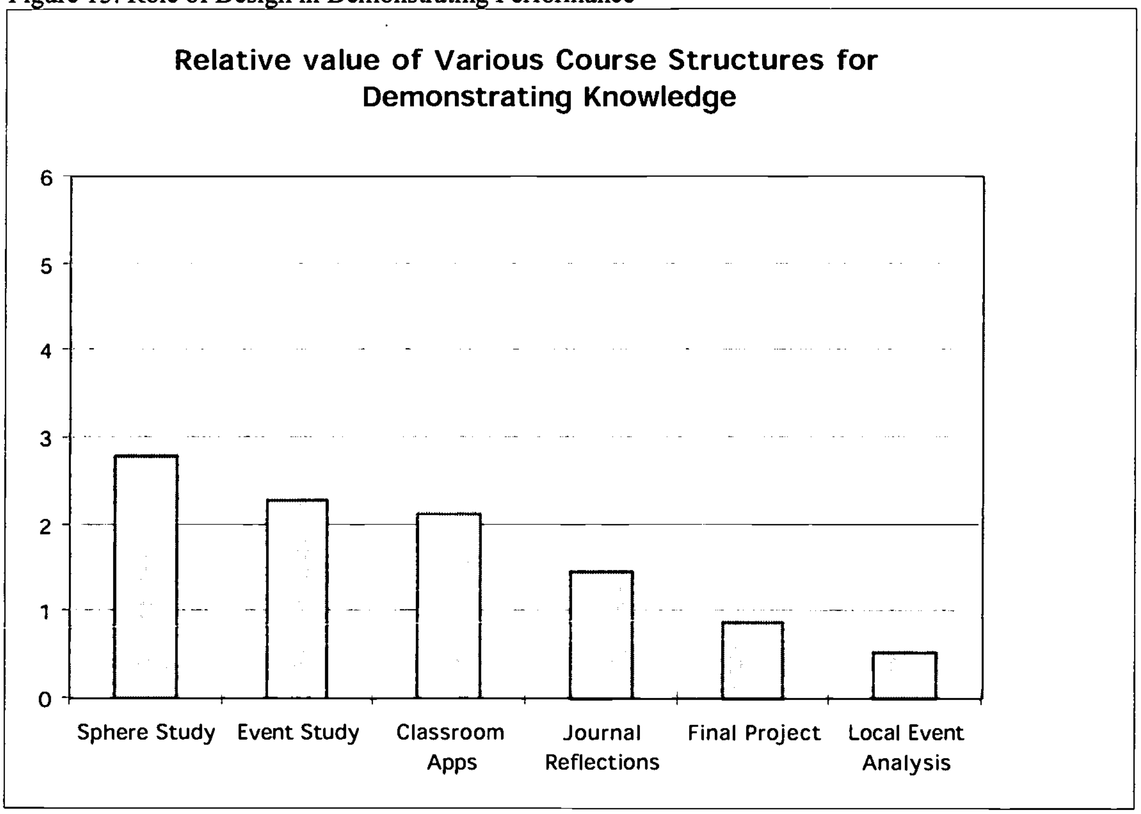


Role of Design in Demonstrating Performance

Course grades were based on individual reflection (journals), use of the ESS ideas and information for teaching (classroom applications) participation (sphere and event study) and synthesis of all the ideas (final product):

• Sphere study	10 points
• Event study	25 points
• Classroom applications	25 points
• Journal reflections	25 points
• Final project	15 points

Figure 13: Role of Design in Demonstrating Performance



Participants were asked to rank from 1-6 (highest) the usefulness of the various structures for showing what they learned. As seen in Figure 10, the relative ranking of the structures was weighed toward the sphere and event study groups. Because of the cooperative learning structure, participants reported gaining insights in the group discussions and learning from a variety of people with different experiences. Many commented on the power of learning about a single sphere, then applying it to an event. By studying each sphere in depth for one of the events, many people felt they improved dramatically in their ability to map the relationships in an ESS diagram.

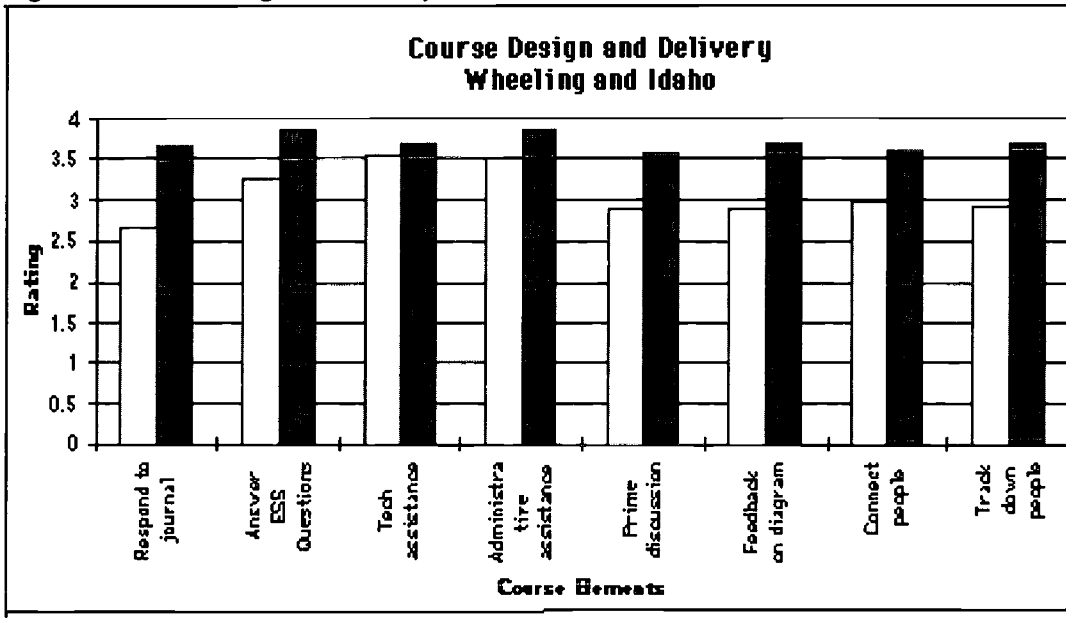
Course Design and Delivery

To examine the flow of ideas, support and feedback in the site design, we asked participants to respond to statements with a rating of frequency in their experience in the course with: (1) Always (2) Often (3) Seldom (4) Never; and a level of importance (1) Very important (2) Sort of important (3) Not very important.

It was important that: and The mentors/facilitators:

- responded to the participants journal entries
- answered questions about ESS content
    - responded to requests for technical assistance
    - responded to requests for administrative assistance, e.g., clarifying assignments, group membership, and location of course content
    - primed group discussion by offering "expert" ideas, hypotheses, or thoughts for our consideration, research, and exploration
    - offered feedback on the earth systems diagrams
    - helped connect people to each other
    - helped track down people who seemed to be "lost" in cyberspace

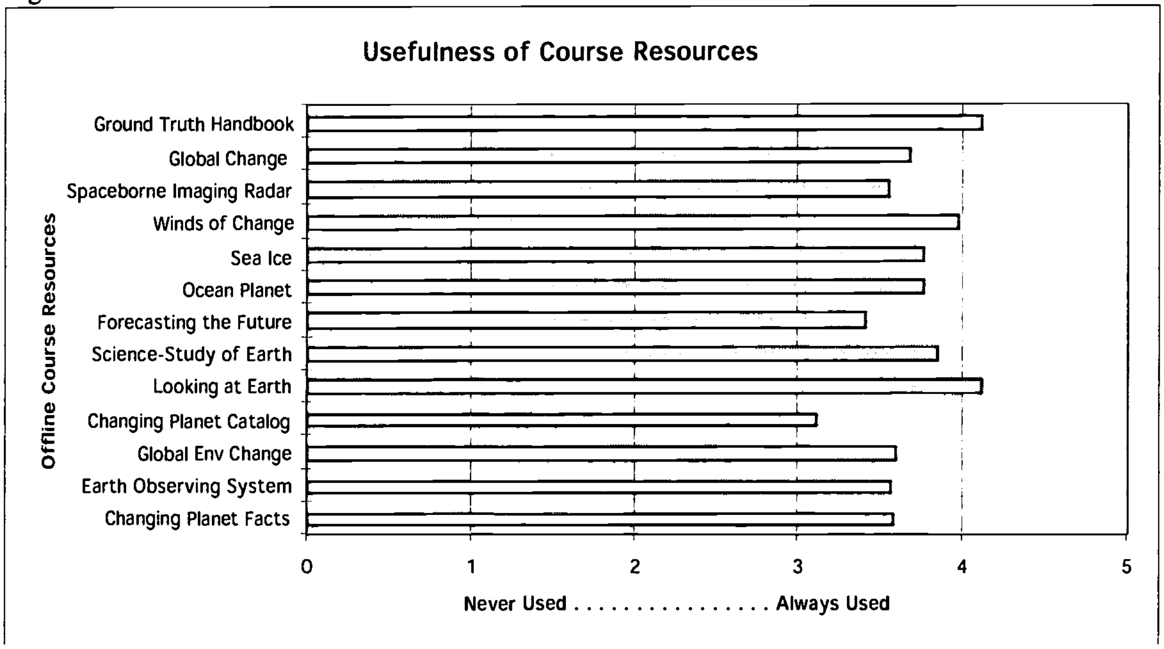
Figure 14: Course Design and Delivery



Usefulness of Course Resources

Participants were asked to rate the course resources sent to them on a scale of 1-5 (never . . . always) in terms of how often they used them. Average ratings ranged from 3.57-4.10, indicating an effective choice of resources for the course.

Figure 15: Usefulness of Course Resources



Educational Importance of the Study

An overriding objective in the development of this online course was to create "reasons" for individuals to engage in the material that could be transferred into the classroom. The population consisted of very busy classroom teachers who needed to be actively involved to compete with their other activities and who could see the practical usefulness of the expectations. Course developers purposely designed the structure so that the course was student-centered and so that participants relied on each other for input. As discussed above, this was accomplished through the jigsaw strategies that made participants depend on each other for essential information in creating the Earth systems diagrams.

As part of this "first run" participants were asking to be forthcoming in their comments throughout the course and in the surveys. Many changes were made along the way to improve communications and better meet the course goals. For example, a participant provided instructions for using of chats for discussions and setting up a web page for a group. Others suggested collapsing the old discussions to make loading quicker. Mentors changed the suggested posting deadlines to give people the whole weekend to work.

Since the course ended, the site has been redesigned with a visual metaphor of the classroom to make the functions of the spaces clearer. The rubrics have been revised and better integrated into the activities. The week-by-week outline has more directions about where (space) and when to participate. One section of this new course is currently being run and others are contemplated as partnerships are formed with teacher inservice programs.

Conclusions

This middle school course was designed to address the needs and style of middle school teachers and their students: high activity, changing groups, ongoing reflection, an opportunity to even out their knowledge of the spheres, and the challenge of doing rigorous analysis of events from an Earth systems science perspective.

While the use of a complex instructional strategy like jigsaw in a non face-to-face environment was considered risky, it was also deemed essential to create the engagement necessary for knowledge-

building. It also provided the perfect opportunity to "walk the talk" about constructivist student-centered strategies (Johnson and Johnson, 1992).

The course evaluations indicate that the design was successful in accomplishing the course goals of increasing the participants' knowledge of Earth systems science and resources, and their use of constructivist and student-centered strategies. While not a goal of the course, comfort with technology and the Internet in particular increased for those participants who had apparently signed up to "get their feet wet" in an environment they see as a strong part of the future of education for themselves and their students.

The importance of place, identity, flow of ideas and information and reflection come alive in a web-based course. The clarity of definition, the scaffolding and the explicitness required caused the team to examine and reexamine both their assumptions and their practice - the goal for the teachers as well as their students. The web provides the opportunity to explore the premise that learning is most powerful in a social context (Vygotsky, 1978). The challenge is to watch ourselves and how our ideas develop through interaction - to become productively self-conscious collaborators in knowledge-building.

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ABSTRACT

This study of 67 preservice and 67 inservice teachers' performances on computer-based scenarios, prompting instructional decision-making and using embedded assessment, illustrates differences in how experienced and novice teachers make technology integration decisions. The major findings that emerged from the comparative analysis of novice and expert teachers' exploration of the scenario and essay responses to its central question are that: (1) Inservice teachers addressed significantly more key elements of educational technology integration and implementation principles; (2) Inservice teachers' essay responses were more focused on the use of technology as a learning tool and the importance of professional development while preservice teachers emphasized neutral topics such as the ubiquitous nature of computers and access to hardware and software; and (3) Both inservice and preservice teachers rarely mentioned assessment in their justifications. These results suggest that the teaching experiences of the inservice teachers influence their justifications for decisions. Experience counts.

(**Keywords:** preservice education, computer-assisted instruction, computer-assisted assessment, technology integration, problem solving, decision making)

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INTRODUCTION

How can online, case-based simulations with embedded assessment be integrated into teacher education to develop, assess, and track preservice and inservice teachers' technology-integration decision making? We will present data on how web-based simulations powered by the IMMEX™ problem-solving assessment software were utilized to capture how experienced and novice teachers differentially make decisions when infusing technology into instruction. Supported by a Department of Education Preparing Tomorrow's Teachers to Use Technology (PT^3) grant, two PT^3 investigators have co-developed case-based, computer simulations of classic classroom technology implementation scenarios to enhance future teachers' conceptual foundations and decision-making skills on integrating technology into the curriculum, called *eTIPs* problem sets.

The complex nature of teaching challenges educators to make subtle judgments and agonizing decisions in daily classroom practice. Expanding instructional options with technology integration increases the complexity of the decisions teachers need to act upon. Skillful teachers anchor their practice in a combination of theory and praxis (Merseth, 1996). Case methods, when used appropriately, have the potential to bridge theory and practice (Shulman, 1992). Considering that preservice teachers lack the practice and are in the process of developing the theory, case methods could be used as a pedagogical tool to provide future teachers with experiences that mimic potential classroom dilemmas, including technology integration, that elicits active analysis, interpretation and the application of technology integration and implementation principles, early in their education, prior to actual classroom teaching.

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Building on the IMMEX digital curriculum of case-based simulations for medical education and K-12 education, eTIPs problem sets for teacher education consist of three essential components: (1) a *prolog*—an opening scenario that presents a technology-integration challenge commonly encountered in "real" classrooms across the nation; (2) a *problem space*—menu items with data for research, analysis, and consideration; (3) an epilog—a summary of the potential logic a teacher could employ in solving the classroom dilemma.

When teachers attempt to solve an eTIPs problem set, they logon with a customized ID and password (Figure 1). The first screen encountered consists of the prolog in the main frame at the center and an accompanying problem space with primary menu options on the menu bar in the top frame (Figure 2). Based on how teachers conceptualize and frame the challenge and question posed in the prolog, teachcrs conduct a search in the problem space by selecting and analyzing individual menu items. Information on the simulated school for teachers to analyze and reach their decisions consist of teacher profile, student profile, school and classroom-based resources, with emphasis on technology, classroom configuration, classroom pedagogy, assessment, and scenario context, including information on student and teacher schedule, attitudes toward technology and professional development. As teachers execute their research in the defined problem space, the IMMEX problem-solving assessment system records each menu-item selection in chronological order. Additionally, the software generates a map that illustrates teachers' step-by-step problem-solving approach, which can be used to guide assessment and engage learners in metacognition (Underdahl, Palacio-Cayetano, & Stevens, 2001). Upon

completion, teachers compose an online justification for their decision to integrate or not integrate technology (Figure 3). Teachers' essays are scored based on the number of *e*ducational *t*echnology *i*ntegration and *i*mplementation *p*rinciples—eTIPs—addressed (Dexter, 2002).

Figure 1--Step 1: Logging on to an eTIPs Problem Set with Individualized ID

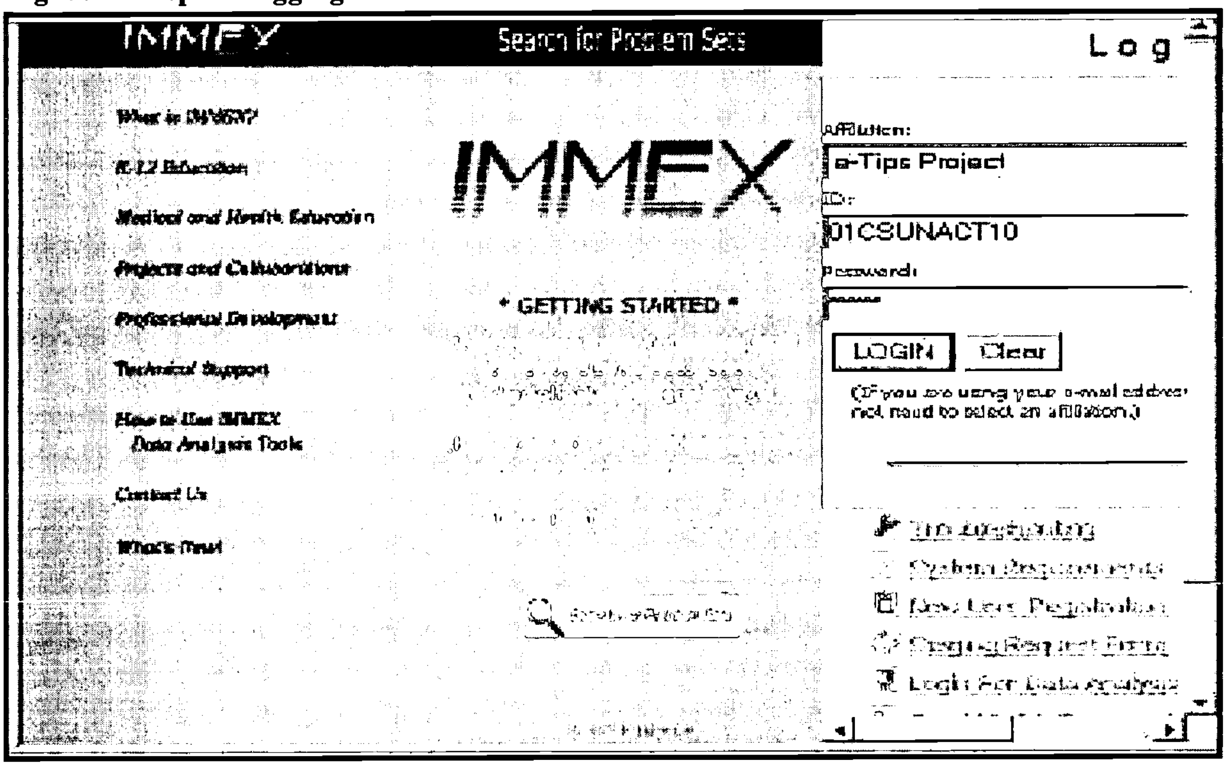

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Figure 2--Step 2: Interactive Problem Solving

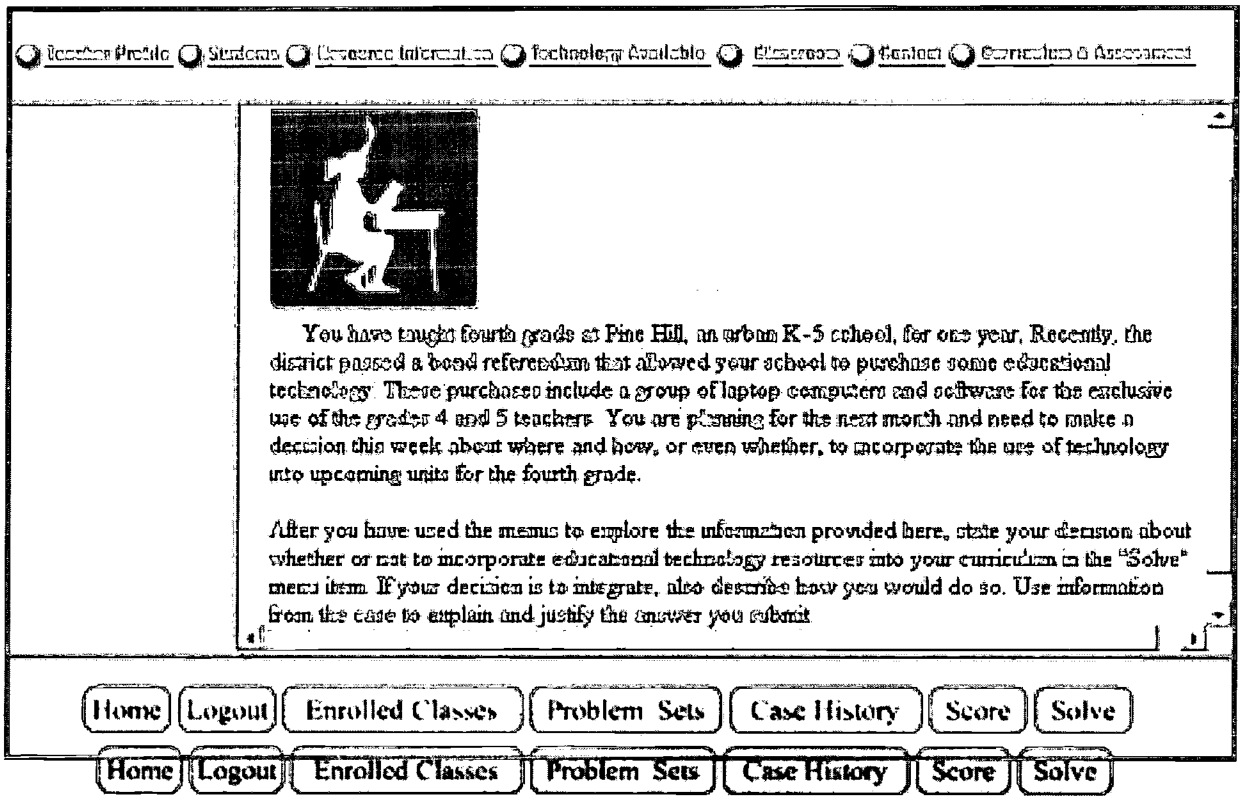

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Figure 3--Step 3: Composition of Essay

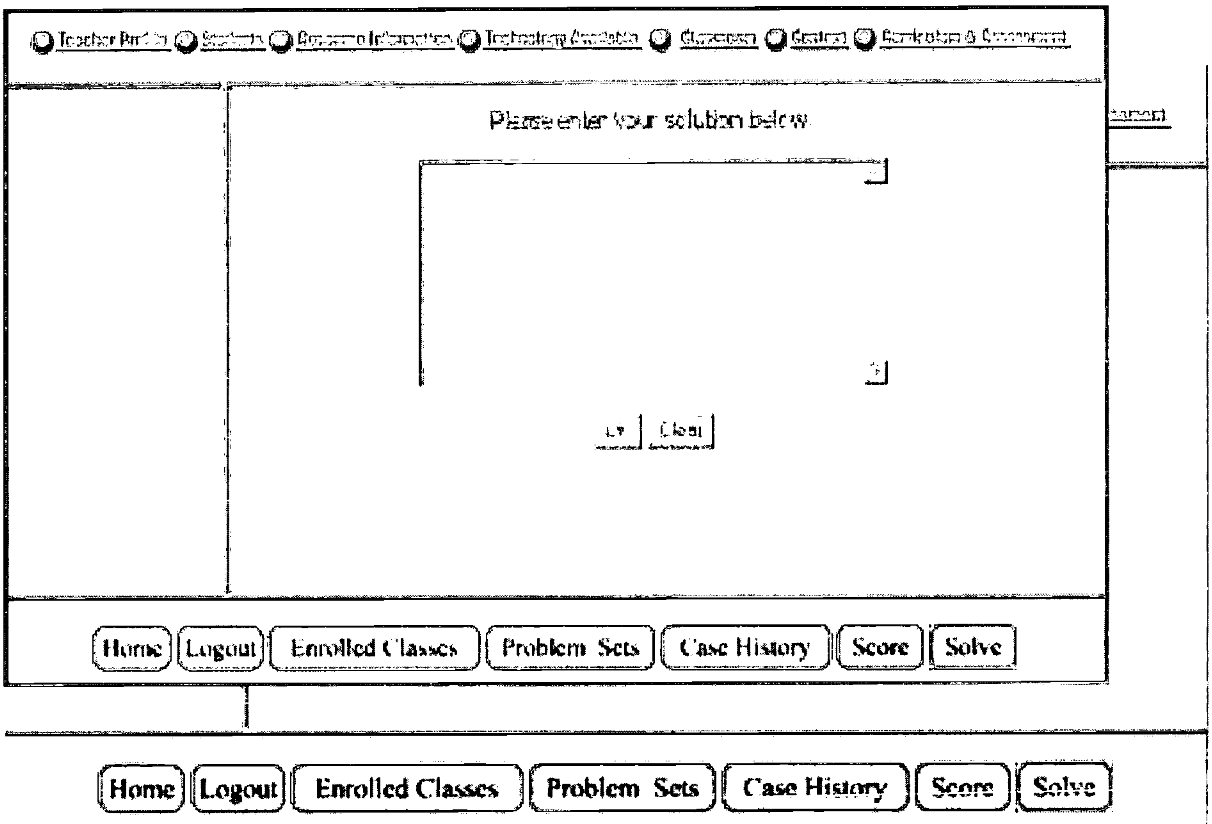

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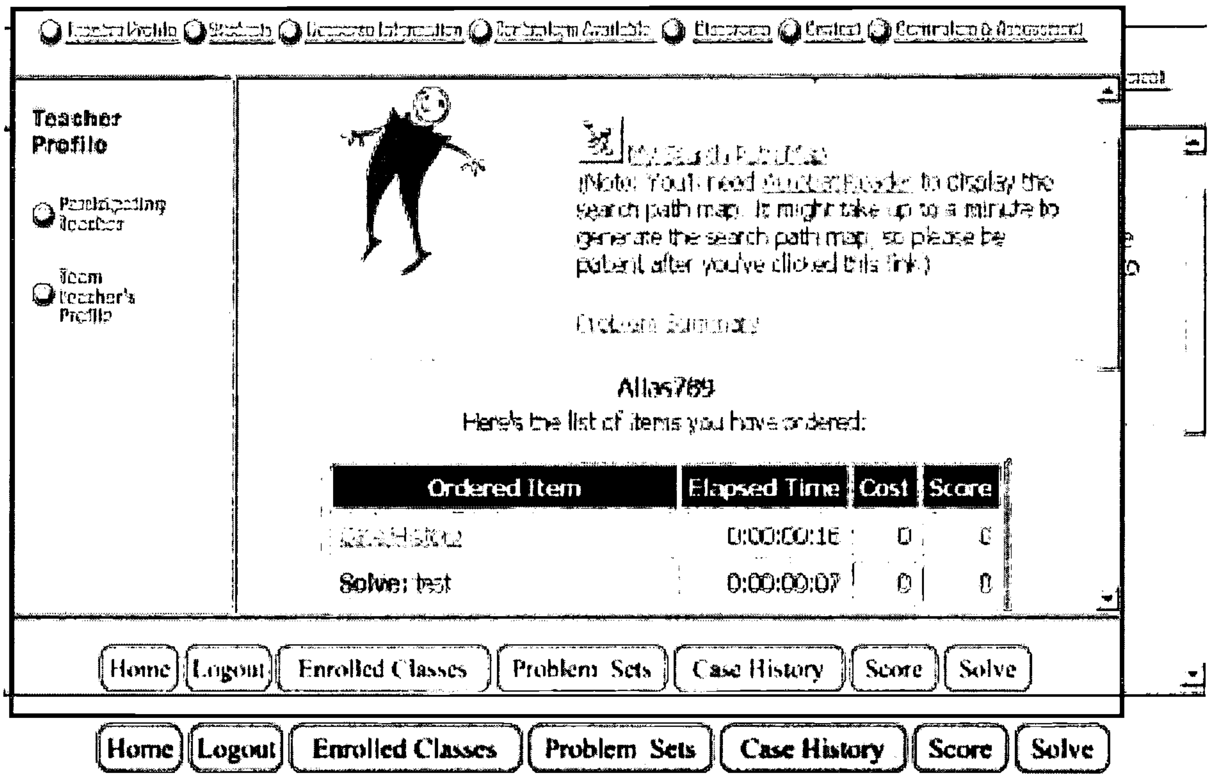
Figure 4--Step 4: Access to Search-Path Map and Problem Summary



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PURPOSE AND OBJECTIVES

Our goal was to conduct a comparative analysis of preservice and inservice teachers' strategies and justifications on computer-based simulations to examine the impact of experience on technology integration and implementation decisions. Hence, the following two questions guided this research.

- What are the primary considerations both experienced and novice teachers make when deciding whether or not and to what extent to integrate technology into instruction?
- How do experienced and novice teachers differentially make technology integration decisions?

THEORETICAL FRAMEWORK

While rapid advances in technology and the proliferation of computers in schools have expanded pedagogical options for educators, teachers continue to struggle with how and when to integrate and implement technology effectively into instruction. According to Pierson (2001), schools are so eager to purchase and have teachers begin using technology, that they mistake simply having and turning on a computer as integration. However, merely knowing how to use a computer is not sufficient to ensure that teachers will effectively integrate technology into the learning curriculum. Instead, a teacher who effectively integrates technology is able to draw on extensive content knowledge and pedagogical knowledge, in combination with technological knowledge, when using technology in the classroom (Pierson, 2001).

One challenge facing teacher education programs today is preparing teachers to use technology effectively in schools (Wedman & Diggs, 2001). Using online problem-solving

scenarios such as IMMEX can provide pre-service teachers with an appropriate context in which to construct knowledge about technology integration. These scenarios provide students multiple opportunities to learn to teach with, not just operate, educational technology around the following *E*ducational *T*echnology *I*ntegration and *I*mplementation *P*rinciples: (Dexter, 2002)

eTIP 1: Learning outcomes drive the selection of technology.

eTIP 2: Technology use provides added value to teaching and learning.

eTIP 3: Technology assist in the assessment of the learning outcomes.

eTIP 4: Ready access to supported hardware/software resources is provided.

eTIP 5: Professional development is targeted at successful technology integration.

eTIP 6: Teachers reflect on, discuss, and provide feedback about the role of and support of educational technology.

IMPORTANCE OF THE STUDY

Cases and case methods have been used as a pedagogical tool in preservice education for many years as far back as the mid-1980s (Merseth, 1996). Traditionally used in law, medicine, and in business, case methods are increasingly utilized in education to prepare teaching credential candidates to practice in a complex world where knowledge about teaching is not sufficient. Teachers and teacher candidates also need to know how to apply this knowledge in often complex and imperfect situations commonly encountered in the classroom. Case-based learning is an alternative method of instruction that enables teacher candidates to interpret complex situations that are in a constant state of flux and understand the theoretical issues involved. Analyzing case methods with frequently encountered classroom dilemmas in

technology integration engage credential candidates in complex cognitive processes that underlie successful performance in classroom settings and provide them with an opportunity to determine and apply suitable theory or principle to a given situation. Most importantly, preservice teachers can begin to acquire tools that will foster informed decision-making in situations where there are no easy, clear-cut answers. Since it is still uncertain how teachers make the decision to integrate technology or not and to what extent despite the significant investment in technology and professional development in recent years, case-based simulations with embedded assessment, like eTIPs problem sets powered by the IMMEX problem-solving assessment software, have the potential to capture and provide visual displays of key decisions teachers make in planning instruction with technology (Zhao & Cziko, 2001).

Collaborating with both preservice and inservice teacher programs provided the UCLA IMMEX Project with a convenient sample and opportunity to contribute to research in teacher technology-integration decision-making, particularly addressing the following two questions. What are the primary considerations experienced and novice teachers use when deciding whether or not or to what extent to integrate technology into instruction? How do experienced and novice teachers differentially make technology integration decisions? Our observation that preservice teachers are inclined to focus on access to technology and marginally consider crucial dimensions of learning with technology such as technology implementation planning, prerequisite skills, and characteristics of learners, suggests curricular areas in need of increased emphases in educational technology curricula. Instructors can utilize data obtained from teachers' performances on IMMEX eTIPs cases to design instructional interventions and refine curricular content for future educational technology courses.

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DATA SOURCES

The data for this study are drawn from 67 preservice teachers from a technology in education course at an urban university in California sponsored by the Department of Education PT^3 implementation grant and 67 inservice teachers in a California Department of Education technology initiative administered by the California State University Chancellor's Office. Preservice teachers solved the eTIPs cases as an assignment in their yearlong credential program. Similarly, inservice teachers performed the eTIPs cases as a requirement for a yearlong educational technology professional development program. Each teacher was supplied with a pre-assigned login ID and password and was given about 45 minutes to work independently in a computer lab setting.

Unlike another research project that we are currently conducting in which the six eTIPs were introduced in the course of study prior to onlinc problem solving, teachers in this study did not receive direct instruction on the six eTIPs or provided with literature on current research on educational technology integration and implementation principles. No specific instructions were given to either group except to gather the data to make an informed decision and then discuss and justify their decisions in a written essay. Technology proficiency survey results from California Technology Assessment Project and IMMEX Project Evaluator's survey confirmed that both preservice and inservice teachers had introductory or novice computer skills.

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METHODS

IMMEX automatically recorded the sequence of actions of each teacher while they performed a parallel case in eTIPs problem sets allowing quantitative and qualitative comparisons of the information acquired by the two groups. Additionally, each sentence in the teacher justifications about whether or not to integrate technology was tagged for key elements of the eTIPs addressed allowing quantitative comparisons of their decisions. The analysis of teachers' essays enables instructors to learn the teacher's decision and his/her rationale for it, as well as the depth of their reasoning, as judged by their coverage of key educational technology integration and implementation principles.

Depending on the depth of a teacher's written response, an essay can earn a maximum 12 points, receiving up to two points for each of the six eTIPs. We used the following criteria to determine the essay's score on each of the six eTIPs.

- Zero--when the teacher makes no reference at all to the substance of the eTIP;
- One--when the teacher makes a general reference to the substance of the eTIP, or implies consideration of the eTIP; and
- Two--when the teacher discusses a specific eTIP comprehensively and provides supporting details from the information presented in the case.

Sample Scoring of Teacher Essay

"I intend to schedule a meeting with the other participating teachers so we can discuss possible objectives and to try to schedule our students for biweekly sessions in the computer room **(Technology integration Planning/Scheduling: eTIP 1).** I will contact my friend in another

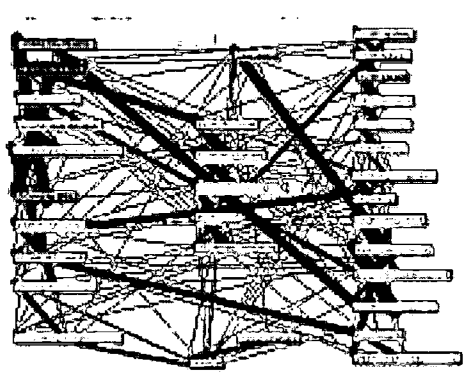
district to see if we can begin having our students sharing information on a regular basis **(Team Teaching: eTIP 6)**. I would like to have our students participate in a hunt for education informational websites. They would be competing with the fourth grade students in my friend's district. Initially we would just graph the number of available sites on a particular subject. We would then have a secondary contest to write reports about specific subjects and exchange them with the students in the other district. Some of the students would be able to send their information from home. Other students would have to use the computers at home. We would also begin the year with a general review of computer knowledge **(Prerequisite Skills: eTIP 2)** to be sure most students are aware of the basics and can also navigate the internet and can use the e-mail I would schedule local High school students to come and work both on reading skills and to also assist the students with their writing **(Computer as Learning Tool: eTIP 2)** and their sharing of information with the students in the other district. I would encourage the other teachers in my group to take laptops home and check on the progress of the students."

RESULTS

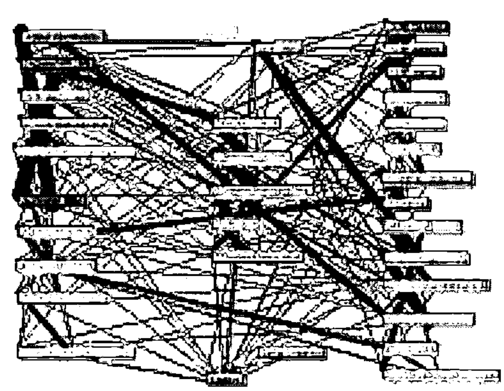
The analysis of the search-path maps (showing teachers' step-by-step search for information) and accompanying written essays revealed several insights into the users' instructional decision making about technology integration. Both preservice and inservice educators examined the majority of the information in the simulation moving sequentially through the menu items (Figure 1). While there were few item-selection differences between the groups, an independent samples T-test showed that inservice teachers addressed significantly more eTIPs in their essays than preservice teachers ($p < .01$). The analysis of essays for score on

each eTIP also showed a differential mention of technology integration topics between the groups. Inservice teachers focused significantly more on eTIP 2, the use of technology as a learning tool ($p < .05$), and eTIP 5, the importance of professional development ($p < .01$) while preservice teachers were more likely to mention more neutral topics such as the ubiquitous nature of computers, impact of technology on teaching, etc. Both groups equally mentioned hardware, software and standards. Interestingly, the mention of eTIP 3, assessment, was rare for either group. A listing of the most frequently mentioned issues is shown in Table 1. These data indicate that although the two groups accessed the same data from the simulations, the experiences of the inservice teachers influenced their perception of the simulations and their written decisions.

Figure 5—Search-Path Maps for Inservice and Preservice Teachers



Inservice Search-Path Map



Preservice Search-Path Map

Table 1—Most Frequently Mentioned Issues

	Preservice (Frequency)	Inservice (Frequency)
Technology Implementation Planning/Curriculum	11	35
Computer as Learning Tool	14	28
Prerequisite Skills	14	20
Cooperative Learning	10	20
Professional Development	4	12
Technical Support	8	15
Linking Curriculum to Technology	0	6

CONCLUSION

While unraveling how teachers make decisions to teach with or without technology is only a single component of developing teachers' technological competencies and instructional planning for technology integration, the impact can be far reaching. The ability to use eTIP IMMEX-powered simulations to capture variations in the quality of both preservice and inservice teachers' considerations and decisions for technology integration in a range of classroom environments by electronically reconstructing teachers' decision-making processes and coding teachers' written justifications for alignment with research-based educational technology integration and implementation principles provide support for eTIPs simulations as a viable instrument for developing and assessing teachers' conceptual knowledge of technology integration. The striking difference between the quality of the preservice and inservice teachers justifications for their decisions despite the similarity in their technology skills based on self reported surveys of technology skills suggests that teaching experience is one of the most significant influences on the quality technology integration. The higher incidence of key

elements of educational technology integration and implementation principles in inservice teachers' essays was not accidental occurrence, but an experiential advantage. Experience counts! The infrequent mention of the assessment potential (eTIP 3) of technology by both preservice and inservice teachers most likely is a reflection of the limited use and access to technology for assessment in current classroom practice.

These findings can help to shape the quality of interventions in professional development and teacher education courses so as to maximize the level of technology integration and implementation capabilities in K-16 educators. Instructors can utilize data obtained from teachers' performances on the IMMEX-powered cases to design instructional interventions and refine curricular content for future educational technology courses. A deeper understanding of how teachers prioritize issues and make decisions about their instructional programs not only has immediate importance for current training programs, but also has implications for future directions of teacher education programs, creation of technology initiatives to enhance preservice and inservice teachers' technological competences, and school-site professional development in technology. Case-based simulations coupled with embedded assessment, like eTIP IMMEX-powered simulations, that can identify, develop and assess how teachers make decisions about designing instructional programs may hold promise for accelerating this understanding how teachers make the decision to integrate technology or not into instruction.

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The Joys and Sorrows of Teaching Computer Literacy Online

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Keywords: Computer Literacy, Online, Teaching, Course delivery

I. Abstract

The first online course at Middle Tennessee State University (MTSU) was offered in the fall semester of 1997. However, until Spring 2001, the Computer Science Department had never offered a course that was completely online, though many courses have had substantial online components. In Fall 2000, the authors decided that an on-line Computer Literacy course should be offered. The development and delivery of the course was a learning experience and provided several insights into what should and should not be done in an online course.

Preparation time for the class was intensive as was soon discovered. A thorough review of the literature was the starting point for course development and delivery. Many decisions had to be made during the course development phase and a list of those major decisions was developed.

When the course actually started, there was a whole new set of learning experiences involved. Learning experiences included the discovery that an online course is not suited for everyone and that an online course is time-intensive for the instructor even after course materials are developed.

This paper will discuss strategies used in the development of the class and the problems that were encountered as the class was offered for the first time. It will also

provide a list of items that were found to be beneficial to the learning process for the student and for the teacher.

II. The What? and Whys? of Computer Literacy Online

Computer Literacy is a one credit-hour class at MTSU that can be used to satisfy one of the general requirements for a baccalaureate degree. This requirement specifies that all students seeking a bachelor's degree must have a basic knowledge of computers, including computer development, applications in today's world, and direct experience in operation. This requirement can be met in a variety of ways, but the computer literacy course is most often the choice for non-computer science majors.

The decision to offer Computer literacy as an online course was made for several reasons: 1) There are large differences among the backgrounds of students enrolled in the course. Some students are extremely bored with the slow pace of the course while others are extremely frustrated at the lightning speed of the course delivery. An online course in which students could work at their own pace, as long as deadlines were met, seemed to be a very good choice. According to Chickering and Ehrman (1996), "Fast, bright students can move quickly through materials they master easily and go on to more difficult tasks; slower students can take more time and get more feedback and direct help from teachers and fellow students." 2) MTSU serves a large number of non-traditional students (single parents, older students who work, part-time students from surrounding counties, etc). An online course would be helpful to allow these non-traditional students to work around their various schedules to complete the course. 3) Portions of the traditional computer literacy class were already online. All laboratory assignments were partially online through the web; therefore, converting the laboratory assignments completely online would be relatively easy.

III. Online Course Preparation

The online course took considerable work to develop the course materials and the authors were very surprised at the amount of time required. It was soon learned that developing an online course is quite different from setting-up other lecture based classes. Many important decisions had to be made during the initial phase of course development. Decisions made during this phase had to be made very carefully because they affected future decisions and goals of the course. A list of course decisions and tasks to be performed was developed and then each item in the list was addressed. The development list included the following key decisions and tasks.

- Research online practices and learn best approaches
- Determine course content
- Determine course delivery method
- Develop learning units over the selected topics
- Develop practice quizzes
- Modify laboratory exercises, if needed
- Determine course specifics (grading criteria)

IV. Previous Work on Best Practices for Online Courses

When the search began for previously published work concerning online computing courses, it was found that very few had been published. This is quickly changing as online course delivery becomes more commonplace. Several sources were found concerning online courses in general. One source written for the traditional classroom was also found to be extremely helpful in keeping the focus on good teaching practices. That source was Chickering and Gamson's (1987) "Seven Principles for Good Practice in Undergraduate Education." Chickering and Gamson's principles are:

- Good teaching practice encourages contact between students and faculty.

- Good teaching practice develops reciprocity and cooperation among students.
- Good teaching practice promotes active learning from students.
- Good teaching practice gives prompt feedback.
- Good teaching practice encourages students to spend sufficient time on learning task.
- Good practice communicates high expectation.
- Good practice for effective teaching respects diverse talents and ways of learning.

This work was revisited in the context of distance learning and online courses (Chickering and Ehrman, 1996; Chizmar and Walber, 1999; Graham, Cagiltay, Lim, Craner, and Duffy, 2001; and Nguyen, Cripps, and Draude, 2001). These sources concentrate on how best to incorporate the seven principles of good teaching practice into online courses.

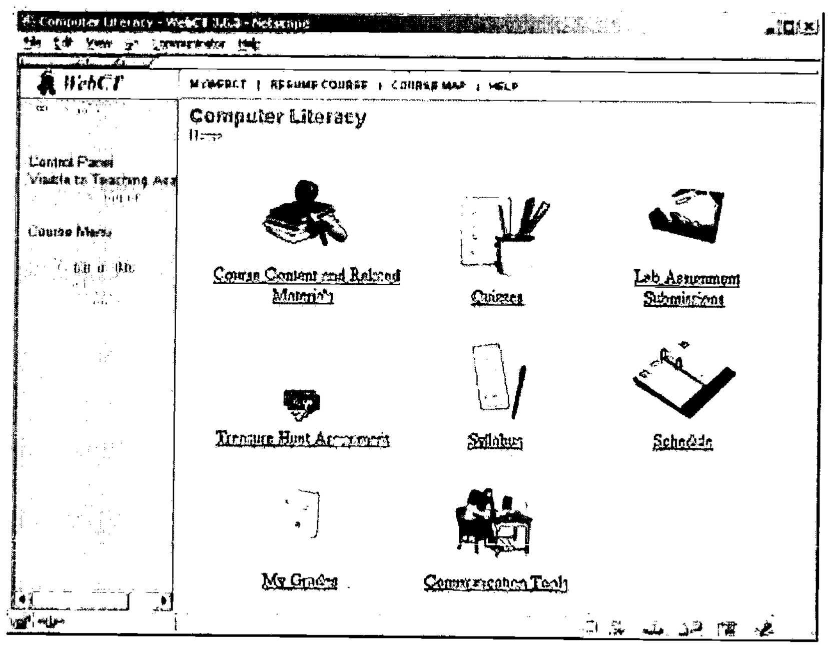
V. Course Content

Determining the course content was relatively easy because the Tennessee Board of Regents mandates topics. However, the authors did not want the course to be tied to any one particular textbook, so an extensive list of topics and subtopics was developed that should be covered in the course. This particular list was reviewed numerous times before a finalized version was decided upon. The decision was also made to present this list of topics to the students in short stand-alone modules.

VI. Online Course Delivery

The next decision that had to be made involved the course delivery method. The first two times the online course was offered, CourseInfo 4.0, an on-line course management system licensed by BlackBoard Corporation (BlackBoard) was used. For spring 2002, the course was switched to WebCt since the university no longer supports CourseInfo. Both course delivery systems were found to be excellent choices for course delivery. These course management systems allow an instructor to post materials including handouts, worksheets, presentation files and course information. They also provide easy on-line test generation,

email capabilities, discussion boards, collaboration tools, electronic submission of assignments, various levels of security, and grading management software. Other online course delivery systems include: WebCt, Learning Space, IntraLearn, eCollege and Webcourse in a Box. Comparisons among some of the best-known online delivery tools can be found at http://www.marshall.edu/it/cit/webct/compare/comparison.html. A screen shot of the beginning WebCt screen for the literacy course is displayed below.



VII. Online Course Specifics

The first decision in actually delivering the course was to determine how the students learn the "rules" of the course. It was decided to set up an introductory web page that instructed students to participate in a "treasure hunt". The purpose of the "treasure hunt" was two-fold: this activity provided a fun way to communicate the "rules" of the course and made sure that students learned how to use the course management system before the class actually began. The treasure hunt provided the student's first contact with the teacher and with the course delivery system. Cooper (2000) and Nguyen (2001) noted that an initial meeting

between faculty and students should be held to address technical issues. The treasure hunt was viewed as this initial "meeting." The treasure hunt exercise included a brief introduction concerning the use of the course delivery system and then listed numerous questions related to the class. The students were required to answer the questions and then electronically submit the answers to these questions. Students were given a deadline for the electronic submission and failure to meet the deadline could result in elimination from the class. Some of our treasure hunt questions follow.

- What is the deadline for taking Test 1? (Students are given deadlines but can take a test any time before the deadline date.)
- Where are the tests to be taken? (MTSU's Continuing Studies department has a test facility where students can schedule a test at their convenience.)
- Who do I contact to schedule a test? (Tests can be scheduled online or by telephone.)
- What happens if I miss a test? (the author's policy is to record a zero for that test since tests can be taken at any time. However, in certain situations, the authors have found it necessary to bend this policy.)

In the development phase of the course, it was realized that the specifics for the course should be very different from the normal lecture based class. Eighteen PowerPoint presentations were developed and online practice quizzes were provided over each presentation. Students could take these quizzes multiple times and the quizzes were automatically graded by the course delivery system to provide immediate feedback. Formosa (2001) indicates that the retention rate is 75% when students are required to practice what they have learned.

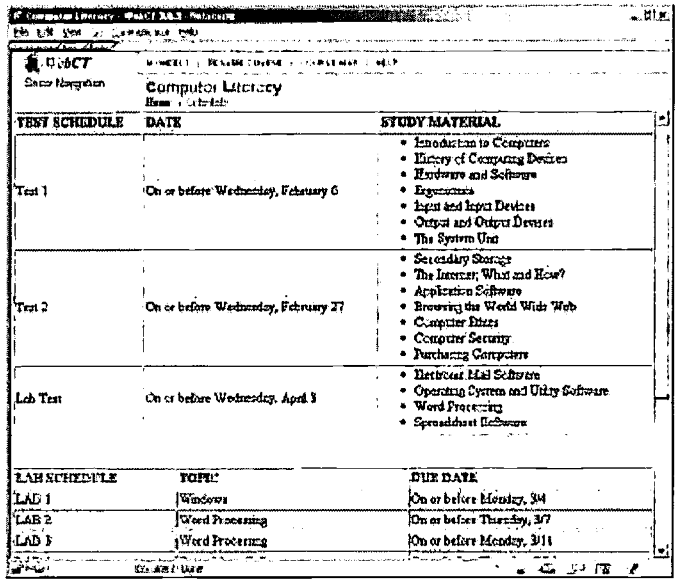
The PowerPoint slides included graphics and sound as well as note pages. Formosa (2001) indicates that various activities can improve the retention rate. For example, the retention rate when listening to a lecture is 5%. The retention rate increases to 20% when audio and video are incorporated into the teaching environment. Inclusion of various

multimedia was done because students learn in different ways. Some are visual learners, some are audio learners, and some are kinesthetic learners.

Adding short videos to the presentation was considered. However the bandwidth and storage capacity required would have been beyond the capacity of many of the literacy students. Also, according to Pullen (2000), "video offers low payoff as a medium for teaching technical subjects, because the important content is in the audio and graphics."

The online course included eight laboratory assignments covering the web, web page creation, word processing, electronic spreadsheets, and presentation software. Laboratory assignments were essential to increase confidence and skills in actually using the computer. Lab assignments helped kinesthetic learners by allowing them to practice what they had been studying. These lab assignments included step-by-step instructions to help the student to solve some task using the computer. The assignments were submitted electronically, were graded electronically, and then electronic mail was used to inform the student of his/her grade and to make comments on the student's lab. Labs were graded within one or two days of submission so students received prompt feedback.

An extensive schedule of events was made available to the student on the first day of class. Shown below is a screen shot of the schedule.



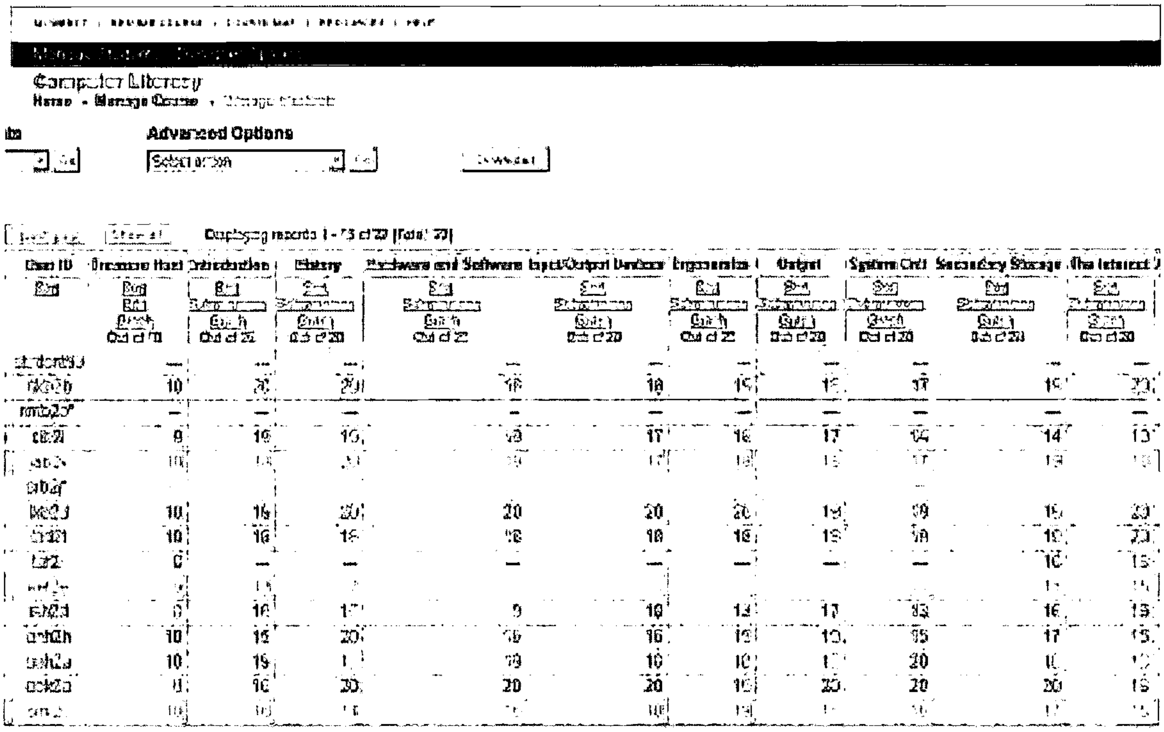
Computer Literacy

TEST SCHEDULE	DATE	STUDY MATERIAL
Test 1	On or before Wednesday, February 6	• Introduction to Computers • History of Computing Devices • Hardware and Software • Ergonomics • Input and Input Devices • Output and Output Devices • The System Unit
Test 2	On or before Wednesday, February 27	• Secondary Storage • The Internet; What and How? • Application Software • Browsing the World Wide Web • Computer Ethics • Computer Security • Purchasing Computers
Lab Test	On or before Wednesday, April 3	• Electronic Mail Software • Operating System and Utility Software • Word Processing • Spreadsheet Software

LAB SCHEDULE	TOPIC	DUE DATE
LAB 1	Windows	On or before Monday, 3/4
LAB 2	Word Processing	On or before Thursday, 3/7
LAB 3	Word Processing	On or before Monday, 3/11

The schedule included deadlines for all assignments and tests as well as material to be covered prior to each test. Students were made aware of the schedule during the treasure hunt activity and were asked several questions concerning deadlines and test taking to make sure they were aware of the "rules" of the course.

The course was set up to include three tests: two tests on computer concepts and one test on computer skills. The computer skills test required the student to submit assignments so that application competency in using various software packages could be measured. All tests were administered by MTSU's testing center and students were required to prove their identification before a test could be administered. All grades were recorded in the electronic grade book and the student could look at their grade book at any time to see grades made on labs, quizzes, and tests. A screen shot of the grade book from a teacher's perspective is shown below.



VIII. Joys and Sorrows of Online Computer Literacy

Development of course materials was a learning experience and was very time intensive. However, when the course actually started, there was a whole new set of learning experiences. The authors quickly found that an online course is definitely not for everyone. It was learned the hard way that students who enroll in the course should be highly disciplined and highly motivated to work on their own. As Carrasquel (1999) noted, many students tend to procrastinate and this does generate serious problems. In recognition of these problems, MTSU has developed a skills assessment quiz that a student can take prior to taking an online course to help the student determine whether taking an online course is a good idea for them. The skills assessment quiz can be found on MTSU's web site at http://www.mtsu.edu/~netcourse/onlineskills/take_quiz.htm.

To ensure the success of the students in the class, a list of criteria were developed that had to be met before enrollment approval would be granted. At MTSU, a student must 1) be admitted to the university and 2) complete a university "Permission to Register" form. This form was emailed to the course instructor. Upon receipt of the form, the instructor sends a reply notifying the student whether or not he/she will be allowed to register for the class. A set of guidelines was developed to indicate whether or not a student would be allowed to register for the online literacy course. Some of those guidelines are:

- Did the student have a good reason for enrolling in this particular course (other than "getting out of class")?
- Did the student have access to the Internet?
- Did the student have access to Microsoft Office (PowerPoint, Word, Excel)?
- Did the student have access to sound files through the Internet?
- Did they understand how to use email?
- They must read over and reply to questions regarding the mechanics of the course.

The authors were mistaken in thinking that an online course would not require much time to be spent with these off-campus students because, in general, computer literacy students in the traditional classroom require very little of an instructor's time outside of the classroom. It was soon learned (as others have noted, Doube (2000) and Dann (1998)) that off-campus students do demand much of the instructor's time, even after all the materials for the course have been developed. Many hours were spent per week answering technical questions and dealing with student excuses and problems. The first time the class was offered this was especially true for two reasons. First, the treasure hunt was not used to force a student to become aware of many of the course specifics. Secondly, the guidelines for enrollment into the course were revisited and students were required to read over and reply to questions regarding course mechanics before enrollment was approved.

Teaching online can be very rewarding. Though the instructor rarely meets the student in person, there can be a closer bond between the instructor and the student than in the traditional classroom. This is due to the many electronic correspondences between the student and instructor. It was found that many students feel more dependent upon the instructor in an online course than for a traditional classroom setting. Thus it is imperative that regular feedback is given and that the course materials are meticulously developed.

A questionnaire was developed to help evaluate the effectiveness of the course and the authors were very pleased with the results. There were no negative responses to the questionnaire and quite often students provided additional information that was not included on the questionnaire. Their responses indicated that many students had a good feeling of accomplishment and they were proud of the knowledge they had gained. More conscientious students made helpful suggestions for course improvement. It was most rewarding to read the student responses.

IX. Our Advice

The authors learned many things related to online teaching through the development and delivery of their first online course. Some of these lessons are listed below in the hopes that it will help others in incorporating distance learning for any course.

- Develop guidelines to determine whether a student should be enrolled in an online course.
- Determine a way to make the student think about whether he/she is disciplined enough and has enough time for an online course.
- Either require an orientation meeting or have some assignment like the treasure hunt that acquaints the student with technical issues, due dates, etc.
- Require weekly email contact with the students to promote motivation and prevent procrastination.
- Develop short (no more than 20 slides) online presentations covering topics that do not overlap. These should be developed to meet diverse learning needs and should at least contain graphics and audio as well as text.

- Develop online quizzes related to the online presentations to review the material presented and to provide prompt feedback.
- If using electronic submission of assignments, print the screen of the digital drop box to have a record of submission dates.
- Require students to do a drop box practice early so that they won't get frustrated and confused when an actual assignment is submitted.
- Organize information in the online delivery system efficiently. Use multiple folders that have good, descriptive titles so that the students can gain access to information easily.
- Answer questions and concerns promptly. Use a discussion board if possible because other students may have the same questions.
- Be prepared to spend many more hours than in a traditional classroom both in preparation time and in contact with students after the class starts.
- Develop an evaluation tool to be used to learn how to improve the course.
- Be prepared for a lot of work but overall an enjoyable experience.

X. Future Improvements

There is always room for making improvement in any course. In future offerings of the online literacy course, the authors would like to add components to the course to require students to develop a sense of community. This could be achieved by requiring participation in a virtual chat session concerning some computing issue and giving a grade based on participation. It could also be achieved by requiring a group project in which the group submits a paper on a recent topic in computing.

The evaluation instrument also needs improvement so that feedback can be obtained from all students who start the course (not just the ones who completed the course successfully). This would help to pinpoint course specifics that students found frustrating or difficult to master on their own. The evaluation instrument used so far has always been optional, so feedback was not received from all of the online students. In the future, the authors would like to make the evaluation a required experience in order to ensure that all of the students have the opportunity to speak their mind concerning the course and not just the most vocal ones.

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Understanding the Role of Self-Efficacy in Teachers' Purposes for Using the Internet with Students

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Abstract

Understanding teachers' purposes for having their students use the World Wide Web may help explain why the Internet has not currently reached its full potential as a learning tool in schools. This study explores the various types of purposes teachers have for using the Internet with their students and examines the role of teachers' confidence related to such use. Interview data analysis of 23 4-8th grade teachers who currently use the Internet reveal that they vary in the types of purposes they have for using the Internet as well as in the confidence they have related to that use. A teacher's confidence or a belief in one's ability to do something is commonly referred to in research literature as self-efficacy. The present study claims that a certain form of self-efficacy, Internet Teaching Efficacy, is associated with the purposes one has for use with their students. Specifically, while lower Internet Teaching Efficacy teachers reported statements regarding the use of the World Wide Web to promote lower level thinking skills and its basic use, higher Internet Teaching Efficacy teachers tended to incorporate broader purposes including autonomous learning and higher level thinking skills in their descriptions of purpose. Implications for the preparation of current and future teachers will be discussed in light of these results.

Keywords:

Self-Efficacy, Teacher Efficacy, Internet, World Wide Web, Beliefs, Technology, Educational Purposes.

Billions of dollars have been spent in recent years to assure that schools are connected to the vast resource of the World Wide Web (Ballard, 2000). This appears to be an important resource for students, as many researchers have noted its potential to challenge users to use higher levels of thinking and help prepare students for the Knowledge Age (Doherty, 1998; Maddux, 1998). According to one report, the number of computers in schools has increased over 15% each year during the last decade (Anderson & Ronkkvist, 1999). Whereas ten years ago the computer to student ratio was one to nineteen, a 1998 survey found the ratio to be one computer for every six students.

As part of the growing use of technologies, access to the Internet has recently become a resource rapidly being incorporated into schools. Recent national surveys suggest that 99% of American schools have some kind of access to the Internet (QED Report, 2000; FRSS, 1999). Researchers have characterized the nature of this inclusion of new technology, particularly the use of the Internet, as being more conducive to individualized, inquiry based learning (e.g. Love & McVey, 2000). However, the influx of computers in schools does not necessarily assure their appropriate use by teachers, students, or for that matter, any use at all. While the problems associated with the availability of computers connected to the Internet have decreased, other problems have begun to surface and many agree that the effect of technology on student learning have yet to be realized (Maddux,1998; Becker, 1999; Cuban, 2001).

Recent research has made it clear that, in order to understand the impact of technology on students, one must consider more than simply the ratio of students to computers. Researchers are now asking more specific questions about how and to what purposes technology is being used.

Since it is the teacher who controls most of the learning that goes on in classrooms, researchers have recently focused on how teachers implement the use of computers and the Internet. Unfortunately, such use by teachers' with students appears to be limited. While 99% of schools have access to the Internet, a recent study showed that only 13% of teachers had required students to use a browser in ten or more lessons during the year (Williams, 2000). Becker's (1999) national survey of teachers' use of the Internet found that 68% of teachers with Internet access have searched the web to find resources to help them with the planning and implementation of lessons. He found that far fewer teachers, however, encourage students' use of the Internet as part of their instruction. Less than half of the teachers who had Internet access in their classrooms had their students use the web as a research tool on at least three occasions during the year.

Further, when teachers actually use the Internet with their students, the purpose of such use does not always reflect broader educational goals. In fact, most research mirrors that of Cuban's in finding that the use of technology has been primarily for traditional purposes or in ways that focus on basic skills. He points out, that regardless of the abundant availability of computers, software, and professional development in schools, this has not led to frequent or extensive teacher use of technologies for tradition-altering classroom instruction (Cuban, 2001).

In light of this apparent underuse by teachers of the Internet, attention has turned to the education of teachers. It was thought that teachers who became more proficient in their knowledge of computers, would naturally increase their use of computers with students. Many schools and districts have chosen to focus inservice opportunities for their teachers on computer workshops. Still, problems persist with getting teachers, even those who are

prepared, to use technology consistently as part of the curriculum. Even when the teachers are prepared well, there still exists a lag in interactive computer use into classroom teaching.

METHODOLOGY

Purpose for Study

This study focuses on answering the following research questions: 1) What kind of educational purposes do teachers have for using the Internet with their students? 2) What is the nature of the association, if any, between teachers' confidence for using the Internet with students (Internet Teaching Efficacy) and their purposes for using the World Wide Web with their students?

Respondent Selection

Participants were selected using an established instrument for measuring one's Internet Teaching Efficacy (see Appendix A). The Personal Internet Efficacy Beliefs Scale (PITEBS) was developed by Koul & Rubba (1999), as described earlier, was chosen to measure each teacher's ITE for two reasons. First, it measures specifically the use of the Internet as a tool used in the classroom with students. This was important, since most other efficacy measurements assess confidence with teachers' ability to use the computer (irrespective of their belief in their ability to apply the skill or knowledge with students). Secondly, the PITEBS had been tested on at least one population with successful validity and reliability conclusions (Koul & Rubba, 1999).

Grade level taught was also important when selecting respondents. It was determined that only those that taught 4-8th grade would be included in the final selection. Finally, only those teachers that taught a minimum of two lessons using the Internet with students were considered.

Following these decision rules, 22 teachers were selected from local schools to be participants for the present study. The respondents represented five different grade levels and eight different schools. Teachers also represented a wide range of teaching experience. While one teacher only had two years of experience, the greatest amount of experience was 34. The total number of respondents averaged 14.1 years of teaching. Table 1 presents these participants by school, grade level, years taught, and ITE score. (Note: All teachers and school names are fictitious).

Table 1

Summary of Participants Selected for Study

Name	School	Grade	Year	ITE Score
		Higher ITE Teachers		
Mary	Adams	5	25	5.85
Jenny	Hoover	4	18	5.69
Karen	Hoover	6	15	5.69
Lynne	Hoover	5	2	5.23
Kris	Adams	5	18	5.15
Haley	Madison	6	4	5.00
Alice	Harding Jr. High	7/8	6	4.54
Marta	Pine	6	6	4.46
Sammy	Hoover	5	15	4.38
Cathy	Hoover	6	19	4.31
Colleen	Columbia Jr. High	7/8	7	4.00
		Lower ITE Teachers		
Michelle	Adams	4	9	4.00
Monica	Monroe Jr. High	7/8	10	3.92
Chris	Adams	5	8	3.85
Elizabeth	Columbia Jr. High	7/8	6	3.69
Candy	Kennedy	4	6	3.38
Susan	Hoover	4	10	3.31
Caroline	Pine	6	34	3.23
Myra	Columbia Jr. High	7/8	12	2.85
Jamie	Madison	4	27	2.81
Donna	Columbia Jr. High	7/8	25	2.54
Summer	McManus Middle	6	20	2.31

To assist in later analysis of the Respondents, their position in Table 1 was determined by the rank order of their ITE scores. Those teachers belonging to the lower half of the ranking are referred to as having "lower ITE" rather than low ITE. While those with scores below the median may represent scores that are low relative to this group, they may not represent an absolute low level of confidence. Interview data, however, did appear to support the notion that teachers who had mean scores less than 4.0 did not express confidence about their ability to teach when using the Internet. For example, Jamie, a 4th grade teacher, who had an ITE score of 2.81 suggested that she wasn't very confident and volunteered that her level of confidence was a 2 on a scale from 1-10. Therefore, for future analysis, teachers will be labeled as "lower ITE" or "higher ITE" teachers.

Interview Coding Procedure

An established coding procedure developed by Copeland & Caston (1994,1998) was used to categorize purpose statements as "broad" or "narrow" (Appendix C). Narrow purposes included concern with Pupil Comportment, Pupil Participation, Follow Directions, and Lower Cognitive Thinking. Broad purposes included a concern for Higher Cognitive Thinking, Affective Thought, and Autonomous Learning. The focus of the present study is primarily on understanding differences displayed among respondents regarding their ratio of broad purpose statements to the narrow purpose statements among teachers.

RESULTS

Teachers' General Use of the Web with Students

The 22 participants selected for the study provided a range of ITE scores and purposes for using the Internet. While respondents differed in the purposes they had for the use of the Internet, all of their descriptions of use are based on students gaining access to web

sites containing information and then dealing with that information. All participants also mentioned using the Internet as an extension of the traditional curriculum of their classroom. Liz's description in the following paragraph is a typical example of this type of use. She described the former use of the library with books recently expanding to include the use of new technologies.

> "It's probably one of the few places I could figure out where to stick the Internet in my curriculum where it made sense. It makes sense as we're using it as a source of information. It makes sense that we're in the library anyway, the computers are there, the books are there, even if they're not enough computers that day the kids can go to books." (Liz, p. 2).

Most Respondents reported this type of integration of the Internet with ongoing curriculum because they lack the time to cover the quantity of material they must cover. Cathy echoed the statements of several other teachers when she reported that, because of the time pressures, one <u>must</u> integrate it with the other curriculum (Cathy, Interview #1, p. 4).

Even though participants viewed the Internet as a source of information similar to that of books or newspapers, they also mentioned several benefits to using the Internet with their students. More specifically, the Internet provided information that was 1) more in amount of information 2) more easily accessible 3) important for future schooling and jobs, and 4) helpful in enhancing motivation

Modifying sub-categories of purpose statements

Though similarities regarding the general use of the Internet were found through the respondents' statements, a more focused analysis revealed a considerable variation in expressions of educational purpose. Before detailing these differences, the original categories based on Copeland & D'Emidio-Caston's (1998) study was modified to fit the present study's data. The original coding procedure was based on statements made by

teachers after observing a reading lesson. The current Respondent's descriptions of their own teaching using the Internet appear to have elicited additional and distinct purposes unrelated to the existing categories. Examples of the data in the present study resulted in the addition of one sub-category to accommodate responses that dealt specifically with the use of the Internet. That sub-category was labeled "Following Directions".

While some teachers had broad goals that allowed students to learn on their own (autonomous learning #9), others mentioned a narrow purpose which included the notion that students should only be allowed access to very specific sites and information that the teacher thought was valuable. This was labeled as sub-category "Following Directions". It included a concern regarding students' tendency to get lost or to stray from sites and information the teacher wanted them to examine. This sub-category is classified as "narrow" since it represents a teacher's concern for students to focus on specific teacher-controlled information (Appendix C). This was thought to be distinct from the existing "pupil comportment" sub-category since the focus was not so much on physical as on cognitive behavior.

A clear example of a teacher having a purpose statement categorized as "following directions" was Monica. When responding to what was important for students to get out the lesson, she mentioned, "a big part of it is following directions. They're given specific rubrics and told that they need to do exactly what is asked of them" (Monica, p. 1). Another example of a teacher's concern with a student following directions was when Karen described the purposes for her lesson:"...and when I give them assignments, it is a line by line assignment telling them exactly where to go and what they should be getting out of it." (Karen, p. 3)

Teachers' Specific Purposes Regarding the Use of the Internet with Students

Now that the general trends about teachers' use have been reviewed and the purpose statement sub-categories refined, one can examine in greater detail the purposes these Respondents' possessed. The analysis of data from the first interview revealed a total of 202 purpose statements related to student learning produced by the twenty-two teachers. The smallest number of statements for any teacher was six while the largest was 13. The Respondents averaged nearly 11 purpose statements per teacher. Table 2 provides a summary of these data.

Table 2
Respondents' ITE Scores, Number of Purpose Statements by Type, and Resulting Broadness Scores

Respondent Name	ITE Score	Purpose Statements: Narrow 1	2	3	4	Total	Purpose Statements: Broad 5	6	7	Total	Broadness Score
Higher ITE Teachers											
Mary	5.85	0	0	0	3	3	2	1	0	3	.50
Jenny	5.69	0	0	0	4	4	2	1	0	3	.43
Karen	5.69	0	2	2	2	6	2	3	2	7	.46
Lynne	5.23	0	0	0	3	3	1	4	1	6	.67
Kris	5.15	0	1	0	2	3	4	2	0	6	.67
Haley	5.00	0	1	0	4	5	1	3	0	4	.44
Alice	4.54	1	0	1	3	5	3	0	1	4	.44
Marta	4.46	0	2	0	2	4	2	1	1	4	.44
Sammy	4.38	0	0	0	3	3	2	3	2	7	.70
Cathy	4.31	0	0	0	3	3	2	4	1	7	.70
Colleen	4.00	0	0	0	6	6	1	2	1	4	.40
Lower ITE Teachers											
Michelle	4.00	0	1	0	3	4	0	2	0	2	.33
Monica	3.92	0	1	3	1	5	3	1	0	4	.40
Chris	3.85	0	0	1	7	8	0	2	0	2	.20
Elizabeth	3.69	0	1	0	7	8	2	1	0	3	.30
Candy	3.38	1	0	1	4	6	2	0	1	3	.33
Susan	3.31	0	0	1	6	7	0	1	0	1	.13
Caroline	3.23	0	2	1	5	8	2	0	0	2	.20
Myra	2.85	1	0	1	3	5	1	0	0	1	.17
Jamie	2.81	0	3	0	5	8	0	3	0	3	.27
Donna	2.54	0	0	1	7	8	1	1	0	2	.20
Summer	2.31	0	2	1	5	8	1	1	0	2	.20

1 = Pupil comportment; 2 = Pupil Participation 3 = Following Directions 4 = Lower Cognitive Thinking
5 = Higher Level Thinking 6 = Affective Thought 7 = Autonomous Learning

Examples of Purpose Statements

It was clear that teachers had different purposes for why they wanted students to use the Internet. Many of them were direct statements regarding purposes and coded with the newly modified categories. These direct statements of purpose tended to come in response to the interview question, "What were some of your purposes for this lesson?" Figure 1 presents two broad and two narrow examples of such direct purpose statements.

Examples of Direct Broad Purposes

"I just think they need to be critical thinkers. They need to be people who can gather information but can process it into something new." –Colleen, p. 3

"...you give them instruction about how to judge what information they're looking up. How to search..how to judge the material and how to organize it and how to use it." –Mary, p. 3

Examples of Direct Narrow Purposes

"Just being able to access the Internet which most of my students don't have that opportunity in their own home." –Michelle, p. 4

"To gather information about aspects of the culture" --Jamie, p. 5

Figure 1. **Examples of Broad and Narrow Purposes**

Use of Additional Indicators

The interview used additional questions to ask about the lesson other than direct questions about purpose. Recall that the analysis of the present study's sample was modeled after Copeland & D'Emidio-Caston's (1998). In it, they interpreted participants' direct statements as well as indirect indicators regarding purposes by using a specific coding procedure (see Appendix D). According to the authors of that study, this approach of considering indirect indicators was valuable in that it reduced the chance that participants would parrot the answer they thought the researchers wanted to hear or what they assumed be the "right" purposes.

The present study was designed so that many questions and probes were used to gather additional information regarding indirect Indicators. These indirect Indicators used by Copeland and D'Emidio-Caston (1998) defined expressions into categories labeled Guiding Principles, Practical Generalizations, Suggested Changes, Theory Links, Value Judgments, and Action Links. Once an expression in a Respondent is identified as being one of these indicators, it can be classified as representing one of the types of educational purposes described above. Of the 202 purpose statements that were identified in the interviews, 114 were identified as being direct statements of purpose. The remaining 88 were identified as being indirect purpose statements associated with these 6 indicators.

Teachers' Purpose Statements. All 202 student-oriented purpose statements (direct and indirect) were coded using the sub-categories found in Appendix C. Recall that there are two major types of purpose statements: narrow and broad. Table 2 also presents the notion of purpose statements made by each Respondent, classified as belonging to each sub-category and whether that category is broad or narrow.

Correlation between ITE and Purposes.

First, a scatterplot (see Figure 4) was created to visually examine the association between each Respondent's ITE and Broadness scores that were presented in Table 2. It appeared from the scatterplot, that in general, there tended to be a relationship between the confidence participants expressed in using the Internet and their purposes for using it. More specifically, as Respondent's grew in confidence with Internet use, they tended to include a broader percentage of broad purposes related to total number of purposes. There also appears to be greater variation among scores as the ITE and broadness scores increase. As

predicted by examining the scatter-plot, a correlation between these two sets of scores was calculated using SPSS to be significant at the .01 level (r=.817).

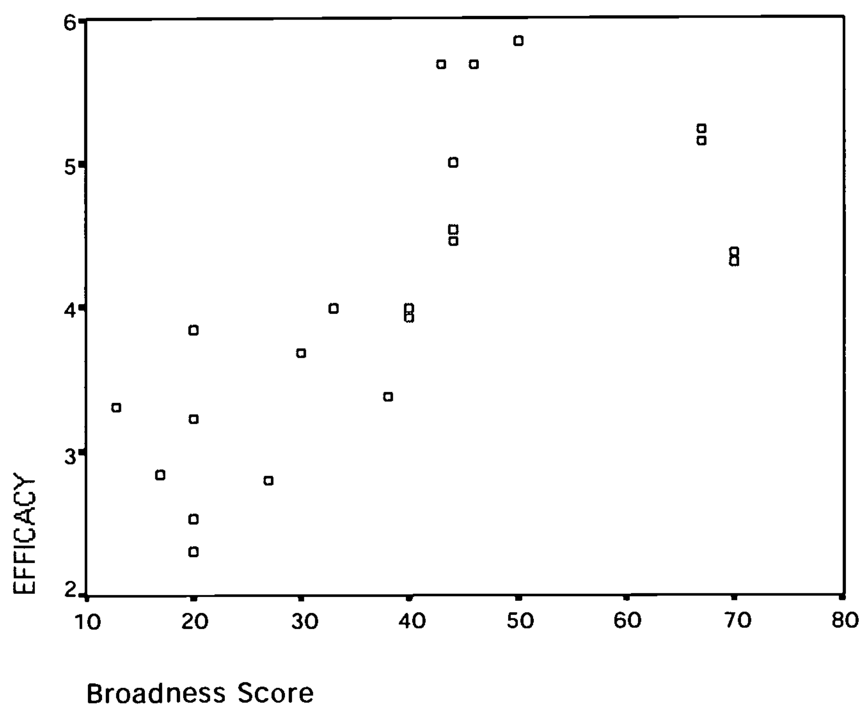

Figure 4. Scatter plot of Participants' Efficacy Scores and Broadness Scores

While a significant correlation between ITE and purposes is an important finding, one can examine in more detail the nature of such an association. In order to accomplish this, the participants were separated into two groups by rank order according to their Broadness Score and dividing them at the median. The two groups were then compared with regards to the number of purpose statements for each. This helped reveal where the greatest discrepancies in categories existed. Figure 2 depicts the difference between higher and lower ITE teachers for the narrow purpose sub-categories. Notice that in each of the narrow purpose sub-categories, there were a greater number of statements provided by teachers with lower ITE than the higher ITE group. The largest difference was evidenced by the sub-category

"Following Directions". While ten statements were made by those teachers with higher ITE (n=8), only 3 were made by those with higher ITE (n=2). (Note: The number of participants making such statements is represented here in the parentheses so that the reader can know not only the number of statements by all participants in a group, but how many participants in that group made such statements. Recall that each group contained 11 Respondents. A concern for lower level thinking was the most common sub-category mentioned and was also substantially different as 53 statements were produced by lower ITE teachers (n=11) while 35 statements came from the higher ITE group (n=11)

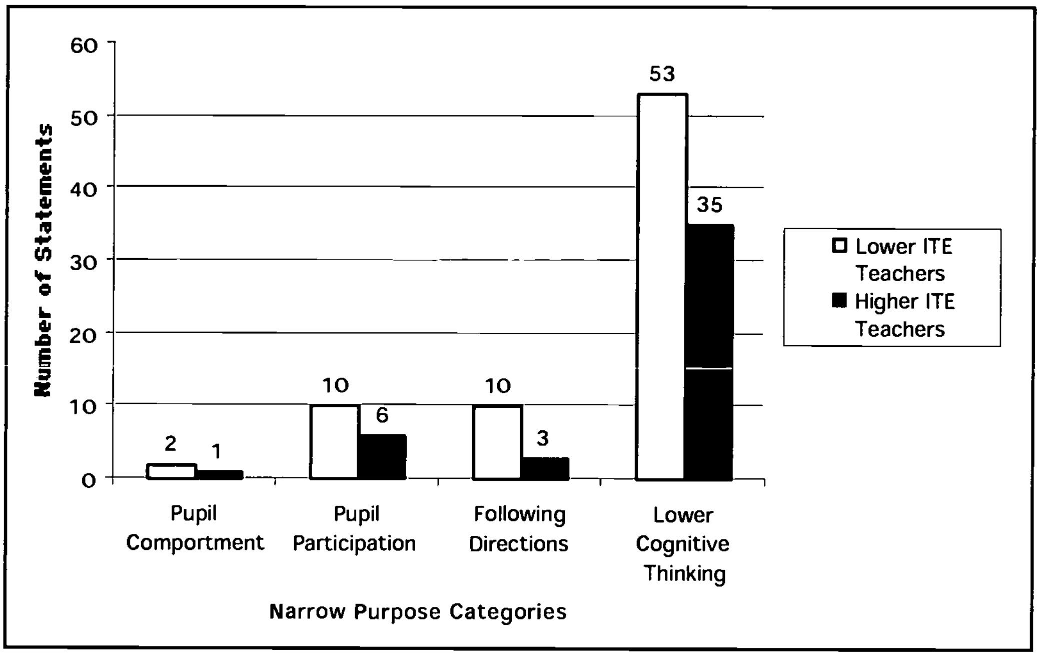

Figure 2. **Narrow Purpose Statements of High and Low ITE Teachers**

In contrast to the previous figure, Figure 3 summarizes the number of statements mentioned by each group for each broad purpose sub-category. Notice that for each broad sub-category, there are more statements provided by the higher ITE teachers than the lower ITE teachers. Specifically, while twelve statements were made regarding the use of higher

levels of thinking by lower ITE participants (n=7), the higher ITE Respondents mentioned a total of twenty-two statements (n=11). Data also revealed that autonomous learning was mentioned only once (n=1) by a lower ITE Respondent whereas the higher ITE teachers mentioned it a total of nine times (n=7). Finally, there was twice as many statements regarding students' affective thought by the higher ITE teachers (24, n=11) as compared to twelve produced by lower ITE teachers (n=8).

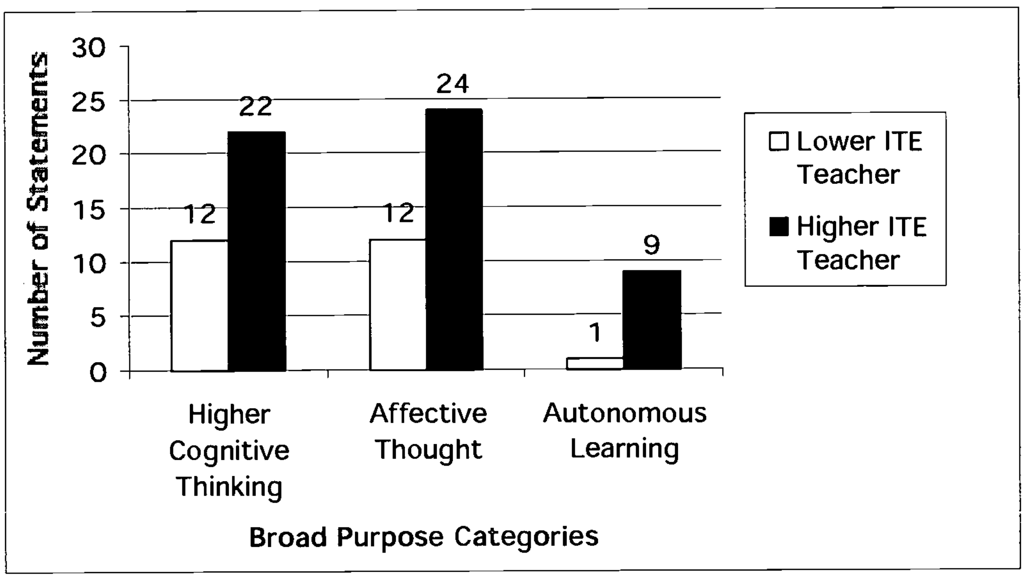

Figure 3. Number of Broad Purpose Statements of High and Low ITE Teachers

Examining Differences Between Groups Among Contrasting Purposes

In addition to examining differences among each separate sub-category, one can examine contrasting sub-categories more closely in order to appreciate the diversity of purposes among groups. It was determined that overall, there were three areas of contrast: use of Cognitive Level of Thinking, Teacher Control, and Affective Concern. Each of these areas included a broad purpose and a narrow purpose sub-category.

Cognitive Level of Thinking. As mentioned previously, all of the teachers participating in the present study used web sites as a source of information for students to access. The purposes for using the Internet and dealing with information, however, differed dramatically when examining statements between groups. While over 90% of all teachers involved with the study included lower cognitive skills in their descriptions of lessons, it was the broad purposes when compared to the percentage of the total purpose statements that differences can be more clearly recognized. Figure 4 demonstrates that not only did lower ITE Respondents report a larger amount of narrow purpose statements, but that they only mention approximately half of the number of statements related to broad purposes when compared to higher ITE teachers. Specifically, all Respondent's mentioned at least one statement related to Low Cognitive Thinking with lower ITE teachers reporting 53 statements (n=11) and higher ITE participants revealing 35 statements (n=11). There were 12 statements involving High Cognitive Thinking by lower ITE Respondents (n=7) and 22 statements provided by higher ITE teachers (n=11).

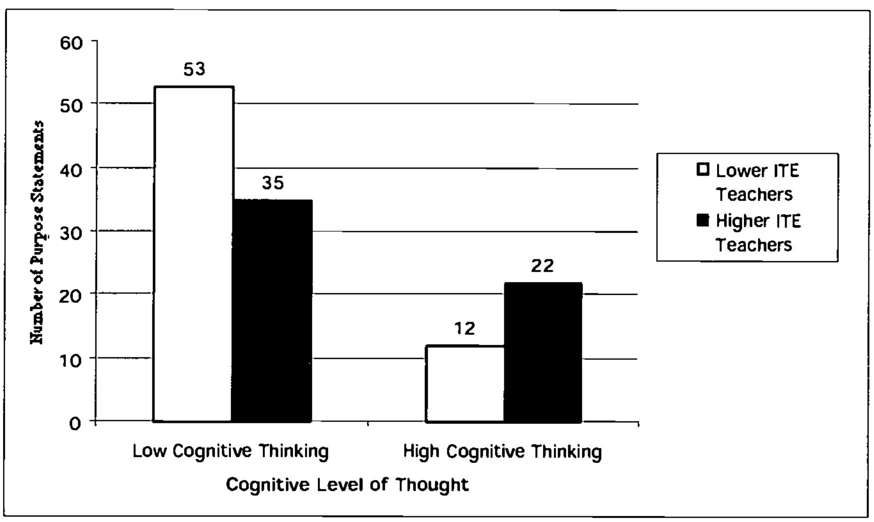

Figure 4. **Differences of Lower and Higher ITE Respondents for Cognitive Thinking**

Among participants' reflections about Low Cognitive Thinking were statements related to the students' use of the World Wide Web to access information. These descriptions mainly focused on students' ability to operate the basic functions of the web (i.e. open a browser, navigate the web, access information that has been book-marked or saved as favorites). Since the basic use of the Internet typically involves the use of lower cognitive skills, this sub-category was placed under the "narrow" purpose domain of Lower Cognitive Thinking. Examples of statements regarding the use of the World Wide Web as a tool as categorized as a narrow purpose are listed in Figure 5.

"One would be that actually they're on computers and they're learning how to use the Internet, navigating through." (Haley, p. 1).

"How to access the Internet and get around a site." (Cathy, p. 2)

"One was getting them to practice exporting or importing pictures." (Lynne, p. 1)

Figure 5. **Examples of Basic Use of Learning Tool**

While higher ITE participants included students' basic use of the web, they also typically reported the importance of using the Internet to support higher level thinking. Many times they mentioned the importance for students to understand "how" to search by using appropriate terms or selecting which information would fit a particular topic. Additionally, the notion of information literacy was included in the purpose statements of several higher ITE Respondents. Consider Karen's description of using the Internet as a source of information. This sixth grade teacher wanted to make sure that her students were able to discriminate the information that they were inquiring about.

> "there is a whole discussion about what is out there and why will you read something one way and you might read another fact over here. Again...history, if you are doing something on Rome and the web site says this is what happened and another one says this is what happened...who is right? Why are they different? And that's why I like teaching 6th grade

> because you can really discuss something like that and talk about how people misinterpret information and perpetrate them on these web sites. I think that's a really important thing for kids at my grade level to get out of the Internet."

In contrast a lower ITE teacher named Donna could not envision her students learning how to decide what information is of value. Instead, she believed she should have to take that role for them. She mentioned that "... hopefully either Linda (lab consultant) or I have had a chance to look at it and go 'well that's not really what you want or this is written for scientist we need to find something written for students'". Later Donna described more specifically why she routinely bookmarks all of the sites the students have access to in order to only let them only use the "good" ones. Figure 6 highlights two more descriptions of using the Internet to support broad purposes.

"I think that it's important for them to show the difference between primary and secondary sources, maybe to be able to tell the difference between one that is really factual and another that is just Mr. Kingsley's 5th grade social studies class." (Monica, p. 3).

"Because they may get to somebody's web site and they're just kids like they are putting stuff that they think they know but they don't really know. So they (students) have to know who are their sources and where is it coming from. And once they've learned that information then they can decide okay this is something I want to teach my students, the other fellow students, or not." (Alice, p. 2)

Figure 6. **Examples of Use of Learning Tool for Higher-Order Thinking**

There are several examples of teachers using both higher and lower cognitive purposes in the same lesson. Sammy, a higher ITE teacher in 5th grade, described the purposes for her lesson as having students answer different types of questions based on the information they find. Some were comprehension questions such as "where was Martin Luther King's 'I Have a Dream Speech' and how many people in attendance?" (narrow) while others were based on inferencing skills such as 'How would you feel if you had been

there and what was the outcome of the speech?' In contrast to this, many of the lower efficacy teachers did not incorporate the use of these broad purposes.

Teachers with lower ITE may have recognized the need for higher cognitive purposes, but appeared to be limited in their ability to implement them. Colleen addresses this type of cognitive dissonance resulting from a workshop that she attended.

> "...and I don't feel like I use it enough or even in ways that could necessarily be the best. I think the Bernie Dodge workshop was a good one for me to realize that they should be doing more sophisticated tasks than just gathering facts. I think I've used the Internet mainly to gather facts like they would out of a book. Instead of gathering facts to come to a new conclusion or to make a project or something like this."

Control: Student vs. Teacher. The issue of control revealed distinctive differences when considering responses to the contrasting sub-categories of "Following Directions" and "Autonomous Learning". Figure 7 clearly displays the descriptive distinctions between them. While higher ITE teachers included only 3 "Following Direction" statements (n=2), they mentioned 9 statements related to autonomous learning (n=7). In contrast to that, lower ITE Respondents mentioned 10 following direction statements (n= 8) and only one related to autonomous learning (n=1). These teachers with lower ITE described the desire to control the information they wanted students to access. They did this when only providing one bookmark to examine and restricting students' ability to explore on their own. They also limited the way in which students interacted with the information by having them respond to specific information in specific ways. (i.e. treasure hunt). Higher ITE teachers mention the willingness to turn the control at least partially to students when they say things like, ""So basically I've gone from..."OK here is one site...you fill in a worksheet" to "OK...here is a site that has all of these connections...research it." (Kris, p. 4)

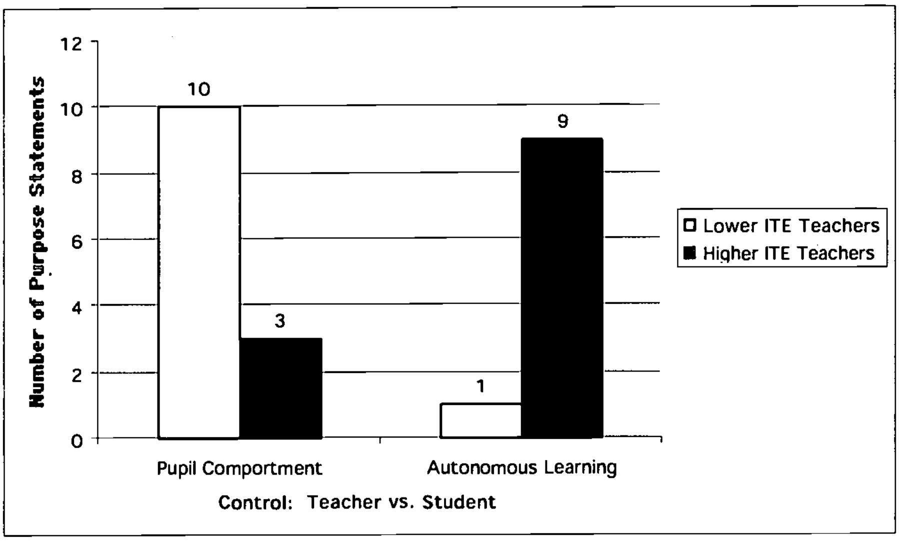

Figure 7. **Differences of Lower and Higher ITE Respondents Regarding Control**

Many of the higher ITE teachers mentioned the need to have a balanced approach. They generally provided their students with some initial structure, and then eventually moved into giving more autonomy over time. Cathy described this process as taking place over the course of the year.

> "So, at the beginning of the year, we are just saying, 'type in this URL, here are the questions'. And we try to get a little bit more open ended as the year goes on. So that they are to try to problem solve, "what kind of search engine should I use, What should I type in, as to what would access this information. Woah, I've got a thousand sites, how can I narrow that down. So we are trying to get them as independent as we can." (Cathy, p. 5)

Concern about Students. Finally the sub-categories involving Affective concerns and those that are not focused on Affective concerns (such as pupil comportment) can be compared and used for further understanding. Figure 8 displays the difference between participants with lower ITE and higher ITE. In the case of affective concerns, there were twice as many statements given by the higher ITE teachers than the low. There were also twice as many statements among lower ITE teachers regarding a focus on students behaving

themselves when compared to higher ITE teachers (although it was only a difference of 2 to 1).

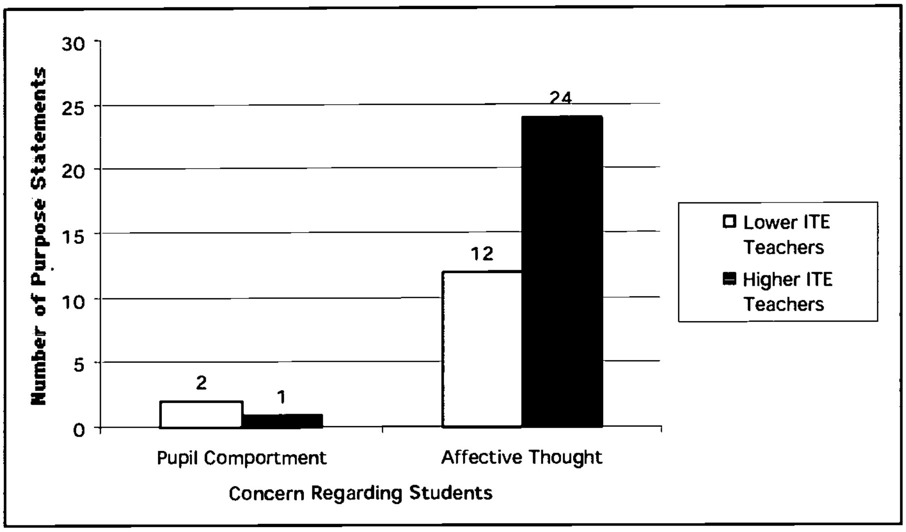

Figure 8. **Differences of Lower and Higher ITE Respondents in Concern for Students**

DISCUSSION

Understanding the relationship that exists between teachers' Internet Teaching Efficacy and thier purposes for using the Internet with their students makes several contributions to both the theoretical underpinnings of the current research base, as well as to practical implications involving inservice and preservice teaching programs. Consideration of the purposes teachers have for the use of the Internet is important not only to realizing the potential of schools' investment related to technology, but to realizing the potential this technology has for helping prepare students to become literate in the Knowledge Age.

The Cost and Potential

Considering the cost of having Internet-compatible computers suggests that their use should be greater than for drill and practice. Billions of dollars are being spent to ensure that computers and Internet access become more and more available to students. According to

one report, $5.4 billion was spent on computers and related infrastructure in 1999 (Ballard, 2000). The federal government estimates another $5-10 billion per year as the cost for maintaining and improving those infrastructures.

Other than considering the cost involved with such a resource, many agree that teachers should employ methods to increase the use of technology as a tool to support higher order thinking skills with their students. Some researchers suggest that teachers should use Bloom's taxonomy as a template for writing questions to ensure that diversity of questions and critical thinking are involved (e.g. Callison, 1998; Gilbert, 1992). Several studies specifically state the importance of higher level thinking as a necessity for survival in a rapidly changing world (Lee & Dinkins, 1998; Paul et. al., 1990). These studies support the notion of including higher level or broad purposes among the existing low/ narrow purposes of teachers: although they do not generally state to what degree they should be employed. The present findings suggest the possibility that modifying teachers Internet Teaching Efficacy may enable teachers to more carefully consider and adopt higher educational purposes for their students Internet use.

Teacher Education Issues

It is important to determine whether one should specifically consider addressing self-efficacy in the preparation of teachers. If the purpose for using technology by teachers differs not just on effectiveness of skill but of efficacy, then one would assume that, along with proficiency workshops, support for specifically increasing one's computer or Internet efficacy might be necessary. An understanding of the sources contributing to the efficacy of Internet use among teachers and their students may be even more helpful. For example, knowing that vicarious experience (modeling) is the most common way teachers increase

their self-efficacy, one could focus on providing good examples of teachers using technology in order to increase their self-efficacy. Some recent studies have undertaken this type of examination of sources of influence related to efficacy. For example, Zeldin & Pajares (2000) used semi-structured interviews to help understand the efficacy sources of women in mathematical and science-related careers. They asked specifically about each source of efficacy information and determined that verbal persuasion (feedback) and vicarious experience (modeling) were the most influential sources. Future research needs to be done related to such sources of efficacy for using the Internet with students.

Program Implications

Teacher education programs may need to consider that providing a strong knowledge base of content and pedagogy may not be sufficient to help teachers grow and succeed as professionals. Many researchers suggest that teacher education programs should be revised to incorporate this notion of explicitly acknowledging the beliefs teachers bring with them to a program (Ashton & Webb, 1986; Hollingsworth, 1989; Ross, 1995). Although not aiming explicitly at developing a teacher education program intervention, the results of this study expands our understanding of the importance of the role teachers' beliefs, specifically the purposes teachers have for using the Internet with students. It is hoped that this new knowledge will help programs appreciate the need for a focus on providing not just skill but opportunities to enhance one's efficacy.

Contribution to Existing Research

While a large number of studies address teacher efficacy and use of technology generically, the majority of the literature does not address self-efficacy as a construct specifically related to the use of the Internet or consideration of the context in which the

technology is being used. This study will add to the research related to self-efficacy by focusing on a specific type of self-efficacy and under a specific and similar context.

The Internet has changed the way people interact with information. No longer is text presented linearly and limited to the physical resources available at a particular place. Students now have access to a plethora of information from all over the world, from different sources, and with the freedom to explore topics based on their interest. The cost of this resource and its potential are tremendous. In trying to understand how learning in schools can better match the requirements associated with those expected of students in the Knowledge Age, it is necessary to begin an exploration into teachers' purposes for using the Internet and identifying the context associated with such use. At a time when standardized testing controls much of what goes on in the classroom, understanding teachers' use of the Internet for higher levels of purpose seems paradoxical, yet intriguing. The present study suggests that by using the framework of self-efficacy theory, the purpose and role for the Internet in the classroom can be better understood. Only then, will teacher preparation programs, inservice developers, policy makers, and administrators be prepared to make better decisions to help teachers with their use.

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Appendix A. Personal Internet Teaching Efficacy Beliefs Scale

Answer on a scale from Strongly Disagree to Strongly Agree.	**Strongly disagree**	**Moderately disagree**	**Disagree slightly more than agree**	**Agree slightly more than disagree**	**Moderately agree**	**Strongly agree**
I am continually finding better ways to teach with the Internet.	O	O	O	O	O	O
Even when I try very hard, I do not teach as well using the Internet as I teach in other ways.	O	O	O	O	O	O
I know how to teach effectively using the Internet	O	O	O	O	O	O
I am not very effective in monitoring activities that involve using the Internet	O	O	O	O	O	O
I generally teach ineffectively when using the Internet.	O	O	O	O	O	O
I understand how to use the Internet well enough to be effective in teaching with it.	O	O	O	O	O	O
I find it difficult to explain to students how the Internet works.	O	O	O	O	O	O
I am typically unable to answer students' Internet questions.	O	O	O	O	O	O
I wonder if I have the necessary skill to teach using the Internet.	O	O	O	O	O	O
Given a choice, I would not invite the principal to evaluate my teaching when I use the Internet in a lesson.	O	O	O	O	O	O
When teaching using the Internet, I usually welcome student questions.	O	O	O	O	O	O
I don't know what to do to turn students on to using the Internet.	O	O	O	O	O	O
When a student has difficulty understanding how to use the Internet, I am usually at a loss as to how to help the student understand it better.	O	O	O	O	O	O

Appendix B. Interview Questions

I. Background Information (warm-up)
A) How many years have you been teaching?
B) How long have you been at the current site?
C) What grade do you currently teach?

II. Questions regarding conditions that promote/restrict usage/efficacy
A. Access and quality of use to the Internet
1) How many computers that have the Internet do your students have access to? How often do you have access to it?
2) What do you consider as support or a hindrance to your access in using the Internet with students?
3) What is the speed of the Internet connection at the school?

B. Level of support
1) How would you characterize the degree of support from other teachers at your school regarding the use of the Internet?
2) How would you describe the degree of support from the principal?
3) Do you have any other form of support as a teacher to using the Internet?
4) Do you have access to professional development regarding the use of computers/internet?
5) Do you take advantage of those opportunities?

C. Personal factors
1) How long have you been teaching using the Internet?
2) Why do you consider the use of the Internet with students important?
3) How confident are you about your ability to teach using the Internet with your students?
4) What do you think has been the biggest contributor to your level of confidence or lack of confidence when using the Internet with students?

III. Questions regarding the purpose for using the Internet
A. Lesson description
1) Thinking over your last Internet lesson with your students, can you describe that for me?
2) What made you decide to use the Internet with your students for this particular lesson?
3) What was the reason you wanted to have that type of lesson?

B. Direct questions regarding purpose
1) What were your main purposes for the students in that lesson?
2) Were there any other goals that you did not mention?
3) Was that typical of the other lessons you taught (or ask about another lesson)?
4) Why do you feel these goals are important to you or your students?
5) How successful do you feel about having reached these goals?
6) How would you change the purposes for this lesson if you were to do it again?

Appendix C. Categories of Purpose Statements

I. Pupil-Oriented Purposes

Narrower Purposes - Those Related to Pupil Behavior and Lower Cognitive Thought

Sub-Category 1. Pupil Comportment
Concern for how students are "behaving themselves" in the classroom. Includes such things as off-task behavior, paying attention, fidgeting, moving about without permission and sitting quietly.

Sub-Category 2. Pupil Participation in the Lesson
Concern for the manner and patterns of student involvement in the publicly experienced classroom conversation. Includes patterns of obtaining opportunities to speak, factors that encourage or inhibit involvement and patterns of involvement which are apparently governed by factors such as gender, race or physical location.

**Sub-Category 3. Following Directions*
Concern for how well students can follow specific directions given for a certain task. Includes such things as not letting students search on their own or go off on uncharted areas of the web. Their concern is that students will get lost or access inappropriate material.

Sub-Category4. Lower-level Cognitive Thought
Concern with students' cognitive thought typified by simple recall of information, work with information that is readily at hand, and the changing of the form of information without changing its meaning (the lowest two levels of Bloom's Cognitive Taxonomy). Includes such thoughtful actions as locating specific information in a book, learning specific information, and reading from and comprehending text.

Broader Purposes - Those related to the Development of Independent, Creative and Self-Regulated Learners

Sub-Category 5. Higher-Level Cognitive Thought
Concern with students' cognitive thought typified by more complex manipulation and use of information (the higher levels of Bloom's Cognitive Taxonomy). Includes determining whether a particular piece of information supports a particular statement, analysis of information into its component parts, creation of new ideas such as hypotheses, and evaluation of the truth or falsity of ideas.

Sub-Category 6. Affective Thought
Concern with students' thought related to attitudes and values, whether found currently in students or the purpose of educational activities. Affective thought may be expressed in relation to either of two types of concerns.

Pupil Affective Dispositions. A concern with the agency of the individual student, i.e., is he or she willing to engage in the learning activity? This is a volitional

concern at the individual level. Includes such behaviors as enjoying or taking pride in participation and being excited about learning.

Conditions that Reflect or Even Promote Affective Thought. A concern with the affective condition of a student or students. This may effect the larger environment in which students work and its promotion of affective thought. Includes the teacher's assumption of a supportive attitude, a comfortable rapport between the teacher and students and students feeling reassured that participation will be accepted.

Sub-Category 7. Development of Learner Autonomy.
A concern with the development of student's ability and inclination to proceed independently in a learning task. Includes appropriate self-concept (self-esteem), self-monitoring skills and a feeling of efficacy (self-empowerment).

Other Pupil -Oriented Purposes

Sub-Category 8. Other
Student behaviors that do not fit into the above six categories.

II. Teacher Oriented Purposes

Sub-Category 9. Teacher Behavior
Any reference that focuses on the behavior of the teacher.

Categories of Purpose Statements: from Copeland & D'Emidio-Caston (1998)

CHALLENGES IN IMPLEMENTING TECHNOLOGY-RICH CURRICULAR HIGH SCHOOL BIOLOGY MATERIALS: FIRST YEAR FINDINGS FROM THE *EXPLORING LIFE* PROJECT

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Eighteen high school biology teachers from a stratified sample of thirteen distinct geographical United States regions participated in evaluation of the first year prototypes of Exploring Life, a biology program that includes a textbook with an accompanying Internet component and wet-lab investigations. Web activities explain and reinforce the text and promote active, hands-on learning.

The major questions we sought to answer through our study were,

- How ready are biology teachers who are early adopters of technology to employ a curriculum that requires students to use computers on a regular or even daily basis?
- What motivation, additional education, hardware, or skills do teachers require in order to integrate almost daily computer use into the curriculum?
- Do high schools have the adequate technology facilities to implement a curricular program that incorporates students using computers on an almost daily basis?
- How might existing schools change to support a technology-based curricular program?

Key words: Technology integration, technology readiness, Internet curriculum, general biology, facilities for technology, teaching skills, educational technology, inquiry, computer uses in education

Introduction

In typical technology champion style, early adopters prophesied a few years back that the best was yet to come for teaching and learning using technology (Jacobsen, 1998;

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Norman, 1997). Unfortunately, the extent to which technology has effected radical change in teaching and learning falls a bit short of the prophecy.

Data from the Digest of Educational Statistics (1998) and the *State-of-the-States survey* (Technical Horizons in Education, 2001) suggests that many schools have advanced beyond the first level of adopting technology: purchasing hardware and software, preparing school facilities, and wiring schools for Internet access. Many schools have also completed the second level of adoption: preparing teachers to operate computers. As a rule, successful completion of the first and second levels makes record keeping easier, improves the quality of presentations, and increases professional communication among teachers.

Despite the apparent readiness of school systems to advance to the next level of technology integration and the presence of better computer facilities than a few years ago technology-rich curricular materials do not appear to have yet been implemented on a large scale. According to the *State-of-the-States survey* (Technological Horizons in Education, 2001), 90% of the responding state-level directors of technology reported that they either require or recommend the integration of computers into the curriculum. However, state directors of technology also reported that they would rate only 80% of their state's teachers as "average" in proficiency in integrating technology. Further, these state directors suggested that only 62% of their teachers used technology to enhance teaching, while fewer than 45% pursued higher level thinking activities with their students. Similarly, the directors rated only 11% of their teachers as above average in using project based learning or cooperative groups.

The Milken Foundation funded a study to identify and list the factors that determine whether schools will be successful in bringing up the level of student use of computers for learning (Lemke & Coughlin, 1998). Missing from their list of keys to success, however, was a well-developed, comprehensive curriculum that can be used for an entire course of study. Such year-long curricula that integrate technology may be crucial to helping teachers bring about the kind of systemic change that technology integration may demand (CEO Forum, 1997; Mann, 1998; Sherman, 1998). There appears to be much support for the desire for such curricula (Bailey, 1997; Dockstader, 1999; Ediger, 1997; Fine 1999; Gunter &Wiens, 1998; Hall & Mantz, 2000). This

support is further reinforced by the fact that 22% of the state-level directors of technology who, when asked why computers are not used in schools, responded that schools needed to revise curriculum.

To address just this need, the present project integrates technology into the full-year curriculum. The product uses a 4 E's learning cycle model, a modification of the 5 E's instructional model (Bybee, 1993) that integrates computer media throughout. The "E's" represent various phases of the constructivist learning cycle (Engage, Explore, Explain, Evaluate). The product, whose prototyping was funded by the National Science Foundation, integrates a shorter (800 page), concept-oriented textbook, a collection of inquiry-based lab and field activities, and an extensive World Wide Web site that provides an interactive learning environment for students. These components are designed to work together to help teachers provide a more interactive classroom in which computers support and enhance delivery of the curriculum. Unlike textbooks "published" (posted) on the Web largely as Acrobat PDF files or other forms of documents and worksheets, *Exploring Life* materials go beyond simple reading, teacher lesson plans, and activity worksheets. Web activities explain and reinforce the text and promote active, hands-on learning. They encourage students to explore, analyze, draw conclusions, and share their findings.

Hoover and Abhava (1995) argued, however, that many "educational" sites are not well suited to classroom use because they lacked strong instructional (pedagogical) design and scientists (content specialists) have difficulty collaborating with educators and website designers to produce the most efficacious sites. In addition, a number of authors argue that teachers need professional development to help them learn how to integrate technology into teaching and learning and we need newer models for such development activities (see for example. Black,1998; Smith-Gratto & Fisher,1999).

Clearly, we needed to explore how this innovative approach to melding a print textbook with online activities influenced what teachers in real school settings might do. The developers produced prototype materials and then asked a sample of teachers to implement them in real classrooms under a wide range of technology availabilities. The major questions we, the evaluators, sought to answer through our study were,

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- How ready are biology teachers who are early adopters of technology to employ a curriculum that requires students to use computers on a regular or even daily basis?
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- Do high schools have the adequate technology facilities to implement a curricular program that incorporates students using computers on an almost daily basis?
- How might existing schools change to support a technology-based curricular program?

Participants

Three evaluation workshops were conducted at different developmental stages during the first year of our project. To attract participants, we posted calls for participation on national and state educational listservs and bulletin boards. Biology teachers who were interested in participating in the *Biology: Exploring Life* evaluation completed a 44-item computer experience questionnaire. This questionnaire allowed us to identify participants' varied demographics and background characteristics, including: geographical area, socio-economic level of the school, years using the Internet for teacher planning/preparation, perceived preparation to use the computer and Internet in classroom activities, training to integrate instructional technologies into curricula, number of computers in the classroom and school, student-to-computer ratio, and extent of technology use in the classroom.

Forty-two high school biology teachers, one preservice biology teacher, and one science supervisor, were selected from a stratified sample of thirteen distinct geographical regions that included Alaska and Hawaii. These 44 people participated in evaluation of the first year prototypes, reviewing the materials in various stages of development at one of the three evaluation workshops (August 2000, October 2000, and March 2001). Although the 42 teachers had volunteered to implement the materials in their classrooms, only 18 were able to do so during the 2000-2001 school year. They pilot-tested the *Biology: Exploring Life* materials with 783 students. The loss of 24 teachers was due primarily to scheduling problems and the timing of the workshops in relation to when the content in the prototypes was covered in their classrooms. For this reason, some of these teachers agreed to participate in the year 2 field test instead. In

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addition, five classrooms were chosen for field observations based on arbitrary volunteer selection.

Data Collection

As noted earlier, we collected demographic data on teachers' past practices, teaching experience, use of computers, and professional development. At the three workshops, teacher participants evaluated how well prototype materials met national and local teaching standards, and the cognitive and interest level of students. In addition, they assessed the quality of prototype use of the interactive qualities of computers and the Internet. To assess the use of the materials in the classroom, the evaluation team conducted five classroom field observations during the school year. Students completed measures of biology content knowledge and concepts before and after using chapter materials, and each teacher submitted a questionnaire and a journal with open-ended responses after using each chapter. To collect a richer and more detailed set of teacher impressions, a member of the evaluation team conducted follow-up phone interviews with teacher participants who completed two or more units and were selected. To obtain a richer pool of student reactions to the prototypes, we selected two volunteer teachers and their students submitted journals.

Findings

Findings are discussed below in terms of the teachers' self-report data prior to implementing the materials in the school setting and then what we learned about their actual use of the materials in the pilot. Although student knowledge of biology, as measured by all four pre-to-post pilot measures, increased significantly [$t(477)=18.64$; $t(212)=15.11$; $t(85)=9.94$; $t(77)=4.79$; all findings $p=.001$] and student reported strong favorable reactions to the prototype materials, this paper focuses on the teacher's experience. Thus, we discuss student findings only in relation to how they might affect teacher actions and decisions in implementing such a technology-rich product.

Participant Self-Report Data Before the Pilot

This section is divided into four main parts: *participants as early adopters, reduced planning time, computer facilities and support,* and *participant use of technology.*

Participants as Early Adopters

According to Rogers (1986), adopters of technology fall into fairly clearly defined categories. Innovators and early adopters lead the way, early majority hold the middle ground, while late majority adopters and laggards wait longest. Given that we used the Web and email as principal means of soliciting a volunteer sample, we assumed our participants might well fall on the leading edge of Rogers' adoption-of-innovation curve (as applied to educational technology use). The demographic data offered some support for this assumption.

Our teachers reported that they used computers for preparation and planning once a week or more (97%) and rated themselves as well or very well prepared to use technology (83%). The vast majority of our participating teachers (88.1%) reported they had used computers for three or more years in teacher planning and preparation and had attended professional development experiences in the past three years related to technology use or implementation. Similarly all participants (100%) reported that they had assigned their students Internet research tasks, while 92.9% reported they had assigned students data-analysis and problem-solving tasks using computers or the Internet reported. Those same respondents reported that they felt ready to use computers for their own professional use, as well as with their students. Participants reported notable levels of reported participation in professional development activities; 76.2% said they had completed nine or more hours in the past 3 years, while one-third reported taking more than 32 hours in that same period. Despite such training, most in our sample identified their own independent learning (97.6%) and interactions among colleagues (83.3%) as main sources of their knowledge about technology and its use. This contrasts with 35.7% who reported that at least a moderate extent of their training came from college courses.

Reduced Planning Time

Participants noted on their questionnaires during the first workshop that additional planning time would be needed to infuse technology into their biology curriculum. This is consistent with other educators (Cummings, 1998; Heck &Wallace, 1999; Schnackenberg, Asuncion, & Rosler, 1999) suggesting technology implementations increase the demand on teacher planning time and restrictions in available time may act as a limiting factor.

However, during focus groups prior to the field test, the teachers espoused the belief-that the prototype materials would actually save planning time. Because these materials included interactive activities that enhanced the text, offered links that were kept up to date, and the publishers were responsible for keeping information updated, participants opined that they would spend less time searching and more time teaching. Because the program offered activities at various cognitive levels, participants also thought the prototype materials might save time adjusting materials for different class levels and interests.

Computer Facilities and Support

Many teachers in our study (73.8%) reported adequate to that their administrators would be supportive of an integrative curriculum. Most (54.8%) rated the number of computers in their school as sufficient to use a Web-based curriculum. Similarly, most respondents (61%) reported that their districts had a computer training requirement.

Participating teachers reported differential access to computers in their instructional settings. Twenty five percent of the participants had what we would call a classroom set, 10 or more computers in their room. Forty nine percent of the teachers had two to nine computers and only 26% had just one computer in their room. Almost all of the teachers (97.6%) reported, however, they also had access to a computer lab.

Participant Use of Technology

At the same time that we saw evidence that our sample might be more active in using technology in schools, we were surprised at the ways teachers reported actually using computers in schools. The three most reported activities --searching for possible activities to use with students, communicating with colleagues, and word processing-- were uses supporting teaching, not uses involving students in the classroom directly. When we looked at how students in their classrooms used computers, most of the reported activities were data collection and reporting.

A majority of the teachers (66.7%) responded that they did not use computers for multimedia presentations at all, or did so infrequently. This finding seems consonant with McDermott and Murray (2000) who contended that the use of computers still remains teacher-centered as opposed to learner-centered. The finding seems particularly

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important here, however, because our prototype materials are student-centered and require teachers to have students use computers in the classroom almost daily.

Pilot Results

This section is organized around four headings. The first three parallel the discussions form above: *planning time not reduced, inconsistent computer facilities issues,* and *teacher use of technology*. The fourth heading, *findings related to specific learners,* addresses how specific populations of students interacted with the prototypes.

Planning Time Not Reduced

Despite teachers' prediction of reduced planning time requirements, once the field test was underway, the majority of teachers reported that they spent additional time planning and preparing to teach. Most of that extra time was spent dealing with the technical requirements: arranging computers, adjusting schedules around labs times, and installing software and Web browser plug-ins. Many teachers reported spending planning time developing supplemental worksheets to be used as an accountability measure as students completed the online tutorials. As anticipated, teachers did feel that the program reduced the amount of time they spent searching for support materials and respondents suggested that they would be able to spend less time planning if their school computers were properly configured and the publisher developed worksheets to be used with materials.

Inconsistent Computer Facilities and Support

Once using the prototype materials on a regular basis, our teachers discovered their school buildings often-did not have an adequate technology support system for implementing such technology-intensive curricular materials. As we talked to teachers, we found that there was little consistency about how schools student computer facilities. Some spread out one or two computers so that every room had a computer; some schools placed all the student use computers in computer labs.

Many of the teachers had planned to use their school's computer lab to do the activities. However, teachers often discovered they were not able to access their computer lab or the availability was very restricted with little scheduling flexibility. Sometimes this meant our teachers were left having to adjust a week or even a month of lessons in order to get lab time. Or such availability might determine whether the

materials got used at all: One teacher was called out of town and her class missed the computer lab day. When she returned, she was unable to reserve another day right away. Unfortunately, she had used up the time that was allotted to the concept by her core curriculum and had to move on to other materials.

Most biology classrooms were not designed to accommodate a large number of computers. Often there are not enough electrical outlets and few (or no) Internet connections. Some schools lined computers up in neat rows but that left little room for students to work in pairs or even work independently because the quarters were so close. Our observations indicated that wireless computers offered greater flexibility in classroom arrangements than using a computer lab, permitting more collaboration and small group work. However, even with wireless computers, difficulties occurred. In one classroom, students had to walk around the room, holding their computers like divining rods to find the service area of their wireless computer hub. Their room was, by the pernicious nature of the technology gods, located in an area that received three separate signals from opposite ends of the school.

Facilities were only part of the problem, however. Most reported difficulties related to preparing computers to use the program. The computers required a minimum system requirements of 64 MB of RAM, Internet Explorer 5 or higher as the Web browser, 350 MHz CPU speed, at least 56K connection speed, and installation of Flash 5 and QuickTime 4 plug-ins on the Web-browser. Every school had a unique network system configuration, requiring knowledge of how the network addresses needed to be configured for network access. Most teachers required computer support persons to help them confirm their computers met the minimum requirements and were configured properly. This included help downloading and installing the Web browser and the necessary plug-ins. When adequate technical support was not available, teachers needed to be "technologically savvy" in order to prepare available computers to implement the curriculum.

Communication between teacher and computer support persons varied greatly from school to school, as did responsiveness. Some teachers were able to call system administrators who quickly came to configure computers, while others had system administrators who responded slowly or didn't show at all. One teacher had computers in

her room for six months before they sent a technician in to set them up and to connect them to the Internet. The knowledge level of the system support people in different schools also varied greatly. In one case, a teacher checked with the system administrator and was assured that the school's computers would be able to run the program. When she began the pilot test, she found that the computers were woefully inadequate.

School system technology policies also proved a barrier in some case. Some systems had blocking software that inhibited learners from accessing externally linked Websites that were linked to prototype activities. Some systems restricted teachers from downloading necessary plug-ins or upgrading their version of Internet Explorer. Two teachers had problems with their systems not connecting to the Website. Because of low memory computers, one teacher had to download the plug-ins in the morning and then take them off at night. Often, school Internet connections was slow, frustrating students and teachers.

Regardless of how much technical support teachers had in their school, all teachers became emergency technicians while pilot testing the prototype materials, troubleshooting problems as necessary during class. Many teachers had to learn to download software, reboot computers, and install audio capabilities on their computers. The amount of time and type of problem was usually a minor annoyance. However, sometimes it constituted enough of a hardship for the teacher that the pilot testing was aborted (18 teachers out of the 42).

Teacher Use of Technology

As we observed teachers in the classroom, it was apparent that being an innovator was not always fun or easy. Few of the teachers had the perfect assemblage and availability of computers. Many teachers had difficulties thinking about ways in which they could adapt use of computers to facilitate their teaching. As previously mentioned, most of the teachers had not used computers with the students on a regular basis or as a critical component for teaching. In order to implement the prototype materials, many teachers had to adjust their normal styles of teaching.

There was no one pattern to how the teachers used the prototype materials. Teachers spent from two to 20 days implementing the chapters. How and what materials teachers used appeared influenced by their comfort level in working with technology, as

well as their need to meet local standards and core curriculum requirements. Teachers also selected different components based on the ability level of their students and the sorts of instructional activities best supported by the arrangement and location of available computers.

It appears that many biology teachers in our sample did not know how to make the most of available computers in their classrooms. Of those teachers who had multiple computers in their classrooms, few reported using them as learning stations. Likewise, few teachers said they used an LCD projector to project visualizations on a screen or a television monitor to call attention to biological concepts presented in the materials. One teacher, who did not know she had the ability to connect her computer to her classroom television monitor, decided to print out an animation screen to illustrate the biological concepts that were presented in the animation. Another teacher, despite having enough computers in her classroom for the students to work in groups, took her students to the library computer lab to do the activities, since she believed the only way to work with prototype materials was individually (one computer per student). Similarly, many teachers were unaware of new products just coming out, like wireless computers, hand-held computers, and SmartBoards that would offer more ways to present interactive segments of the prototype materials.

Many teachers customized the instructional design of the materials to accommodate their pedagogical styles. The materials are designed in such a way that teachers can selectively choose different components to meet the diverse needs of their students. For example, one teacher chose to use the Web components to enhance her lecture material. In contrast, after implementing the wet lab, another teacher had students use the computer activities to check their understanding of concepts presented in the lab and reinforce that learning.

Most teachers did not implement all computer-based activities in a chapter. When teachers had limited time, wet labs were the first activities to be omitted and teachers tended to use the Webquests at the beginning of the chapters as an introduction to the chapter's content. Interactive tutorials were next most likely to be used by teachers to illustrate concepts or to reinforce vocabulary.

Teachers experienced management issues when using the prototype materials in a computer lab. In computer labs, eye contact was a problem with students seated behind computer monitor or with their backs to the teacher. Computer audio could also be a problem: As an extreme example, the students in one lab were completing an activity in which a bear burps after he has eaten an apple. They decided to devote time to trying to get all computers to play the bear's burp in unison and the teacher had trouble getting them back on task.

Teachers who were accustomed to using teacher-centered approach found it difficult to be the center of activity in a computer lab. One teacher commented that she felt a bit useless and didn't quite know what to do when the students became focused on the computers and busy with the activities. Student data suggested that teachers were not the only ones aware of the change: Several students noted in their journals that their learning became more intrinsic and relied less on the teacher's direct instruction. Many students said they enjoyed the shift in emphasis to a more student-centered atmosphere. However, not all students preferred learning autonomously with computers. In two schools, higher level biology students reported that they preferred a more traditional textbook-centered curriculum to the prototype materials.

We deemed a successful implementation of the prototype materials to be one in which classroom students were able to use the prototype materials that were assigned by the teacher. A variety of factors contributed to successful implementation. In the most successful classrooms, the teachers appeared to have a pedagogical style that permitted them to incorporate the materials without radically changing their approach to teaching. Such a style usually was one that permitted a combination of teacher-centered and student-centered learning, with easy transitions between the two. Structuring the classroom environment for students to work in small groups proved to be a most advantageous way to implement the materials. Teachers circulated among groups, guiding activities and assisting the students and students often discussed the concepts among themselves to derive responses to questions in the tutorials. Teachers who had multiple ways to use computers and multiple types of hardware also appeared to have more success. For instance, teachers who used a combination of projected computer animations for whole-group guided discussion and stand-alone computers for small group

activities also reported success implementing the materials. Similarly, five to seven computers spread out to allow students to work in small groups or wireless connections where students could form their own workgroups dynamically seemed good ways to configure for student-centered activities.

Findings Related to Specific Learners

Some student findings had implications for teachers implementing such a technology-rich product. In particular, we saw some evidence that this approach might have had unanticipated effects on specific populations of learners. For instance, one teacher noted that the academic performance of her students with Individual Education Plans (IEPs) for learning disabilities improved while implementing the program. The most dramatic observation was a student whose mark improved from a D average to a B average. In an unfortunate confirmation of the learner's preference for the prototype approach, the student's mark slipped back to a D when the textbook-centered curriculum was reinstated at the end of the pilot test. In the same class, two English-as-a-second-language students' marks also improved while using the prototype materials. During study hall, they were able to access the Website and complete activities at their own pace. While novelty may play some role in these findings, it is worth noting that the implementation covered a period of one to three weeks per chapter.

In contrast, analysis of student journals indicated that low-proficiency readers had more difficulty reading text on a computer monitor than with a textbook. These learners also became disorientated with activities that launched more than one browser window. For instance, some of the Webquests required learners to navigate across Websites, opening several concurrent windows. As a result, such students appeared to have trouble staying focused and on task, jumping instead between and among Websites.

Recommendations

As a result of the first year's pilot test, we are able to make a few recommendations. These recommendations have already shaped our guidelines for the second year's filed test. They may well also apply to implementing other kinds of technology-rich science materials.

- Technology-rich products still demand more technological sophistication than many teachers currently possess and more technical support than many schools currently provide.

Cutting-edge really means early implementers give blood so that later users may have fewer problems. As we saw in our pilot, present levels of technology call for a lot of troubleshooting. Until things become simpler, teachers need to be adept troubleshooters if they wish to use technology-rich materials in their classrooms. Given the troubles that some of our teachers had with technical support in their buildings, administrations that wish to see their teachers use such materials may need to make certain that the necessary level of technical support –and responsiveness—is there for teachers. In addition, teachers need to be made aware of the sorts of teaching technologies that exist, from large monitor connections to data projectors, to SmartBoards and amplified speaker connections. Not only should schools help their teachers understand what these technologies are and how to use them in teaching, but materials produced for use in schools settings should include strong materials on how to use those materials in a wide range of delivery techniques.

- Teachers wishing to implement the materials will need to rely on a more diverse set of computer configurations than just using the computer lab.

Our teachers certainly encountered a number of problems in working with computer labs. Availability and scheduling problems made it difficult to complete activities where they fell in the curriculum. If teachers want to stay on schedule, they may need to think in terms of a combination of approaches, only some of which might occur in a computer lab. And, any activities in the computer lab need to be scheduled well in advance. Further, for technology-rich learning products to succeed, schools need to recognize the importance of instructional uses of computer labs, not simply use of such facilities for word processing and other activities calling for the use of tool/productivity programs. Similarly, schools need to think about Internet access for classrooms.

Technology continues to advance. Wireless computers certainly appeared to help those teachers who had them implement our prototypes in more flexible ways. Unfortunately, once a technology solution finds its way into a school, competition for that resource becomes greater. For instance, a teacher in our sample had received a grant

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to purchase wireless laptop computers for her school's biology department. At the beginning of the school year she was the only teacher using the equipment. However, as more and more teachers began using her wireless laptop computers, she had more and more trouble scheduling them for her own use with our prototypes.

- Technology-rich materials may change the nature of teacher planning for instruction.

While our teachers did not achieve the anticipated saving in planning time, the way in which they used their planning time did change a bit. It may be that having such rich materials may mean that teachers spend their advance time planning which parts of the product to implement when; how to prepare students for their interactions with the materials; which things to cover in whole-class settings, which in small groups, and which individually; how to match materials and activities to one's individual teaching style and philosophy; and how to assess student learning after using the materials. Of course, another use of planning time will continue for the present to be setting up the technology and preparing the setting for its use.

- Professional development may need to focus more on helping teachers and administrators understand how best to implement learner-centered approaches.

Our findings suggest that many teachers (and perhaps administrators) may not have as broad an understanding of learner-centered approaches to teaching biology as they might. It is worth noting that high school science teachers are more likely to have a science degree rather than a science education or education degree and may not have received training in incorporating technology into instructional contexts (U.S. Department of Education, National Center for Education Statistics, Fast Response Survey System, Teacher Survey on Professional Development and Training, 1998). If such teachers are to employ more learner-centered approaches as recommended in the report above, then professional development focusing on acquiring a diverse repertoire of pedagogical approaches is highly desirable.

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PARTICIPATION IN A TECHNOLOGICAL WORLD:

THE MEANING OF EDUCATIONAL TECHNOLOGY IN THE LIVES OF YOUNG ADULT CENTRAL AMERICAN IMMIGRANTS

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Key Words: technology, immigrants, computers

Abstract

Many communities throughout the US are experiencing a large influx of Central American immigrants. Langley Park, Maryland is typical of the pockets that are formed by the new arrivals. Community members of Latino background now account for 60% of the population, while in 1990 they were only 40% (US Census, 2000). "The increasing Hispanic population has had an impact on everything from political campaigns to business marketing" (Cohn and Fears, 2001). As the immigrants move into Langley Park, both the formal and informal educational systems are faced with the task of preparing children and young adults to succeed in an increasingly complex and competitive society where proficiency in technology is becoming a requirement for success. This paper presents a subset of a larger ethnographic study. Here cases of nine Central American female immigrants who have chosen to take technology related training are presented in order to reveal their behaviors, attitudes, and beliefs towards technology use. Information was collected through observations and interviews while providing the participants with training in basic computer usage.

Introduction

Many communities throughout the US are experiencing a large influx of Central American immigrants. Langley Park, Maryland is typical of the pockets that are formed by the new arrivals. In the Langley Park community, the Latino population increased from 6,956 to 10,294 over the 1990s (Barrio de Langley Park Newsletter, 2001). Community members of Latino background now account for 60% of the population, while in 1990 they were only 40% (US Census, 2000). As immigrants move into Langley Park, both the formal and informal educational systems are faced with the task of preparing children and young adults to succeed in an increasingly complex and competitive society where proficiency in technology is becoming a requirement for success.

The study took place in the context of a larger ethnographic project which began in 2000 in one of the urban areas of Maryland surrounding the District of Columbia. Here cases of nine Central American female immigrants who have chosen to take technology related training are presented in order to reveal their behaviors, attitudes, and beliefs towards technology use. Data was collected through observations and interviews over the course of six months while providing the participants with training in basic computer usage over the Winter and Spring of 2002.

Significance of Study

As Hispanic[1] immigration to the U.S. continues to increase, it must become a focus of our educational technology policy. Career choice patterns of the Latino population indicate a lack of familiarity with and knowledge of the use of technology for employment. Studies by the Maryland State Department of Education and the US Government[2] have pointed to a growing gap between the technological haves and have nots. Referred to as the "digital divide"[3], some population groups are less likely to have computers and other technology based learning tools at school and/or at home. Although technology use isn't the only factor that contributes to educational and career "success", it is an important one because employment is becoming increasingly dependent on one's fluency with technology. As a result, educational initiatives and policies are being designed to target this technology gap.

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[1] The term "Hispanic" is used by many agencics (such as the Bureau of the Census), to collect and distribute population data. The term designates "individuals [who] immigrated to the United States or are native-born U.S. citizens who self-identify under several national origin designations (e.g., Mexican American, Puerto Rican, Cuban, Guatemalan, Salvadoran) or racial/ethnic group (e.g., Chicano, Latino, mestizo, Hispanic)" (Padilla in Freidenberg, 2000, p. 275). For a thorough analysis of the Latino/a-Hispanic debate, see Oboler (1995). In the 2000 census, for the first time the U.S. census bureau asked Hispanics to distinguish themselves by origin. Surprisingly, 17% did not pick one group, but designated themselves as other, which may mean for example, a mixture of Salvadorian and American or Latino and African American. While I prefer the term "Latino," I will use both terms throughout this paper.

[2] **Falling Through the Net Series,** National Telecommunications and Information Administration, US Department of Commerce, July 1995, July 1998, July 1999, and October 2000

[3] In the context of this paper, the "digital divide" is the gap between those students who have access to and make effective use of technology for education (formal and informal) and those who do not. This same concept can also refer to a divide in technology access for workers, or the general population.

In today's society computer literacy is the "basic skill" of an information-based economy and workforce. Many jobs require at minimum, basic computer fluency. Yet, data demonstrates that Hispanics do not have access to computer technology at home or at school, therefore are more likely not to be computer literate, and are unqualified for these jobs. The "fault line" is most emphatically real between those who can use technology to process information and those who cannot. Thus, a method to bridge this gap is needed. Clearly, a qualitative understanding of Central American immigrants' attitudes toward technology, could help build such a bridge. The objective of my research is to examine the participation, experience, and stories of Central American immigrants in the Langley Park, Maryland area, in regards to technology use, so as to ascertain their needs and offer policy recommendations.

The divide between the technological haves and the have nots results in impacts beyond the group in question. The US economy is increasingly dependent on a technologically literate work force[4]. As the economy grows, this need grows accordingly. Thus, the need to increase the technical fluency of the immigrant expands beyond benevolence; it becomes a capitalist imperative. Economic costs to society of a technologically uneducated workforce are well documented[5]. Government at all levels has turned its attention to formulating policies to increase technology literacy.

C. Suarez-Orozco and M. Suarez-Orozco (1995) argue that the U.S. education models use middle-class majority-culture traits as the yardstick for normality, making

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[4] See Lenhart (2000), Milken (1998), Oakes (1990), Sanders and Stone (1986), and US Department of Commerce (1995,1998, 1999, 2000)

[5] See Catterall (1985), Fine (1991), Tucker (1997), and US Department of Education (1993, 1995, 1998, 1999, 2000)

ethnic and minority deviations from this arbitrary standard pathological.[6] Others[7] argue that the American assessment measures are mechanistic and do not account for human agency, group variability or change. Statistical data taken from assessment scores, for example, often drives policy commitments. However, this data is collected on a stand-alone basis, divorced from the educational social context[8]. These initiatives tend not to look at the broader cultural content both in and out of school that influence the population at risk[9].

The cultural content of immigrant lives cannot be examined solely by quantitative data, which only highlights a small portion of the larger complex story. For example, are the goals of the immigrant those of the others in the U.S., or have they remained true to their country of origin? What are their definitions of success? What factors relate to what McDermott (1977) refers to as a *context* for learning,[10] and impact substantially on achievement[11] but are generally ignored. Many immigrants speak little or no English.

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[6] See Suárez-Orozco, C & Suárez Orozco, M. (1995). p. 58

[7] See Gumperz (1981), Carter and Segura (1979), Delgado-Gaitan and Trueba (1991), Suarez-Orozco (1986, 1987), Suarez-Orozco C. & Suarez-Orozco M. (1995), Trueba (1989a, 1989b, 1993), and Trueba, Rodriguez, Zou, and Cintron, (1993)

[8] See Levinson (1993), Muniz (2000), Schiefelbein, E. and Schiefelbein, P. (2000), and Suarez-Orozco C. & Suarez-Orozco M. (1995)

[9] See Muniz (2000), Suarez-Orozco C. & Suarez-Orozco M. (1995), and Trueba (1989a, 1989b)

[10] Margaret Mead's famous book *Coming of Age in Samoa* (1928) reminds us that there is a distinction between education and schooling. Mead shows how education can be a larger part of what Levinson (1998) terms "enculturation", the constant learning of cultural knowledge.

[11] See Failde and Doyle (1997), Izquierdo and Sanchez (2000), and Levinson (2000).

They are often well behind the educational pace of U.S. students, as their home countries offer limited formal educational opportunities. Compounding the difficulties immigrant youths face in school is the fact that they often need to work to help support their families financially (Suarez-Orozco C. & Suarez-Orozco M., 1995). They may hold two jobs or may be asked to care for siblings while other members of the family work. Most policy makers do not include these factors. Instead their design focuses mainly on school based performance assessments. By neglecting other aspects of students' lives, standardized assessment results done in the educational arena present an oversimplified quantitative picture of complex cultural issues.

To form a more complete picture of recent Central American immigrants, one should not be limited to the conventional educational environment[12]. Research studies[13] have shown that students conduct themselves differently at school, work, play, and home. An understanding of the broader life conditions that impact on students can help to formulate more constructive policy recommendations. It is important to know the context in which student educational experiences are contained, and what forces act to mold their educational aspirations. Both my experiences over the last seven years with this community and the literature review conducted for this study indicate that this

[12] Education should not refer only to the classroom. Education is the uniquely human method of acquiring, transmitting, and producing knowledge, which serves to interpret and act upon the world. For education to be effective, individuals must be able to design their own educational resources from their available cultural resources. In an integrated society, education can be a balancing act between group interests and individual concerns (Levinson, et. al., 2000, p. 2).

[13] See Evans and Boyte (1992), and Levinson, Foley and Holland (1996)

groups' needs largely go unrecognized by policy makers who seek solutions only in response to more standard assessment measures.

In order to gain insight into these complex issues, and to better understand how cultural background, as well as the behaviors and attitudes toward educational technology, plays into the lives of this group, a qualitative study was undertaken, of which the results presented here are but a piece. This larger study used an interpretive perspective to examine the use of educational technology in the broader cultural context, Information gathered will be used to gain an understanding of the perceptions, aspirations, and behaviors of this population towards technology use that will have implications for educators and policymakers who want to help narrow the digital divide, and who want to make a positive difference in Latino immigrant learning, achievement and persistence in technology knowledge and skills.

Personal Experience and Interest

My interest in Central American immigrants grew while teaching chemistry within the Montgomery County Public School system from 1994 to 2000 and simultaneously serving as advisor to the Technology Club and Girls Computer Club at a predominately "Hispanic" high school (65% Hispanic, primarily El Salvadoran immigrants). Over this same time period, I began graduate school in the College of Education at the University of Maryland, College Park, with a focus on educational policy and leadership. In addition to taking the core education classes, my research interest directed me toward classes in qualitative research, sociology, and anthropology. I applied the knowledge gained in my graduate work to my teaching, and through action research I was able to investigate Hispanic attitudes toward technology, but only in a

limited manner. Survey questionnaires, interviews, and participant observations were all accomplished during a short period of time. Even such a limited investigation revealed some commonalties within this Latino group, as well as differences between this group and other ethnicities.

Previously I had worked in Prince George's County, in a predominantly African-American school. Many aspects of the Latino culture differed from my previous school; the strong importance of socializing, the desire to work in groups, and the lack of free time (many worked after school to help support the family) were facets of the culture that would require different teaching techniques than I was currently employing. A student could not be expected to come after school for extra help if he/she had to work to support his family or watch his siblings so his parents could work. Cultural exploration had begun. I undertook other ethnographic pilot studies, which revealed beneficial aspects of technology for both this group, and other groups for whom English was not their primary language, or whose English was severely limited. For example, when writing papers, the computer gave students a means of checking spelling and grammar without having to be embarrassed by their lack of mastery of the English language. Thus, the computer served not only as an instructional tool, but also as a means for building self-confidence and increasing their knowledge of the English language.

Current Investigation

Originally, I began to observe this community via an open laboratory at a local technology center, housed in an elementary school where the Community College also taught introductory computer courses. However, no one seemed to come to the laboratory. I was told by the director of the community center that local residents felt

that the computers were for courses only. At her urging I started two introductory computer courses in the evenings at the computer laboratory in the community center (within the same building) offered via the Parks & Recreation department. I offered to teach the courses at no cost to the residents, but the director said that a nominal fee makes the residents feel that the course has worth; a free course either has a catch or is worth what they are paying. For the first sessions, I had 5 students in one class and four in the other, all women. There was one student in her 60's, two in their late teens, and the rest were in the late twenties through the mid 30's. The courses really connected with the community, and fifteen students are currently signed up for each of the next two sessions, including all nine students returning. Through discussion with the students and my observations, I have extracted some of the central themes which have made the courses successful, based on the needs and desires of this audience. The goal of my work was not to train computer experts; it was to help computers become approachable.

Themes

For this discussion, I will summarize the themes in three broad subject areas. First, I will discuss the course content which made it desirable to the participants. Second, the subject matter chosen and how it was presented will be examined. Finally, descriptions of how I observed a feeling of empowerment arise in these students will be discussed.

As indicated previously, rather than having a free course, there was a small fee associated for the course: $35 for a six week session. In contrast, the community college offered a 14 week course for prices ranging from $75 to $100. From a price standpoint, they are nearly identical, however, the smaller up front course allows a trial period, i.e. I

will try it and if I don't like it I can stop. More importantly, the formality of a community college course was intimidating to those who wished to work in a more informal setting. The community college had a number of forms that needed to be filled out, as well as an application with an additional fee (one time only). The Parks and Recreation department has a simple form which solely required a name and address. The extensive paperwork can appear to be a huge hurdle to someone who's English is poor. Additionally, they may not feel qualified to take a "college" course, even though it is directed at their level. A more casual, community center program permits them to come to the class and not feel that there are any requirements – either real or imaginary.

The subject matter of my course was tailored to what the participants interest. I was surprised to learn that half of the students had computers at home. Participants wanted to learn how to use the word processor, make cards, posters, take pictures, and save their work. They wanted to learn basic computer skills that could help them in their everyday life and make it easier. For word processing practice I would provide a page of text, utilizing different color, style, and size fonts, indenting, lists, and other formatting used in standard documents, and had them replicate it. Step by step instructions were not given. Knowledge and skills were gained by doing. They learned they could not "break" the computer, and errors could be fixed. Class participants used a digital camera to get pictures, and downloaded other pictures from the internet to include in cards and posters. In word processor exercises, participants could start with either a blank document, or from a variety of templates provided. All the students wanted to print their work, save it to floppy, and bring it home to show their families and practice the exercises again, or use them for their own projects.

One of the participants wanted to learn ways to use the computer to help her business. She cleaned houses, not a profession you may think would require a computer. However, she wanted the computer to make her job more professional. She learned to download invoice templates that she could use for billing. She also learned to print business cards for advertising. Thus, the computer was being used to make her business more efficient, save her time, create advertisements, and help her succeed.

Finally, the computer seemed to empower these ladies, native Spanish speakers with varying English ability, to ease their transition into English, while keeping them connected with their homeland. The nine original students had a range of English abilities, from almost none to conversant. However, they all were excited about the spell checking and grammar checking features of their word processors. Although not perfect, it at least allowed them to fix basic mistakes based on their limited English ability. For Internet sites, they learned to use several on-line translators to convert English language sites to Spanish. The translators were not perfect, but they allowed the participants to utilize previously incomprehensible sites. In fact, the imperfections of the translators gave them a chuckle, and showed them that in some ways they were superior to the computer.

The Internet allowed them access to a number of Spanish sites that enabled them to keep up with information "back home." They used on-line technology tutorials that were provided in Spanish to help them learn. They also utilized travel sites to find pictures of beaches and cities from their homeland, which they then incorporated into their processing documents. Thus, they found that rather than language being an additional barrier keeping them from computers, they found that technology exists in

their native language and can help them operate in a predominantly English speaking society.

Conclusion

The information presented here is a small part of a larger study, and are focused on a small group with particular interests. However, the themes extracted resonate with other research and observations made in the educational arena. Current policies are often drawn from the lessons learned with a middle class, white, English speaking society. Educational technology goals are directed toward career advancement, success on standardized tests, and facilitating curriculum. For this group, the goals are much simpler. How can the computer make ***my*** life easier, and help a Spanish speaker in an English speaking country? What tools are available to assist me as I don't have the time or expertise to start everything from scratch? These ideas represent a different cultural target toward which we should aim our educational dart. This study only shows us a small portion of the information we need; larger ethnographic/qualitative studies are needed to acquire a richer, more complete cultural description.

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Online Databases in the History Curriculum: Encouraging Historical Thinking Skills and Positive Discussion Strategies

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Abstract:
How can students use technology as a tool to further learning in the classroom? How can an online database discussion improve participation and encourage historical thinking skills for all students? How can FileMaker Pro help students transcend the constraints of classroom time and space to facilitate a more global design of classroom discussion? This paper will discuss an ongoing investigation of using an online discussion database in the history classroom.

In February 2001 I attended a seminar given by Professor Robert Bain, hosted by the California History Social Studies Project. Professor Bain discussed a model for teaching high school students how to "study" history by "doing" what historians do. I was encouraged to wonder how many of my struggling students viewed history as an exercise in reading and memorizing facts. I referenced the California History Historical Thinking Standards and found that these standards actually mirrored important questioning procedures that professional historians employ, skills I had neglected to explicitly discuss in my classroom. I theorized that if students began to ask such questions of historical texts, they would become more engaged and ultimately walk away from my class with practical historical thinking skills that would improve any future study of history. Taking it one step further, I asked myself how technology might be used as a tool to support this questioning process? The following paper highlights my classroom-based research on the subject.

Questioning Assumptions

I began my research with a grade level Cloze Test taken straight from our history textbook showed that approximately 25 percent of my class had struggled to

gain a basic level of understanding from the text. As a humanities teacher, my assumption was that this percentage of students could be generally classified as low level readers. Yet, as I observed these same students reading our novel for English class, my initial assumption regarding the correlation between reading level and history book comprehension was challenged. A number of students who struggled with the history text were able to successfully analyze, question and make meaning of our English texts. Thus, it seemed some readers clearly struggled with particular skills needed to read a history book and/or any type of historical text. When asked, "What do you need to be a good history student," students expressed a preconceived idea that to be good at history meant to be good at memorizing facts. Every year students can point to a class history buff who apparently eats, sleeps and breathes history. Still, I was puzzled by my students who excelled in critical thinking as evidenced by their written work and oral participation in English class, but did not seem to apply the same type of thinking in history. What barriers stood in the way of these students' historical understanding? How could I identify these barriers in order to help these students when I was unsure of what the barriers were?

Posing Problems

Could I change the way my students thought about history? Carefully constructed history tests, comprised of essay questions and comparisons, still evoked sterilized, memorized material. Classroom history discussions were sometimes dreadfully slow, dominated by one interested individual or ultimately teacher directed a handful of students remaining silent unless called upon. Even when encouraged to ask questions and/or make predictions regarding new information, very few students ever raised a hand unless they were pretty sure they had a right answer. Our discussion seemed to be driven by game show rules, a defeated look often resulted from a wrong answer. How could I engage all students with such

varied backgrounds and understandings to jump in on a historical discussion? How could I teach and encourage them to hypothesize and question our historical units of study? As I struggled with how to encourage more meaningful participation in my history class, I was also inspired by the fact that I knew this same group of students was capable of and had demonstrated higher level thinking in our English class. Our school as a whole places a major emphasis on teaching students to become both critical and confident readers and writers. Students are well aware of the tools they need to use to read and discuss a piece of literature thoroughly as well as what elements must be included and developed to produce a strong writing piece. To demonstrate these skills, students participate in scored discussions. Students are always excited, animated and involved in "Socratic Seminars" where they demonstrate ownership of the following strategies of literature discussion: Question, Predict, Clarify, Connect, Summarize, and Evaluate.

So why don't students employ these strategies while reading our history textbook? My prediction was that students felt uncomfortable questioning a history book because they felt it represented stone cold facts. Thus, in creating a challenge for both the classroom and myself, I began to ask myself, "What makes a good historian? What are the fundamental skills/tools a historian needs to do his/her work? How does our understanding of these skills /tools encourage higher level critical thinking and discussion skills in the history classroom? Can all levels and types of learners engage themselves in a historical discussion as such?"

Proposing a Solution

Just as professional doctors and dentists are trained to assess patients and decide upon appropriate tools and/or procedures, students should be aware of concrete tools that they can use to approach and investigate a historical text in order to gain a thorough understanding, as would a historian. If students can learn to apply

such tools, they exit the history classroom with more applicable skills than memorization. If we desire students to feel confident enough to search for a meaningful understanding of history, it seems logical that as teachers we should pass on certain "tools of the trade" which are essential to the discipline and practice of history. Today's historians rely on the forward thinking of many different minds to piece together a more accurate view of the past, shouldn't students be encouraged to see themselves as parts of this larger forum?

Can discussion about a completely unfamiliar topic or primary source spark the interest and involvement of all of my students? In collaborating in this way, will students begin to think more historically (see History-Social Science Standard: "Historical and Social Sciences Analysis Skills) rather than focusing upon memorized facts? In spite of having little or no background regarding the given online topic, can students learn to implement and use certain "History Tools" in order to make meaning of a historical text and/or develop their own questions for deeper understanding?

In response, I used FileMaker Pro 4.0 to in conjunction with Claris HomePage to create an online database for student discourse. I wanted to experiment with posting student responses on the web in a way that would allow them to look carefully at their own thought process and the thought processes of their peers. From the web site, students would be able to post, search and re-search the collected responses by subject, history tool and student. I hoped that such a format would encourage more students to jump into the "conversation" and at the same time offer a structure of support to improve student thinking and understanding in the history curriculum.

To introduce my students to structure we would use as a basis for our online discussions, I passed out index cards which had one of the 5 history tools I adapted from the California State Standards: Historical Thinking Skills. (see appendix) In our

class of 30, each card was repeated approximately 6 times. In the computer lab and students viewed a 3-frame web page. (figures 1-4) Accessible links from this page included: "Good Discussion Strategies" (see appendix) taken directly from "Socratic Seminar" guidelines the students were already familiar with, and the 5 "History Tools" derived from the history standards. The center frame contained a primary source excerpt of "Hammurabi's Code" and a general question to guide the students' initial response. Students were then asked to click on "Student Responses" and enter their thoughts regarding the text, using the history tool they were assigned. For homework, students accessed the web site from home using a password to search the responses of their classmates who shared the same history tool they were assigned. This allowed each student to view 6 different responses for each history tool. Next they were asked to do a search for all records. They were asked to read at least one response from each of the 4 other history tools. After looking through their classmates' responses and thinking about Hammurabi's Code a bit more, they were to submit a new response, now focusing on a statement Hammurabi made about his laws, "I have brought justice to all my subjects." From what you know so far, do you agree with this statement? Why or why not? Explain. Students were encouraged to use any of the listed positive discussion strategies, earning extra credit if they did so.

In a written reflection, students found the first computer trial a bit hectic. John, an A student wrote, "I think it is pointless to do this assignment on a computer. I learn twice as much when it's a normal discussion. Its too much bother to go online when it would take 30 second for someone just to teach it to you." Chaz, a C student wrote," I did not like it because its very confusing." Julia, a B student wrote, "The advantages are you don't' have to worry about messing up your words or having anyone score you. Also, you don't have to worry about forgetting you're thought, you just write it down and don't have to worry about screaming it out. Kaelan a B student wrote, " I like the online discussion because you weren't

embarrassed about sharing your thoughts. But I think that it should not be homework because so many things can happen with different computers." Cezanne, a struggling student said," you cannot interrupt people by accident, you can talk the whole time." Alfredo another struggling student said, "I like the online discussion it was fun. I could see what they (my classmates) wrote." I shared some particularly stunning responses with my students the next day in class.

The second online discussion asked students to respond to a primary source entitled, "Hymn to the Nile." Previously organized into city groups for the study of Egypt, students labeled their responses with their city name. Each city had at least one group member in charge of each history tool. After entering their initial responses to the passage, students did a search for the responses of their group members and were exposed to the passage through each of the 5 tools. Next they were asked to make a new entry adding any further ideas and answering "How might this passage connect to what we know about the geography of Egypt? What can we learn about Egyptian values and/or daily life form this passage? " After the second go round, students reflected on the process. Cezanne wrote about the benefits of online discussion," An advantage would be that you get a little more info to improve yours." John wrote, "You can build on others ideas and get more ideas. Reading others makes you question, 'Am I right?' But sometimes people will copy you and you feel you ideas didn't get any credit." Jenny V. said, "It was a really creative way of learning! I think the passage should be further explained though. Next time if you can add a spell check, for some people it will be much clearer." Chaz wrote, "Make it easier."

The final discussion for the year examined a current event and was related to our study of India. For this assignment, students were not assigned a history tool. They read the article and entered their immediate thoughts. Some questions were given to prompt those who could not get started on their own. "Why do you think

both groups of people feel so strongly about these statues? What ideas seem to separate these people? How does the destruction of these statues affect other people in the world? What "boundaries" do you think each group desires to protect? What "message" is sent by each group's actions?

Each online discussion gave me new ideas for the next. While assisting students with the online environment, I noticed features of the online environment that posed barriers and could be improved. Thus, students held online discussions in three differently structured environments. Some students experienced frustration because the instructions were not always consistent; but for the most part, each revision tended to streamline both the web environment and the activity instructions. One very important change was to make sure students could simultaneously view the text in question and the online database. This simulated the process of writing "marginalia" which students were familiar with from their English class and placed emphasis upon interaction with the text at hand. By the third design, students could access the prompt, directions, research tools and discussion strategies online. This was a natural improvement, as students became more familiar with the activity

Increased Participation

"This is kinda fun, huh?" It was February and Alfred, a low performing student, responded positively about a class activity for the first time since September. Alfred receives one period a day of reading support in effort to catch up to grade level standards. He has been tested for special education but does not qualify for additional services. He is regularly held after school for not completing his schoolwork and/or not working cooperatively with his peers. Early in the year I noticed he could barely read, let alone understand the history textbook. By October, Alfred's self esteem was abysmal. Our first attempt using the online database was an

exercise in patience. I answered numerous questions and took many notes for things to change for the next time. I worried about Alfred and wondered if he would reach a certain frustration point with the trial activity and ultimately refuse to work, his usual protocol.

Alfred had a number of questions, but continued to work successfully. Even though he shared a computer station with another student, I did not have to mediate any altercation. By the second discussion, Alfred was visibly more comfortable with the activity and spoke positively about the activity. His responses regarding the Egypt prompt shows that he understood the history tool he was assigned and made a strong effort to apply it to the text. He comments, "...even the people who died there names are still known to be famous." Alfred evaluates that "Ra" who is mentioned in the text, is of great importance and is remembered from generation to generation. The third discussion asked students to submit their immediate responses about the giant Buddha statues that were recently destroyed by the Taliban regime. Alfred states, "I think the sates should have been let alone were they were made. Who know's how long they took to make and keep them in good shape and in one piece." The previous day in class we held an informal debate regarding the preservation of art. Although Alfred misunderstood the online article and failed to realize that the statues had already been destroyed, he succeeded in connecting the two discussions. He also began to ask questions instead of refusing to do the activity and parroting his favorite line, "I don't get it." The online discussions gave me my first opportunity to see Alfred focused and determined to input his ideas.

All Voices Are Heard

Cezanne is another low performing student who does not qualify for special services. She struggles with reading, spelling and verbal directions. In class, students

are often asked to share their written work with their peers and Cezanne struggles every time. Students cannot read her work and often give up or comment in a fashion that leaves her defeated. She is extremely self-conscious about her spelling. To her credit, she often volunteers to read aloud, yet struggles to restate what she has just read. When we began the Online Discussion, I wondered how she would feel having her work publicly displayed. She surprised me. Cezanne responded thoughtfully and carefully edited her work to an extent I never knew she was capable of. As a result, she was most often the last student finished, but she was proud of her work. A couple of times she voluntarily gave up her break to finish her response. Her insightful response to the Egypt prompt shows high level inferencing, "I think that someone that was very pouerfull wrote this, and they were there during the time when the land was rich with watter and thay ned somone to thank. so thay ch to wershp Ra for it."

Reflection and Re-thinking

Jun is a high performing, quiet student. English is his second language and he rarely participates in class discussion unless called upon. Even during Socratic Seminars where students are scored based on their style and amount of participation, Jun struggles to jump into the conversation. However, Jun's participation blossomed during our online discussions. After our first session, I was taken aback by the length of Jun's response. I had never heard that much from him at one time. The next day, I read a couple of responses aloud to the class including Jun's response to Hammurabi's Code. "Final response- I still think that these rules are a bit too cruel. All of the rules lead to a death or some kind of severe punishment. I think Hammurabi is over reacting to just a small punishment. All though some of these laws were fair, others were not. One of the laws were to cut off a mans hand, if failed to cure another man of a deases. That I think is inconsiderate, and is tampering with

the man's rights as well as his life. His quote, "I have brought justice to all my subjects," I think he is wrong. I think that he is only making these rules to what he wants, not what's right for the society for the Sumerian civilians/public." Here Jun demonstrates a confidence in sharing his opinion. In class, Jun continues to share very little.

Conclusions

Overall, the online database seemed to offer all students an opportunity to participate and challenge themselves. Low performers like Alfredo, were able to use the history tools to find a concrete way to respond to the prompt and enter the discussion. Students like Cezanne, who often turn in smudged, messy, disorganized papers, were able to view their own response in a format which looked neat and uniform. Students that usually took little care and time with their work, now seemed to show greater interest and pride in their work. Cezanne, who in class often asked me to repeat directions several times, enjoyed the freedom and independence of viewing the assignment online. Quiet students like Jun seemed to find the online discussions a safe way to participate and share their thoughts.

Because a real time conversation dictates that one student is speaking at a time and the rest are listening, it follows that fewer students are able to participate in class than in an online discussion. As a teacher, I am excited to find that online discussions truly hold students accountable for participation and challenge each student to do their best. At the end of each online session, I hold responses from each student in my hand. Students who for one reason or another, did not participate in class discussions, can now "see" their thoughts and input as part of the class as a whole. Still, some students missed the face to face interaction and drama of real time discussions. It is clear that students benefit from this type of discussion, but because the online environment maintains that each student add something to

the conversation, incorporating a balance of both forms of discussion would encourages the best from all students. The database gives each student the time and space to blossom.

Another valuable feature of the online database is that students can search the responses of their peers. John mentioned that this bothered him because he felt it encouraged students to copy each other. On the contrary, I feel it supported students to state their opinions, hunches and make predictions. I watched unsure students hesitate, search and review others' responses and then write a response of their own. In essence, this allowed students the ability to confer, collaborate and build upon each other's ideas while a larger issue was discussed, something that is not as easily done in a 45-minute class period without interrupting the flow of the conversation.

I found that once students have input their initial thoughts and checked each other's responses, it is still necessary, to respond to them as a teacher. After the first discussion, I read particularly thoughtful responses to the class and surprised them with their own intelligence. I addressed questions that came up and helped clarify some general misconceptions that were evident from the class report. I also thought it would be good for the students to look back on what they wrote earlier, so after we finished our Egypt unit, students searched the database and then entered a final response regarding Egypt and the Nile, correcting or confirming any of their previous assumptions. This seemed to be somewhat successful and offered the students a chance to show off what they had learned. Even students who felt they had nothing to add, felt compelled to input something.

Since I can easily track the responses of each student, the database allows me to chart student improvement and participation. By searching the database by subject or discussion topic, I can evaluate concepts and ideas my students struggle with in order to give them further assistance and tailor my lessons. Organizationally,

the database offers me a multi-faceted research tool to improve my own teaching. I think the database has the potential to grow into an invaluable teaching tool that allows students to use technology to improve their learning. If more teachers and students become involved in the collaborative process the database encourages, in effect we are using the microcosm of our own classrooms, to teach the strategies and benefits of collaborating world wide.

Overall, the online discourse database seems to challenge all students to improve their analytical thinking skills. Students are encouraged to move beyond Bloom's lower order cognitive skills such as "list, name, recite" towards greater fluency and use of higher order thinking skills as "evaluate, critique, and formulate." It is possible for students to move beyond their current analytical ability because the history tools provide the initial scaffolding support and the database results provide models of student thinking. At its best, the online discourse database is a true example of reciprocal teaching.

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School Change with Technology: Crossing the Digital Divide

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ABSTRACT
Closing the digital divide requires much more than buying equipment, it requires increasing the knowledge and skills of teachers using the technology, and access to digital tools in the community. In such a larger system of change, technology can serve as a catalyst for increasing teacher and student learning.

The Anaheim City School District (ACSD) tackled the problem of closing the digital divide by creating the Technology Learning Community. This community approach to school change engaged students, teachers, and principals of two schools, researchers from two universities, school and local librarians and members of the Hispanic community in a process of continual learning centered on the use of technology.

In this paper, we explore the process of school change documenting the school and community efforts to close the technical, cultural, and structural dimensions of the digital divide. These changes are evident on test scores but even more so in changes in the way teachers relate to their own learning and to that of their students.

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An AlphaSmart for Each Student: Does Teaching and Learning Change with Full Access to Word Processors?

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Introduction

Over the past decade, the presence of computers in schools has exploded. Whereas schools had one computer for every 125 students in 1983, they had one for every 9 students in 1995, and 1 for every 6 students in 1998 (Market Data Retrieval, 1999). Among the many ways in which teachers use computers during instruction, computers are used most often for student writing (Becker, 1999). As several studies demonstrate, regular use of computers for writing over extended periods of time can lead to significant improvements to students' writing skills (see Russell & Plati (2001) for a fuller review of the literature on computers and writing). To capitalize on these benefits, a few schools have made computers available to all of their students (i.e. a 1:1 ratio of students to computers). In most schools, however, the relatively high cost of computers prohibits schools from acquiring a sufficient quantity of computers for all students to use simultaneously.

In attempts to provide an entire class of students with computer access, some schools place large numbers of computers into a shared computer lab. Other schools have experimented with mobile carts of laptop computers which teachers can sign out and bring into their classroom as needed. While these strategies succeed in providing large numbers of students simultaneous access to computers, it often encourages teachers to treat working with computers as a special event rather than a practice central to their classroom teaching. Additionally, sharing limited resources across multiple classrooms is difficult with the demand exceeding the school's computer resources. For example, an English teacher who wishes to bring his 10^{th} grade class into the computer lab for a word processing exercise can only do so if the lab is not being used by another teacher. To schedule multiple classes into a communal computer lab is often so difficult that many teachers do not depend on such access and forgo using computers with their students (Cuban, 2001).

However, the introduction of portable writing devices, such as AlphaSmarts, DreamWriters and eMates, provides schools with a more affordable option that allows all students to write with a word processor in their classrooms.

Picture of AlphaSmart 3000

Picture of students composing text with AlphaSmarts

These devices are capable of running basic word processing programs allowing students to compose, edit, cut-copy-and-paste text, print, and in some cases perform spell-checking. Moreover, schools are able to purchase six to eight portable writing devices for the same price as one desktop computer. Instead of sharing a limited number of computers in a classroom or taking turns using computers in a lab, portable writing devices can enable all students within a classroom to write simultaneously using word processors.

Although portable writing devices are relatively new to schools, their presence is increasing rapidly. At last estimate, there are between 800,000 and on million AlphaSmarts in approximately 40% of American schools. Although the number of computers in schools still outpaces the quantity of portable writing devices, schools are rapidly turning to portable writing devices as a strategy for providing all students regular and extended time writing with a word processor.

Although increasing numbers of schools are investing in portable writing devices, few have attempted to provide one device for each student. Instead, classroom sets of portable writing devices are often shared across classrooms or classrooms are equipped with a limited number of devices that are shared among students. As an example of the latter, Wellesley Public Schools, a suburban district near Boston, has placed six to eight AlphaSmarts in each third, fourth and fifth grade classrooms. Although students make regular use of the AlphaSmarts in their classrooms, students are often unable to access the device when needed because other students are using them. In the current study, we use a variety of methodological tools (teacher interviews, student interviews, student drawings, and over 50 classroom observations) to examine what happened in three Wellesley 4th grade classrooms when each student received their own AlphaSmart. Before describing our methodology and presenting the results of this study, we first summarize the literature on the effects of computers and writing as well as research on laptops and portable writing devices in schools.

Computers and Writing

The research on computers and writing suggests many ways in which writing on computers may help students produce better work. Although much of this research was performed before large numbers of computers were present in schools, formal studies report that when students write on computer they tend to produce more text and make more revisions. Studies that compare student work produced on computer with work produced on paper find that for some groups of students, writing on computer also has a positive effect on the quality of student writing. This positive effect is strongest for students with learning disabilities, early elementary-aged students and college-aged students. Additionally, when applied to meet curricular goals, education technology provides alternative approaches to sustaining student interest, developing student knowledge and skill, and provides supplementary materials that teachers can use to extend student learning. As one example, several studies have shown that writing with a computer can increase the amount of writing students perform, the extent to which students edit their writing (Dauite, 1986, Vacc, 1987; Etchinson, 1989), and, in turn, leads to higher quality writing (Kerchner & Kistinger, 1984; Williamson & Pence, 1989; Hannafin & Dalton, 1987).

Research on Laptops and Portable Writing Devices

During the late 1990's, a small number of schools began experimenting with providing every student with a laptop computer. In most cases, students were allowed to use the laptop in school and at home. These experimental programs were funded through special fund raisers (Stevenson, 1999), local donors and grants (Cromwell, 1999), and increases in tuition at private schools (Thompson, 2001).

Although much of the research on laptop programs is still on-going, preliminary findings report several positive effects. Focusing on laptop programs in Carmen Arce Middle School in Connecticut, Cromwell (1999) provides anecdotal evidence from staff and administrators that laptops have increased students' sense of excitement about learning as well as their interest in research and writing. This finding is echoed by Rockman (1998) who reports that the use of laptops has led to an increase in student motivation and a movement toward student centered classrooms. In Town County Middle School in Georgia, Baldwin (1999) reports that after implementing a laptop program, average daily attendance increased, tardiness decreased, and disciplinary referrals decreased. In addition, teachers reported an increase in students' willingness to revise their work and an increased efficiency in introducing students to more advanced mathematics. Students also reported spending more time on homework and less time watching television (Baldwin, 1999).

In Kent Center School in Connecticut, Guignon (1998) reports that the amount of literary analysis and the subsequent quality of analysis improved greatly when students were provided with their own laptops. Stevenson's (1999) research in Beaufort County, South Carolina, reports that the standardized tests scores for students who participated in a laptop program for two years increased while scores for students who did not participate were unchanged. Stevenson also reports that improvements were greater for females and that students from poor economic backgrounds benefited the most from the project.

Overall, the small amount of research published to date on laptop programs suggests that providing one laptop for each student increases student motivation and can have positive impacts on student learning. In addition, the often-cited and controversial issue of equity is solved when each student is provided with the same resources. Unfortunately, the prohibitive cost of laptop computers make it difficult for most schools to provide each student individual laptops. As described above, however, portable writing devices provide a less expensive approach to providing each student with a digital writing tool. Despite the increasing use of portable writing devices in classrooms, our review of the literature failed to identify any published research on the impact these devices have on teaching or learning. Our search, however, did find one study archived in ERIC that focused on the use of eMates for journal writing in a single fifth grade class of sixteen students. This study reported that using eMates for journal writing resulted in students writing about the same number of words as when they used paper and pencil. The author, however, notes that students' interest in journal writing increased when students used eMates (Padgett, 2000).

The study reported here emerged from a question posed to us by the Wellesley (Massachusetts) Public Schools: "How does teaching and learning change when each student is provided with their own AlphaSmart?" In other words, what classroom practices change, if any, when the ratio of students to technology is increased from about 3 to 1 to 1 to 1? Specifically, what kind of changes occur in the way that students produce work, interact with each other, and interact with their teachers when they are provided full access to their own AlphaSmart. To provide an answer to the posed question, we devised a research design that included classroom observations before and after the AlphaSmart ratio was increased, student interviews, teacher interviews and student drawings. Below we detail our methodology and present the findings from this study.

Methodology

To examine the ways in which teaching and learning change when classrooms are equipped with one AlphaSmart for each student, a combination of data collection methodologies were employed. These methods included classroom observations, student interviews, teacher interviews, and drawings produced by students of themselves working during Writer's Workshop. Data collection occurred in three fourth grade classrooms in one elementary school located in Wellesley, Massachusetts. The three teachers were identified by the district and were selected because they all agreed to participate and taught in the same school. Prior to this study, their level of instructional uses of technology ranged from several times a day to once or twice a week. Although the district is generally regarded as serving students whose families are financially secure, the three classrooms also contained students who lived in a local public housing unit. In addition, one or two students within each classroom participated in the METCO program which brings students from Boston to suburban schools. Finally, the classrooms were fully inclusive and included approximately twenty-four students with a range of special needs.

As in all fourth grade classrooms across the district, these classrooms were equipped with five computers (three or four being desktops and one or two being iBooks), six to eight AlphaSmarts, and at least one printer. Throughout this paper each classroom/teacher is identified and referred to by the letters: "A", "B" and "C".

At the start of the study, the teachers differed with respect to their instructional uses of technology. While all three used technology regularly for personal and professional purposes, Teacher C used technology the most for instructional purposes. To assure that all students had an opportunity to use AlphaSmarts, Teacher C developed a rotation schedule that assigned students to computers, AlphaSmarts and paper-and-pencil each day. Teacher A also used technology often with her students, but did not require or actively encourage students to use AlphaSmarts or computers for writing. Instead, she allowed students to choose their preferred writing tool. While Teacher B often encouraged, and at times required, students to produce final drafts in digital format, she required students to perform all first drafts on paper. Only after students completed a first draft on paper could students in this classroom transcribe and then edit their work using an AlphaSmart or computer. It should also be noted that prior to this year, Teacher B had taught early elementary students.

A description of each methodological procedure is presented separately below.

Classroom Observations

Classroom observations were conducted in each of the three classrooms during the late fall and then again during the late spring by a single blind observer. In the fall, each classroom was equipped with six to eight AlphaSmarts. Following winter recess, the number of AlphaSmarts in all three classrooms was increased so there was one AlphaSmart available for each student. Teachers were given three months to develop classroom policies and practices regarding the use of AlphaSmarts before the second set of classroom observations were conducted. To examine changes that may result due to the increased availability of AlphaSmarts, observations were conducted during science, social studies and language arts instruction (Writer's workshop). Anticipating that the most use of AlphaSmarts would occur during language arts instruction, the majority of the observations within each classroom were conducted during Writer's workshop. Due to the fact that the social studies curriculum had been covered in the three classrooms before the second set of observations occurred, no observations during social studies were recorded for Spring. Table 1 shows the number of observations that occurred during each subject within each classroom.

Table 1: Number of classroom observations conducted by subject area

	Classroom A	Classroom B	Classroom C
6–8 AlphaSmarts per class (Fall)			
Language Arts	6	6	6
Science	3	3	3
Social Studies	3	3	3
AlphaSmart for every student (Spring)			
Language Arts	6	6	6
Science	3	3	3
Social Studies	0	0	0

All observations were conducted by an observer who was "blind" to the treatment. That is, the observer was not informed that the number of AlphaSmarts in each classroom was increased between the fall and the spring. This decision was made so as to increase the likelihood that the observer would not focus exclusively on those students who worked with AlphaSmarts. During the course of each observation, the observer was instructed to record as much of what occurred in the classroom as possible. In particular, the observer was asked to focus on:

- the activities teachers and students engage in
- the tools teachers and students use
- the location in which teachers and students work
- conversations and interactions between teachers and students

Thus, the observations became a running record of as many events that the observer was able to record within each observation period. For all observations, the observer recorded notes on a laptop computer and generally sat in one corner of the room. After each observation session, the observer would review, elaborate and edit his notes to produce a detailed description of what occurred during each period of instruction. During each observation, the period of instruction ranged from thirty to sixty minutes. The participating three teachers generously had an open-door policy with the observer who was free to drop in and visit classrooms without formally scheduling dates and times.

After all observations were complete, the observation data was analyzed in three ways. First, the observer was asked to review his records and to identify any changes that he observed between the fall observations and the spring observations. Next, a second person who was also "blind" to the study and who had never visited the classrooms was asked to review all of the observation transcripts and identify any changes he saw between the fall and the spring. Third, a formal analytic content analysis was conducted, for which observation records were systematically coded using HyperResearch and patterns and changes over time were examined.

The codes used to categorize the observation texts were developed through a four-step process. First, drawing upon the observations of the observer and independent reader as well as literature on how computers impact teaching, learning and classroom culture, an initial list of codes was created. This list of codes was organized into four broad categories:

- Teacher Actions
- Individual Student Actions
- Student-to-Student Actions
- Classroom Environment

Next, the initial list of codes was applied by two different raters to a small sample of the observations. During this time, the coders were asked to develop new codes as needed. After reviewing the utility of the initial codes and the new codes that emerged through this trial period, a new list of codes was developed. This new list of codes was then applied to a second sample of five observation reports and the inter-rater reliability was assessed. When examining the inter-rater reliability, it became clear that the meaning of several codes remained ambiguous. For this reason, we again reviewed the codes, developed operational definitions for each code and retrained the raters so that

a common understanding for each code would be reached. The revised coding scheme was then applied by the two raters to a third set of classroom observations. The inter-rater was re-examined and found to be acceptable. A single researcher then coded all of the observation reports. The master list of all codes used in the content analysis of the classroom observations appears in Appendix A.

With a reliable and operationally defined coding scheme, two approaches were used to analyze the content analysis results. First, the quantity of each code applied within each classroom was compared over time (Fall versus Spring). Based on the initial pattern of changes, both specific codes of interest as well as those that appeared to change over time were used to identify issues to explore further. For this further exploration, the specific blocks of text associated with each code were examined to develop a deeper understanding of what actually changed, if anything.

Student Interviews

To develop a better understanding of how increased access to AlphaSmarts impacted the ways in which students worked in the classroom, six students from each of the three classrooms were interviewed by a researcher at the completion of the study. Within each classroom, teachers were asked to divide students into three groups: high achieving, average and low achieving. Two students from within each subgroup per classroom were randomly selected to be interviewed (n=18).

The interviews focused on the following seven questions:

1. In the fall, did you ever use an AlphaSmart? If so, describe how you used AlphaSmarts in the fall?
2. In the fall, did you prefer to write first drafts on paper or on an AlphaSmart? Why?
3. Did your use of AlphaSmarts change after your class was given one for each student? If so, how?
4. Do you produce better work when you work on paper or with an AlphaSmart?
5. What was your favorite and least favorite things about using AlphaSmarts?
6. Did your teacher have any rules or policies about when or how often you could use an AlphaSmart in the fall...in the spring? If so, what were they?
7. How would you feel if AlphaSmarts were removed from your classroom?

Notes were taken as students responded to each question. After all interviews were completed, the notes were coded using HyperResearch.

Student Drawings

Although student drawings are an unusual tool for collecting information about students and their classrooms, Haney and his colleagues have used drawings in this way on several occasions (see Wheelock, Bebell & Haney (2000) for a review). To triangulate information provided by the student interviews about their use of AlphaSmarts

during writing, all students were asked to participate in the drawing exercise after the completion of the study (Spring). Specifically, students in the three classes were asked to draw a picture of themselves at work during their Writer's Workshop class. Specific features of the drawings were then coded using an emergent analytic technique. The specific features coded in the drawings fell into four broad categories: Student Characteristics (what the students were doing), Technology Present (type of technology depicted), Student Demeanor (whether the student was depicted positively, negatively, or neutral), and Other features (presence of teacher or other students, classroom decorations, multi-frame drawing).

Ideally, student drawings would have been collected at the beginning of the study (i.e.., in the fall) and at the completion of the study (i.e., in the spring). However, the participating teachers initially were reluctant to use student drawings, so they were not administered in the fall. After working with the classroom observer throughout the year, the teachers re-thought their decision about student drawings and granted permission to administer the prompt in the spring. Although it would have been more powerful to compare images produced in the fall and the spring, we are only able to present drawings produced in the spring.

Teacher Interviews

In addition to collecting information from the classroom itself (observations) and the students (student interviews, drawing exercise), the three participating teachers were interviewed after all observations were completed. Again, the researcher conducting the interview recorded responses and results were coded and analyzed via content analysis.

Results

The current study aimed to document and analyze the changes that occur when there is a marked increase in the technology resources inside a self-contained elementary school classroom. Specifically, multiple methods of inquiry were used to study how the classroom experience changed in three 4th grade classrooms when the ratio of AlphaSmarts to students was increased from 3:1 to 1:1. These results represent an amalgamation of teacher and student interviews, student drawings and over 50 classroom observations performed throughout the school year.

The results of the study are reported in two ways. First, the results of the classroom observations, student drawings and teacher interviews are summarized in tables below. The results of the different methodologies are then used to support five main findings of this study. Note that the range of responses provided by students during interviews could not easily be summarized in a table form. For this reason, the student interviews are not summarized in this section, but are integrated into the presentation of main findings.

Classroom Observations

As previously discussed, the classroom observation were analyzed three ways. The blind observer offered a holistic impression of the observations after the observations were conducted, a second "blind" researcher read all of the transcripts and offered his own holistic impressions of what happened and the transcripts were empirically coded using content analysis. The chief findings of the content analysis are displayed in Figure 1.

Figure 1: Content analysis of Classroom Observations Results (Total)

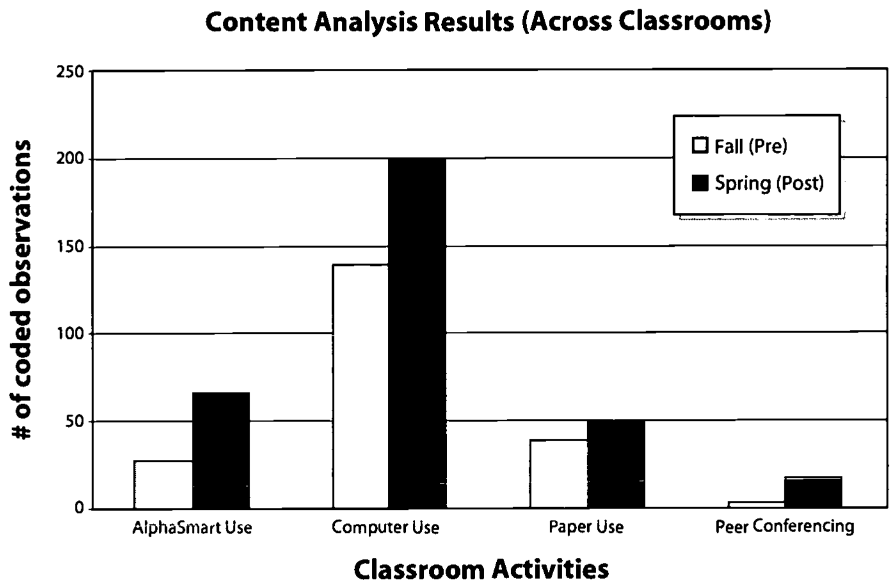


Figure 1 shows the number of times different classroom activities were captured in the classroom observations both in the Fall before the increased technology was introduced and in the Spring when each student had his/her own AlphaSmart. First, it is evident that computer use is more prevalent than Alphasmart and paper and pencil use in the observations for both Spring and Fall. This does not mean that each student used the computer(s) more than AlphaSmarts or paper and pencil but that the number of times in which the classroom observer wrote about computers and computer use in the classroom was greater than the other technologies. When reviewing the transcripts of the observations, computer use is more often referred to because students typically took turns using the classroom computers during the course of a single observation. When students were using paper and pencil or AlphaSmarts they typically used that technology for the duration of the class. Therefore, when the classroom observer records each time a different student uses the computer, the frequency of computer use in the content analysis is inflated by the short and shared nature of its use. Despite this, it should be apparent that across the three classrooms students engaged in computer use, AlphaSmart use and paper and pencil use both in the Fall and Spring observations.

Figure 1 also shows that across the three classrooms AlphaSmart use, computer use, paper and pencil use and peer conferencing all increased in the Spring after the increased technology was introduced. Specifically, the most dramatic increase in the coded classroom observations was found for AlphaSmarts where use increased more than two-fold. This finding is especially powerful considering that the frequency counts of the classroom observations are biased towards those classroom activities that involved shuffling students and shared resources. In other words, the increase in AlphaSmarts as evidenced by the frequency codes of a content analysis of the observations is a conservative estimate of the increase in use that actually occurred in the classrooms. Computer use across the three classrooms also exhibited a notable 30% increase in the content analysis codes. An increase was also found in the paper and pencil use across the three classrooms, although to a much lesser extent than AlphaSmart and computer use. Since one of the goals of the research was to look beyond just technology use we have examined if student to student interactions seemed to change after the increased technology was introduced. To this end, we see that the number of times peer conferencing was coded in the content analysis before the influx of new technology was virtually non-existent and rose to 17 separately coded events in the Spring observations across the three classrooms, a substantial increase.

An alternative approach to examining changes in the types of classroom behavior is to express the propotional change in number of times a given event is captured in the spring observations relative to the fall. For each code presented in Figure 1, a proportional change was calculated by dividing the large number of codes assigned during one time period by the number of codes assigned during the other time period and then subtracting one (so that no change is represented as a 0). If the number of coded observations increased between the fall and the spring, the propotional change is positive. If the number of codes decreased between the fall and spring, the propotional change is negative. For example, the overall number of coded observations containing AlphaSmart use in the Fall and Spring was 27 and 66, respectively. By dividing 66 by 27 and then subtracting one, it is possible to acquire a sense of the relative increase in use that occurred after the additional technology was introduced to the classrooms, which in this case is an increase of 1.4. If there was no difference in the frequency of codes from Fall to Spring the effect difference would be 0. Figure 2 shows the proportional change for AlphaSmart use, computer use, paper and pencil use, and peer conferencing across all classrooms and within each individual classroom.

Figure 2: Proportional change for the three participating classrooms

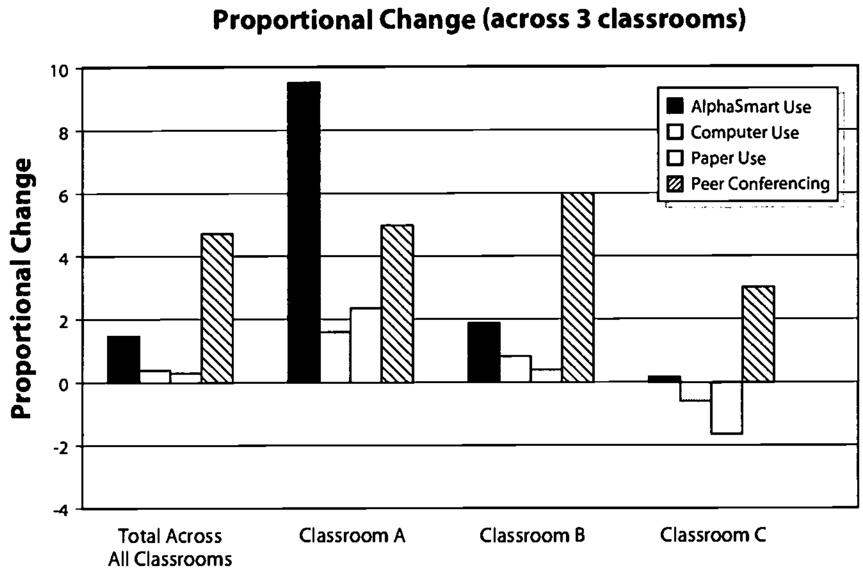


Figure 2 shows that the increase in AlphaSmart use was evident for each of the classrooms, however, the extent of the increase varied greatly. This effect difference ranged from classroom A's nearly ten-fold increase to classroom C's fairly insignificant 0.2 increase. Computer use also rose for two of the participating classrooms (A and B) but fell slightly for classroom C in the Spring. The same general pattern was repeated for paper and pencil use with greatest increases in classroom A, very little difference in classroom B and a nearly two-fold drop in classroom C. Peer conferencing rose fairly dramatically in classroom A and B and to a lesser extent in classroom C. However, it is important to remember that the large effect increases in peer conferencing are undoubtedly a product of the fact that peer conferencing codes were almost nonexistent in the Fall observations. From these findings it is evident that the classrooms changed after the technology was introduced. It is also evident that the type and degree of change was not "constant" across the three participating classrooms.

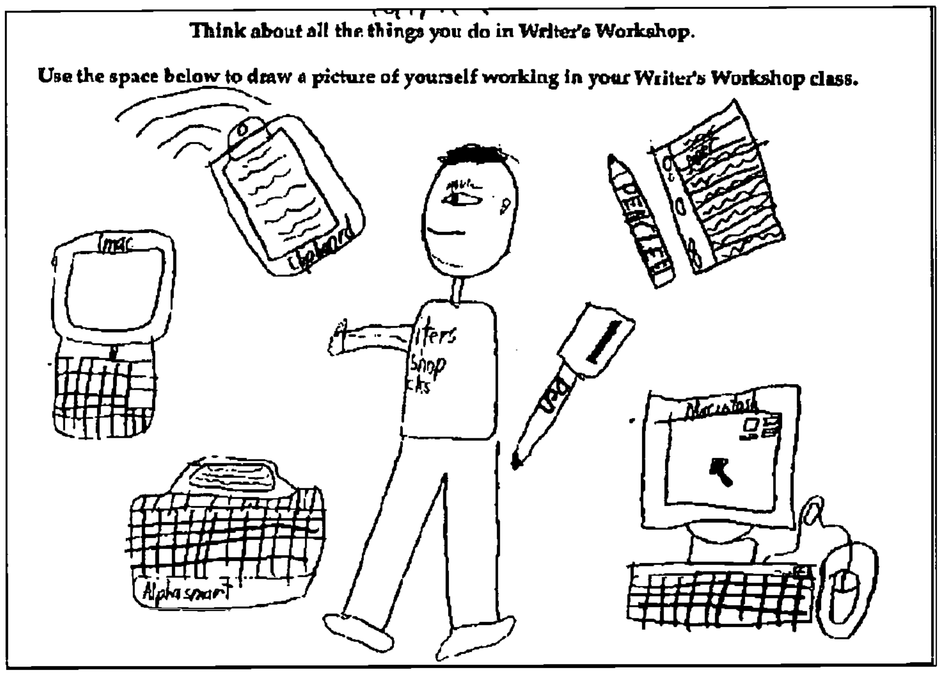
Student Drawings

In addition to the classroom observations, we also attempted to get the often overlooked student perspective through a post-study exercise where students were asked to depict themselves working in their writing class. The drawings were examined holistically and then coded using an emergent analytic coding matrix developed specifically for this drawing prompt. Table 2 displays the frequency of different content areas coded in the student drawings across the three classrooms.

Table 2: Characteristics of the student drawings for the three classrooms

	Class "A"	Class "B"	Class "C"	Total
Student characteristics				
At desk	50.0%	66.7%	42.1%	52.9%
Writing with pencil	16.7%	44.4%	15.8%	25.6%
Writing with AlphaSmart	22.2%	33.3%	15.8%	23.8%
Writing with iBook (laptop)	0.0%	5.6%	5.3%	3.6%
Writing with desktop	44.4%	27.8%	31.6%	34.6%
Thinking	11.1%	0.0%	0.0%	3.7%
Reading	5.6%	0.0%	10.5%	5.4%
Talking with teacher	5.6%	0.0%	5.3%	3.6%
Talking with other student	0.0%	0.0%	0.0%	0.0%
Technology present				
AlphaSmart	38.9%	44.4%	42.1%	41.8%
iBook (laptop computer)	11.1%	5.6%	5.3%	7.3%
G3 (desktop computer)	55.6%	27.8%	36.8%	40.1%
Paper	44.4%	50.0%	42.1%	45.5%
Pencil	33.3%	50.0%	15.8%	33.0%
Other				
Other students present	11.1%	0.0%	0.0%	3.7%
Teacher present	5.6%	0.0%	15.8%	7.1%
Classroom Aecorations	0.0%	0.0%	0.0%	0.0%
Multi-frame drawing	11.1%	11.1%	0.0%	7.4%
Classroom Aecorations	16.7%	0.0%	5.3%	7.3%
Student Demeanor				
Positive	27.8%	33.3%	52.6%	37.9%
Negative	0.0%	0.0%	0.0%	0.0%
Neutral	22.2%	33.3%	31.6%	29.0%
Can't Discern	50.0%	33.3%	10.5%	31.3%

The student drawing results shows that students across the three classrooms were about as likely to depict an AlphaSmart or computer as they were paper and pencil when depicting their writing class. Additionally, many students depicted their writing class as involving both high-tech tools (laptop computers) and more traditional tools (clipboards and pencils). The drawing reproduced below illustrates such a depiction.



Teacher Interviews

After all classroom observations were complete, the three participating teachers were interviewed. Their responses are truncated and reported in Table 3.

Table 3: Teacher responses from the post-study teacher interview

Questions	Teacher "A"	Teacher "B"	Teacher "C"
How has the increased availability of AlphaSmarts changed instruction in your classroom?	flexibility and availability	less logistics/ management troubles	parents more involved
After AlphaSmarts were made more available in your classroom, did you use them more for writing across the curriculum (e.g., social studies journals, math journals, science reports)?	Yes	Yes	Yes
How has the increased availability of AlphaSmarts changed the way students produce work in your classroom? In which subject areas?	increase in productivity and writing	increase in productivity and writing	increase in writing and comfort level
Did more students use AlphaSmarts when they were made more available?	Yes	Yes	Yes
Did the increased availability of AlphaSmarts benefit all students? Did all students regularly use an AlphaSmart? If not, briefly describe why you think some students opted not to make use of the AlphaSmarts.	yes	All but 1 dyslexic boy	Yes
How has the increased availability of AlphaSmarts changed classroom management and.or the logistics of managing use of technology in your classroom?	Improved logistics/ management	Improved logistics/ management	Improved logistics/ management
Has the increased availability of AlphaSmarts led you to develop or modify any policies or classroom rules related to the use of technology?	Yes	Yes	Yes
What was the biggest surprise or unexpected result of increasing the availability of AlphaSmarts in your classroom?	Ease and comfort level	Ease	Ease in big project, more work at school
Describe any positive effects the increased availability of AlphaSmarts has had in your classroom?	classroom management	ownership, logistics	independence, ownership,
Describe any negative effects the increased availability of AlphaSmarts has had in your classroom?	none	not always enough computers for editing and uploading	getting things up and running (wires, etc.)
Has the increased availability of AlphaSmarts changed the frequency, ways and location in which students use technology? (Please address all three issues.)	take them home, increased use overall	kids from Boston could access them in the morning	mobility increased, more use
Did any students take AlphaSmarts home? If so, what type of students? How often? For what purpose? Did you encounter any problems when students brought AlphaSmarts home?	Yes, for big projects	Yes, for big projects	Yes, for big projects
Did the increased availability of AlphaSmarts impact the quality of student work?	Yes, punctuation, and grammar rules increased	Yes, spelling, editing were better	Yes, publishing was increased too
What additional supports would you like to have in order to make the use of AlphaSmarts easier in your classroom?	Space, cable entanglement	additional tech savvy staff	setting up cords, batteries, etc.

The agreement between the teachers is highly evident in their responses as well as their overall positive impression of the additional technology in their classroom. Specific responses and sets of responses are detailed below in the research findings and discussion section of this paper.

Research Findings

The purpose of this study was to examine how teaching and learning change, if at all, when each student is provided with his/her own AlphaSmart. The results presented in table form above indicate that several aspects of teaching and learning did change when the ratio of students to AlphaSmarts increased from approximately 3:1 to 1:1. Looking across all forms of data, including classroom observation, teacher interviews, student interviews and student drawings, five major findings were identified. These findings include:

1. There was a clear increase in student's use of AlphaSmarts after each classroom was equipped with one AlphaSmart per student. For many students, AlphaSmarts became the preferred tool for writing. This increased use of AlphaSmarts also altered the way desktop computers were used.
2. The 1:1 student to Alphasmart ratio led to changes in the way each teacher thought about and used technology with their class. This effect was evidenced in both policy and practice. When every student had the same resources (i.e. 1 AlphaSmart), the management of the technology was generally easier and less time consuming for the teachers. To this end, the teachers who made the most extensive use of technology in their lessons found the greatest degree of improvement in general classroom management.
3. When each student was given their own AlphaSmart, a high percentage of students saw word processors as a primary tool for writing. Having unfettered access to their own AlphaSmart also changed the way they approached writing and according to their teachers, nearly universally improved the quality of their work.
4. The 1:1 AlphaSmart to student ratio encouraged a greater sense of student ownership, responsibility and empowerment. This included allowing students without technology resources at home to take the AlphaSmarts home when needed.
5. The increase in AlphaSmarts led to varied results in the three classrooms. In other words, the way in which the new technology was incorporated into each teacher's classrooms was somewhat unique and based upon their own philosophy, pedagogy and approach.

1. There was a clear increase in student's use of AlphaSmarts after each classroom was equipped with one AlphaSmart per student. For many students, AlphaSmarts became the preferred tool for writing. This increased use of AlphaSmarts also altered the way desktop computers were used.

Across all three classrooms, the most obvious and dramatic change that occurred after the classrooms were provided with one AlphaSmart per student was an increased use of AlphaSmarts. The classroom observations documented increased use across subject areas including writer's workshop, science, social studies and was reported by

teachers to have occurred even in math. Additionally, during the student interviews, eight students (44%) described how they used AlphaSmarts throughout the spring to take notes during class and for research projects. One teacher predicted that when the curriculum is revised and updated, the use of AlphaSmarts will be even greater (presumably because the teachers will be more accustomed to using AlphaSmarts in the classroom and because more emphasis will be placed on writing across the curriculum). While the student drawings cannot be used to examine change over time, they do provide confirmatory evidence that AlphaSmarts were used during Writer's Workshop by many students.

More specifically, the holistic analysis of the Spring classroom observations recorded a large increase in the number of students who drafted using AlphaSmarts instead of paper, particularly in Writer's workshop. In turn, students began using the classroom computers less often to draft papers and more often to finalize and "publish" their products. The increase in AlphaSmart use was also evident in the content analyses of the observations. This increased use of AlphaSmarts was paralleled by an increased use of laptops and desktop computers. This use of computer-based technologies was also evident in the student drawings. In two of the three classrooms, only 16% of the student drawings depicted students writing with a pencil, while over 50% of the students depicted themselves writing with a computer-based tool. Similarly, all of the students who participated in the post study interview (n=18) reported that they used Alphsmarts in the Spring as their main editing tool as compared to only about 65% in the Fall.

In addition, eleven students indicated in the interviews that they now preferred drafting directly on an AlphaSmart, whereas in the Fall only six students regularly drafted using an AlphaSmart. Those who preferred writing on an AlphaSmart stated that it is "easier" or "more convenient" to work with an AlphaSmart, that it takes less time to write and revise using an AlphaSmart, and that they preferred "typing" over writing by hand. A few students also indicated that they liked AlphaSmarts "now", suggesting that the students had come to like them since using them more regularly. Other students explained that they could type faster than they can write by hand, that their hands get tired when writing on paper, and that it is more efficient to continuously edit while working on the AlphaSmart.

Finally, the observations documented a change in the way students used desktop computers. In the fall, students seemed to use desktop computers for a variety of reasons including writing, editing, and printing papers, performing searches for specific information and for more general, non-specific browsing. In the spring, students' other use of desktop computers became more purposeful. Rather than simply browsing the internet, students seemed to perform specific searches. As the blind reader described, "when on the computers, students seemed focused a majority of the time on what they are looking for, as compared to before [in the fall] when half of their time was spent in research and the other half browsing." While this change may not be entirely attributable to full access to AlphaSmarts, the emphasis placed on using different technological tools for different tasks (e.g., drafting with an AlphaSmart, finalizing with a computer) may have helped students see computer-based technologies as tools rather than toys. Moreover, the universal increase in the use of technology that resulted after full access to AlphaSmarts was provided may have encouraged students to be more efficient in their use of desktop and laptop computers.

2. **The 1:1 student to AlphaSmart ratio led to changes in the way each teacher thought about and used technology with their class. When every student had the same resources (i.e. 1 AlphaSmart), the management of the technology was easier and less time consuming for the teachers.**

During the teacher interviews, all three teachers noted several times that the increase in AlphaSmarts allowed the learning environment to become more dynamic and flexible than in the fall. Several factors contributed to this change. First, the ability to have all students use an AlphaSmart at the same time decreased the need for teachers to manage whose turn it is to use AlphaSmarts and computers. Whereas the almost daily ritual of assigning which students could use technology and which students had to work on paper appeared regularly in the Fall observations, the ritual was absent from the Spring observations. This logistical improvement in the management of classroom technology was repeatedly noted by each of the teachers during interviews and was deemed one of the most important changes that resulted from full access to AlphaSmarts.

Second, full access to AlphaSmarts enabled the teacher to have all students work on the same activity at the same time. As a result, the teacher and aides were better able to identify students who were in need of assistance and to work individually with students as they worked on their writing or research. In turn the amount of whole class instruction decreased while the amount of individual attention provided to students by the teachers and aides increased.

Third, rather than a handful of students printing work, uploading and editing work on the laptop and desktop computers, and/or saving work to the server, all students performed these tasks on a regular basis when one AlphaSmart was available for each student. As a result, students' comfort and skill with the technology increased as did the use of computer-based technologies in the classroom. In turn, the amount of time teachers spent helping students with "technical" problems decreased. As an example, during an observation conducted in the fall, the observer noted that "since the kids have started using computers [during the observed lesson] the teacher has spent 75–85% of her time helping students find files, websites and answer technical questions about saving files to the server." In the spring, the amount of time teachers spent providing technical help decreased noticeably and was replaced by teachers working independently with students on their writing.

Fourth, the spring observations documented students working more with each other and in more creative ways. As an example, a small group of students in one classroom developed the idea of selecting their favorite stories written that year and combining them into an anthology. As the observer wrote, "These anthologies of student work are pretty easy to make because the students' stories are all saved as files on the server. The teacher remarks that a lot of kids really like the idea and it was great...she only wishes that she had thought of it herself."

Finally, full access to AlphaSmarts led teachers to change their policies regarding use of technology in the classroom. In one classroom, the Teacher encouraged all students to produce drafts on paper during the fall. Students could then use the AlphaSmarts or computers to type in their text and perform further edits. In the other

classrooms, throughout the fall students were free to use AlphaSmarts to produce drafts (when it was their turn to have an AlphaSmart), but they could also use computers to draft. In these two classrooms, the teachers did not seem to have any restrictions or specific rules about use of computers. However, during the spring all three teachers limited the use of desktop computers during Writer's Workshop to editing and printing, only. One observation specifically described an incident in which a student asked several times to use a stationary computer for composing text but the teacher refused because the student had not yet completed a first draft using her AlphaSmart. A few minutes later, another student began drafting text on a desktop computer and the girl reported this to the teacher who then asked the student to stop using the computer and to use the AlphaSmart instead. This same teacher also began to monitor more closely the amount of time students spent working on the desktop computers so that everyone has a chance to upload and finalize work composed with an AlphaSmart.

3. When each student was given their own AlphaSmart, a high percentage of students saw word processors as a primary writing tool. Having unfettered access to their own AlphaSmart also changed the way they approached writing and according to their teachers, nearly universally improved the quality if their work.

When AlphaSmarts were made available to every student, the students began to more clearly see word processing as a primary writing tool. Across all three classrooms most students indicated that the ways in which and frequency with which they used AlphaSmarts changed between the fall and the spring. Before the additional technology was introduced, the majority of interviewed students reported that they usually wrote first, and often second drafts, on paper. Most of these students then transcribed their drafts to a digital format using either the shared AlphaSmarts or computers. While some students indicated that they performed edits as they transcribed their text from paper to computer, for most students this transcription process had little educational value and was an inefficient use of AlphaSmarts.

In the Spring, however, most students composed text directly on an AlphaSmart. In addition, the majority of these students indicated that their editing process occurred concurrently with their drafting process. As they wrote text directly on the AlphaSmart they continually revised their work, sometimes changing individual words and sometimes moving or deleting more extended passages. Other students described pausing at the end of each paragraph to review what they had written so far, making changes as needed, and then continuing with their drafting. Still others indicated that they would complete an entire draft before starting the revising process. Finally, two students indicated that they would upload their text from an AlphaSmart to a computer and would then do all their editing on the computer. Both of these students indicated that it was easier to edit on the computer because their text was more visible (AlphaSmarts only display four lines of text). Despite the strategy students selected, the ability to compose and edit directly on the AlphaSmart increased the efficiency with which students were able to produce writing.

Perhaps more importantly, all three participating teachers reported that the increased technology led to higher quality student work. The teachers elaborated that students were more willing to write longer drafts of their papers for all subject areas

and they "are more apt to remember about paragraphs and quotation and punctuation marks." Another Teacher explained that "once the students became comfortable with the AlphaSmarts they were writing longer, were taking more notes, were taking more risks (in their writing) because they could edit easier." The same teacher also reported that she had witnessed "more note-taking, understanding of phrases versus sentences, more poetry, and more publishing" in the Spring. Teachers saw improvements in the quality of student work for nearly all of the students, with the single exception being a student with dyslexia who found composing her text on paper easier than with an AlphaSmart.

4. The 1:1 AlphaSmart to student ratio encouraged a greater sense of student ownership, responsibility, independence and empowerment.

When each student no longer had to share a limited number of AlphaSmarts, the students in each class developed a greater sense of ownership, responsibility, independence and empowerment. The participating teachers all noted in the post-study interview that the technology was a motivational tool for the students and that by providing each student with their own AlphaSmart to use, each student exhibited a greater sense of importance towards their work. All three teachers spoke of how the students became more responsible and empowered when they had their own AlphaSmart.

Several observations also describe how students took the AlphaSmarts to all corners of the room and often into the hallway or library to write. As an example, one observation described the following: "At 1:45, six kids are using AlphaSmarts at their desks. The kids with the AlphaSmarts are both typing in previously written materials and the others are composing on the AlphaSmarts. Two students are using iBooks at their desks and the same two girls and one boy are working on the big stationary Macs in the back of the room... The [student] gets an AlphaSmart and reads his story to the aide from it...One boy gets an ibook and sits in the corner of the room. Another boy joins him with a clipboard and a draft of his story. The two boys ask each other about each others story." In this way, students were free to choose where in the room they worked with the portable technologies.

In many ways, providing each student with his/her own AlphaSmart greatly reduced concerns about inequitable access and use of technology in the classroom and at home. In the classroom, all students could use an AlphaSmart at any time and began to refer to the AlphaSmarts as "mine" or "his/hers." For those students who did not have a computer at home, having their own AlphaSmart enabled them to bring their written work home with them in a digital format. As one student explained, "I liked that we got to take them home...I wrote at home. When we were doing a report, I'd work on it at home...I also did some free writing at home...I liked being able to bring it home because I could use it to help my little brother." While AlphaSmarts clearly are not as powerful as a standard computer, the ability to bring them home went a long way towards providing all students with a word processing tool that they could use anywhere and at any time.

5. Change occurred across all classrooms, but was mitigated by each teacher's prior instructional practices and uses of technology.

All of the changes described above were evident in each of the classrooms. However, the extent to which these changes occurred varied across classrooms. This variation was related to differences in the instructional practices and uses of technology that teachers employed within their classrooms prior to the provision of one AlphaSmart for each student.

In the Fall, Teacher C made a concerted effort to have all students use technology on a regular basis. Due to limited access to technology, this teacher created a schedule to assign students to different technologies each day. To assure that all students had equal opportunities to use various types of technologies in the classroom, this schedule was strictly followed. Since students used different types of technologies for different activities (e.g. students used desktop and laptop computers for internet searches, desktops for curriculum specific software like Geometer's SketchPad, AlphaSmarts for writing, etc.), the teacher organized classroom instructional time such that multiple activities occurred simultaneously. As a result, some students might be working on a writing activity using AlphaSmarts or paper-and-pencil, while some may be conducting research for a Social Studies project using the laptops, and others worked with mathematics software on the desktop computers.

Teacher A also valued instructional uses of technology, but did not make a concerted effort to have all students use technology. Instead, she allowed students to choose which tools they used. For students that preferred to work on paper, Teacher A did not actively encourage them to try writing with a word processor.

Among the three teachers, Teacher B was the least enthusiastic about technology, but was by no means a technophobe. In many ways, she was like the typical Teacher described by Cuban (2001) in that she used computers regularly outside of instruction and gladly used computers in the classroom when provided with ideas and guidance on how to use them for instructional purposes. For this reason, she tended to use technology for very specific purposes (e.g., mathematics software), but did not actively encourage students to use computer-based technologies on a regular basis. In fact, Teacher B required students to produce first drafts of their writing on paper rather than with a word processor. It should also be noted that although this teacher had taught for many years, this was the first time she had taught fourth grade. Among the three teachers, Teacher B also maintained the most tightly structured classroom environment in which all students were often engaged in the same activity.

After these classrooms were provided with one AlphaSmart for each student, instructional practices changed in all three classrooms. But the type of changed varied between classrooms. In classrooms A and B, universal access to AlphaSmarts led teachers to allow students to use them whenever they wanted. As seen in the classroom observations, there was a dramatic increase in the use of AlphaSmarts in these two classrooms (A and B). During the interviews, these teachers also described how access to AlphaSmarts allowed them to create a more dynamic learning environment. This was most evident in classroom B in which student workspace expanded from their desktops to all corners of the room and often spilled into the hallways. In classroom B, this led to a change in policy regarding the tools students could use when creating

first drafts: no longer were they limited to paper. As a result, students in classroom B worked more regularly with all writing tools in the classroom, including paper, AlphaSmarts, laptops and desktops.

In classroom C, however, the increase in AlphaSmart use was less dramatic. In the fall, Teacher C strongly encouraged all students to work with AlphaSmarts as well as other writing tools. The rotational schedule assured that on any given day, seven or eight students used an AlphaSmart in the fall. The number of AlphaSmarts, however, was a limiting factor in terms of how many students could work with AlphaSmarts at a given moment. In the spring, universal access to AlphaSmarts eliminated the need for a rotational schedule and allowed all students to use AlphaSmarts simultaneously. Thus, the major change in Classroom C between the fall and the spring was not the frequency with which AlphaSmarts were used during a given a class, but the number of students who could use them. Being an advocate for instructional uses of technology, the greatest benefit to having one AlphaSmart per student noted by Teacher C was the elimination of her need to manage and rotate student access to AlphaSmarts.

A second change that occurred in Classroom C related to the number of different activities that occurred simultaneously within the classroom. In the fall, the teacher attempted to maximize student access to technology by having different sets of students work on different tasks. With full access to AlphaSmarts in the spring, all students were more often engaged in the same activity, especially during Writer's Workshop. This focus on a single activity allowed the teacher to spend more time working individually with students.

The ways in which each teacher's policies regarding uses of technology for writing also differed across the classrooms. Being an advocate for technology, the only change in Teacher C's policy was to encourage all students to draft using an AlphaSmart rather than the desktops. Once all students were provided with their own AlphaSmart, Teacher C no longer needed to maximize students' access to word processors by having as many students as possible use the limited AlphaSmarts and have others use the desktop and laptop computers. In addition, given that nearly all students were drafting on AlphaSmarts in the spring, the teacher attempted to maximize the use of desktop and laptops for finalizing papers.

In Classrooms A, in which students were previously allowed to use AlphaSmarts but were not encouraged to do so, full access to AlphaSmarts led this teacher to start encouraging students to use the AlphaSmarts. In addition, this teacher instituted a strict policy that required students to write first drafts and/or to transcribe text originally written on paper using an AlphaSmart. In this classroom, the desktop and laptop computers were reserved for performing Internet searches and for finalizing papers during Writer's Workshop. At one point during the spring, however, this teacher became frustrated with the ways in which students were using technology when they were supposed to be writing. From the teacher's perspective, students were spending too much time changing fonts and focusing on other aspects of formatting rather than on the content of their text. In response, the teacher briefly instituted a policy that all first drafts had to be written on paper and then transcribed to an electronic format. This policy, however, was short lived and was replaced by the prior policy that students had to compose text using an AlphaSmart or on paper and could only use the desktop and laptop computers for finalizing text.

In Classroom B, the teacher's policy changed from requiring all students to draft on paper to allowing students to draft using an AlphaSmart or paper. Like Teacher A, there was a period of time when Teacher B again encouraged students to draft on paper, but this fluctuation was short lived.

Finally, the way in which uses of AlphaSmarts, desktops and laptops in other subject areas changed also differed across the classroom. Beyond allowing all students to use technology at a given time, there was little change in the use of technology in other subject areas within Classroom C. In Classrooms A and B, however, increased access to AlphaSmarts and the resulting increased use of technology for writing seemed to spill over into the other subject areas. Whereas technology was infrequently used in Classrooms A and, especially, B for social studies and science (except to perform web searches) during the fall, technology was used much more often for these subject areas in the spring. Perhaps most notable was the universal use of AlphaSmarts by all students in both classrooms for a Social Studies project that required students to select and write a report about a region or state within the country. For this project all students used AlphaSmarts to record notes and to then draft their reports. As Teacher A later explained, this was the first time she had students take notes and write their first drafts for this assignment using technology. Both Teachers A and B also noted that the use was so successful that they now cannot imagine requiring students to perform this assignment without AlphaSmarts.

In short, providing full access to AlphaSmarts allowed Teacher C to apply her philosophy regarding instructional uses of technology in a more universal manner and without the need to actively manage who had access to technology at a given time. In Classrooms A and B, full access to AlphaSmarts led to meangingful changes in beliefs about and policies regarding use of technology. While both these teachers' policies fluctuated initially, they both ended the year with policies that were consistent with their current belief that drafting with a word processor makes the writing process more fluid and efficient and ultimately helps improve the quality of student writing.

Discussion

This study is unusual in several ways. First, it was initiated by a District that approached us with a relatively straightforward question: How does teaching and learning change, if at all, when each student is provided with his/her own AlphaSmart? The district sought an answer to this question in order to help inform a decision that could have significant budget implications, namely should the district dramatically increase its investment in AlphaSmarts.

Second, to answer the District's question, multiple methods of data collection were employed. These methods included classroom observations and teacher interviews. To acquire the often overlooked perspective of students, this study also interviewed approximately a quarter of the students involved in the study and collected drawings of the students working in the classroom from all of the students.

Third, to examine change in practices, data was collected before and after the classrooms were provided with one AlphaSmart for each student. Recognizing that teachers and students would need some time to become accustomed to the increased technology, post-intervention data was not collected immediately after the number of

AlphaSmarts was increased. Instead, classrooms were given three months to experiment with the AlphaSmarts before post-intervention data was collected.

Finally, to avoid bias during the the data collection and interpretation stages of this study, a blind observer was employed to conduct all classroom observations. In addition, a blind reader was employed to review all classroom observation summary reports and was then asked to identify changes in practice. The holistic impressions provided by the blind observer and the blind reader were used to triangulate findings that emerged from more systematic coding and analyses of the observations, interviews and drawings.

As described in greater detail above, this study found that providing classrooms with one AlphaSmart per student led to an increase in the use of AlphaSmarts for writing. Although this increase was most notable during Writer's Workshop, the use of AlphaSmarts increased across all curricular areas.

This increased use, however, differed across classrooms. For the teacher who was previously the strongest advocate for and user of technology, the increased access allowed her to more fully and fluently implement her instructional philosophy regarding use of technology. For the teacher who was the least enthusiastic about instructional uses of technology (but still used technology in and out of the classroom), the increased access led her to shift her beliefs which in turn led to a dramatic change in her policies regarding the use of technology for writing. Whereas students were previously forbidden from using technology to draft papers, they were now allowed to draft directly on an AlphaSmart.

Cuban (2001) argues that to date access to technology to schools has not led to the types of changes in instructional practices that some advocates have hoped for. Specifically, Cuban argues that despite access to technology, teachers infrequently use technology for instructional purposes. In addition, the ways in which teachers "deliver" instruction have remained largely unchanged since the influx of technology. In some respects, the fall classrooms studied here were similar to those studied by Cuban with respect to access to technology, with one significant difference: in addition to a printer and five computers, the Wellesley classrooms also had six to eight AlphaSmarts. Like Cuban's classrooms, the instructional use of technology (especially for writing), differed among teachers.

Cuban and others have expressed concern that despite the investment in computers for schools and classrooms, they are not widely and regularly used for instructional purposes and have not led to meaningful changes in instructional practices. The results of this study, however, suggest that meaningful change can occur when full, rather than limited, access to technology is provided. This study also calls into question targets established by state departments of education and other advocates of technology that call for less than a 1:1 ratio. As seen in two of the three classrooms studied here, a ratio of approximately one word processing device (desktop, laptop or AlphaSmart) for every two students was associated with much less use of technology than occurred when every student was provided with their own AlphaSmart. And, even though AlphaSmarts were designed for word processing only, the provision and subsequent use of one AlphaSmart per student led to increased use of desktop and laptop computers. This increased use seemed to increase students comfort and skill with technology which in turn decreased the amount of time teachers spent providing

students with technical support. Full access and subsequent increased use of technology also led to an increase in peer conferencing and individual instruction as well as a decrease in whole group instruction.

Although this study was limited to three classrooms, the findings suggest that full access to word processors can have a positive impact on the use of technology in the upper elementary classroom. Given the relatively low cost of AlphaSmarts and the resulting benefits of providing each student with their own AlphaSmart found in this study, we strongly encourage technology leaders within schools as well as policy makers to consider policies and practices that promote full access to AlphaSmarts in upper elementary classrooms. While access alone will not guarantee that technology will be used, for those teachers who either advocate or have actively attempted to use technology for instructional purposes, full access to word processors eliminates many of the managerial and technical issues that impeded regular use of technology in the classroom.

We want to thank Tom Plati, Director of Libraries and Technology for Wellesley Public Schools, for inviting us to conduct this study. We also thank the three teachers and their students for opening their classrooms to us. Finally, we thank Wellesley Public Schools for providing funding to support classroom observations conducted for this study.

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Appendix A:
Master coding list used in the content analysis of classroom observations

TEACHER ACTIONS

- 1.10 Direct Instruction
- 1.11 Whole Class Discussion
- 1.12 Directions
- 1.13 Assigning Work
- 1.14 Reading to Whole Class
- 1.151 Conferencing with Ind Students with technology
- 1.152 Conferencing with Ind Students without technology
- 1.161 Working/Talking with Groups of Students with Technology
- 1.162 Working/Talking with Groups of Students w/o tech
- 1.17 Classroom Preparation/Clean-Up
- 1.18 Technical Assistance
- 1.19 Grading/Correcting in Isolation
- 1.20 Teacher Using Computer Individually
- 1.211 Aide Working Individually with Student with Technology
- 1.212 Aide Working Individually with Student w/o technology
- 1.221 Aide Working with Groups of Students with technology
- 1.222 Aide Working with Groups of Students w/o Technology
- 1.23 Aide Working Individually on a Computer
- 1.24 Aide Providing Technical Assistance
- 1.25 Discussing Technology with Whole Class
- 1.26 Other involving technology
- 1.27 Teacher Asking Question
- 1.28 Discipline

INDIVIDUAL STUDENT ACTIONS

- 2.10 Reading to themselves-DEAR time
- 2.11 Composing text on a desktop computer
- 2.12 Composing text on a laptop
- 2.14 Composing text on paper
- 2.15 Editing text on desktop computer
- 2.16 Editing text on laptop
- 2.18 Editing text on paper
- 2.21 Taking alphasmart out of room
- 2.22 Using laptop at their desk
- 2.23 Using laptop in other part of room
- 2.24 Taking laptop out of room
- 2.26 Transcribing text from paper to laptop
- 2.27 Transcribing text from paper to desktop
- 2.28 Uploading aphasmart
- 2.29 Printing their work
- 2.30 Printing CD ROM-Web Resources
- 2.31 Working on the Web
- 2.32 Working with a CD ROM
- 2.33 Saving work to the server
- 2.34 Testing/Quizzing
- 2.37 Presenting to the class
- 2.38 Working on project or assignment-no writing-individually
- 2.39 Other involving technology
- 2.40 Asking a question in a group setting

2.41 Asking a question individually
2.42 Other Alphasmart
2.43 Other Laptop
2.44 Other Desktop
2.45 Student Leaving the Classroom
2.46 Using Desktop
2.47 Using Alphasmart

STUDENT-TO-STUDENT ACTIONS
3.10 Working in groups on project or assign-not writing-no tech
3.11 Working in groups on proj. or assign-not writing-with tech
3.12 Using Alphasmart
3.14 Taking alphasmart out of room
3.15 Using laptop at a student desk
3.16 Using laptop in other part of the room
3.17 Taking laptop out of room
3.18 Eating together
3.19 Peer conferencing with work produced on paper
3.20 Peer conferencing with work printed from a computer
3.21 Peer conferencing with work displayed on an alphasmart
3.22 Peer conferencing with work displayed on a laptop
3.23 Peer conferencing with work displayed on desktop
3.26 Presenting to whole class as a group
3.27 Presenting to teacher as a group
3.28 Providing technical assistance
3.29 Sharing Web-CD ROM sources
3.30 Off-topic conversations
3.31 Other involving technology
3.32 Using desktop
3.33 Other alphasmart
3.34 Other laptop
3.35 Other desktop
3.37 Reading

CLASSROOM BNVIRONMENT
4.10 Student Placement
4.11 Visibility of Technology
4.12 Kids complaining
4.13 Visitor in classroom
4.14 Display of student work
4.15 Engagement
4.16 Dis-Engagement
4.17 Classroom Noise
4.18 Disruptive Behavi

Learning to Integrate Technology Lessons Learned Learned from a PT3 Implementation Project

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Key Words. Technology Integration; Preservice Teacher Education; Faculty Development; Technology Standards; PT3

Abstract

Learning and Integrating New Knowledge and Skills (LINKS) was a technology project designed to integrate established and emerging technologies into the teacher preparation program at Texas Woman's University (TWU). The project was supported by a U.S. Department of Education, PT3 grant. The LINKS project encouraged institutionalized efforts by prompting change in university faculty involvement and roles, technology curriculum content and delivery, and preservice teachers' performance and responsibilities in field-based locations. This study's purpose was to describe changes in institutional processes as well as changes in behaviors and attitudes of faculty, mentor and supervising teachers, and preservice teachers during the second year of implementation. Specifically, the study addressed these questions: (a) how did LINKS support technology infusion in teacher preparation, (b) to what extent did preservice teachers build technological skills and understanding, (c) how did mentor and supervising teachers build technological skills and serve as guides of technology integration, (d) to what extent did university instructors build proficiency for web-based course delivery and model technology integration for preservice teachers; and (e) what progress was made toward institutionalizing the LINKS efforts toward infusion of technology into classroom courses across disciplines, education courses in particular, and the university overall?

Learning to Integrate Technology: Lessons Learned from a PT3 Implementation Project

Learning and Integrating New Knowledge and Skills (LINKS) was a three-year technology project supported by a U.S. Department of Education's Preparing Tomorrow's Teachers to Use Technology (PT3) grant. Implemented at Texas Woman's University (TWU), LINKS redesigned TWU's teacher education program to address the technology proficiencies required by schools, recommended by the National Council for the Accreditation of Teacher Education (NCATE), and delineated by professional associations. The project encouraged development of university faculty's ability to use and model web-based technologies, changes in teacher education technology curriculum content and delivery, and enhancement of preservice teachers' performance requirements and responsibilities in field-based locations.

This study's purpose was to describe changes in TWU's institutional processes as well as changes in behaviors and attitudes of faculty, mentor and supervising teachers, and preservice teachers as impacted by the LINKS project during the second year of the three-year project. Specifically, the study addressed these questions: (a) how did LINKS support technology infusion in teacher preparation, (b) to what extent did preservice teachers build technological skills and understanding, (c) how did mentor and supervising teachers build technological skills and serve as guides of technology integration, (d) to what extent did university instructors build proficiency for web-based course delivery and model technology integration for preservice teachers; and (e) what progress was made toward institutionalizing the LINKS efforts toward infusion of technology into classroom courses across disciplines, education courses in particular, and the university overall?

Background

For decades colleges of education have endeavored to integrate technology into their teacher education programs. As early as 1990, Ball State University's Center for Information and Communication Sciences conducted a survey of 282 colleges of teacher education and found that "almost all [were] implementing changes" to integrate technology into their programs to help their teacher education "students to function in the information age" (as cited in Faison, 1994).

With the rapid advances in technology and the changing face of the Internet, colleges of education found it difficult to keep pace. Although intentions were good, outcomes were mixed. Indeed, in 1995, OTA's report, "Teachers and Technology: Making the Connections," found that "overall teacher education programs . . . [did] not prepare graduates to use technology as a teaching tool" (p.184). Not surprisingly, more recent reports suggest that new teachers entering classrooms are unprepared to use technology to its full potential (CEO Forum on Education and Technology, January 2000). Even though 66% of teachers report using computers or the Internet for instruction, most lessons fail to involve complex inquiries, exploration, or problem-solving activities (NCES, 2000). Furthermore, only 33% of teachers feel either "well prepared" or "very well prepared" to use technology.

The challenge for higher education institutions today, particularly colleges of education, is to create a place where preservice teachers learn to employ a variety of technology tools to improve the effectiveness of their instruction. Currently, the debate centers on the best means to integrate technology into teacher education programs. Approaches range from simply encouraging students to use email to more advanced programs advocating the infusion of technology into all aspects of the teacher education curriculum. Innovations that have been implemented with varying success include electronic contacts via email, listservs, and dialogue (Blake, 1998; McIntyre & Tlusty, 1995); virtual workshops and add-on coursework (Simmons &

Linnell, 1998, Veen, Lam, & Taconis, 1998), as well as comprehensive, integrated approaches (Dradowski, 1998; Parker & Farrelly, 1994, Schrum, 1998).

Concerns about individual attitudes and perceptions that pose significant barriers to technology integration have been the focus of other research efforts (Blake, 1998; Buhendwa, 1996, Medcalf & Davenport, 1999; Smithey & Hough, 1999; Strudler & Wetzel, 1999). Though much research has been conducted, according to Shaw (1998) in his Report to the President on the Use of Technology to Strengthen K-12 Education in the United States, "a large scale program of rigorous, systematic research on ...educational technology...will ultimately prove necessary to ensure both the efficacy and cost-effectiveness of technology use within our nation's K-12 schools" (p. 115). As a result of these types of directives, national educational technology standards for students and teachers have been developed and are specified by ISTE (2000).

The Study

The LINKS project was integrated into the existing curriculum for teacher preparation in TWU's College of Professional Education. Each semester, approximately 300 future teachers progressed through university coursework, technology seminars, documentation of proficiencies, and field-based placements. Responsibility for preparing students was divided among university instructors, technology seminar leaders, university liaisons, and supervising teachers in the field. As illustrated in Figure 1, the LINKS project addressed the technology needs of preservice teachers by supporting their development through three semesters of coursework and field-based experiences (Intern I, Intern II, and Resident), as well as the associated development of their university instructors, and mentor and supervising teachers.

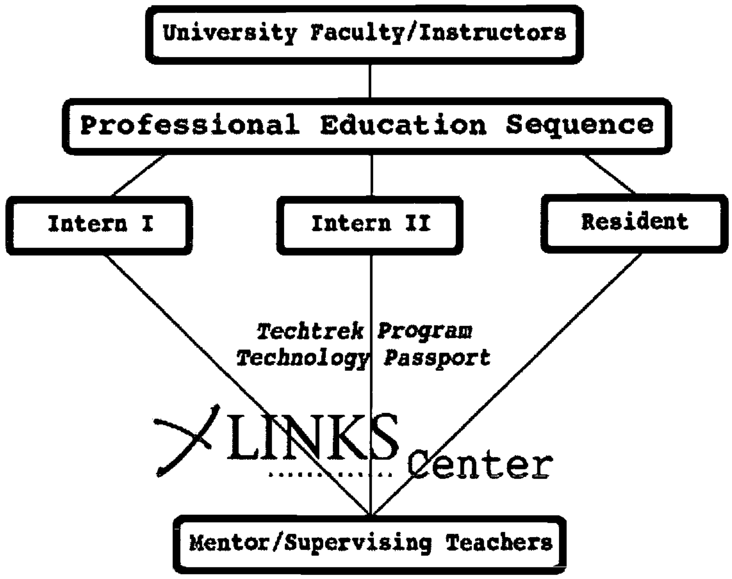

Figure 1. Texas Woman's University (TWU) Teacher Education Program.

In the first two years of the project (fall 1999-spring 2001), implementation and outcome data were collected for events involving three populations: (1) preservice teachers (three disparate cohort groups), (2) mentor and supervising teachers, and (3) university instructors.

Populations and Program

Preservice teachers. In the LINKS preservice strand, students progressed through Intern I, Intern II, and Residency over three semesters. This study focused on the second and third cohort groups. Cohort 2 included 62 Intern II(s) in fall 2000, 41 of which continued as Residents in spring 2001. For Cohort 3, 66 preservice teachers participated as Intern I(s) in fall 2000, and 62 progressed to Intern II(s) in spring 2001. Table 1, shown below, indicates the nature of the cohort distribution.

Table 1
Data Collection Patterns for Preservice Teacher Cohort Groups Progressing Through Intern I, Intern II, and Residency

Preservice	Year 1		Year 2		Year 3	
Teachers	Fall 1999	Spring 2000	Fall 2000	Spring 2001	Fall 2001	Spring 2002
Cohort 1	Intern I	Intern II	Resident	-	-	-
Cohort 2	-	Intern I	Intern II	Resident	-	-
Cohort 3	-	-	Intern I	Intern II	Resident	-

Note. Data collection instruments and procedures varied for Intern I, Intern II, and Residents. No data from Year 1 will be included in this report.

As Intern I(s) and Intern II(s), preservice teachers participated in various integrated technology seminars, bi-weekly online conferencing groups, lab sessions related to individual, developmental needs and, documented progress according to the associated four cornerstones of the program: (1) foundations; (2) connectivity; (3) productivity; and (4) integration. During Residency, preservice teachers began their student teaching and attended two full-day technology seminars. All student activities were supported through the TechTrek technology integration curriculum via online and face-to-face experiences. The technology curriculum was not part of a separate methods course. Instead, it supported preservice teachers' use of established technologies within an integrated context of meaningful learning as an integral part of the established course work. Preservice teachers document competencies related to the four cornerstones utilizing a unique tool of the LINKS project, the Technology Passport (http://www7.twu.edu/~f_snider/links/techpassport/index.htm).

Mentor teachers and supervisors. Each semester, Interns interacted with mentor teachers during classroom observations. Mentors (N=30) participated in on-campus training sessions and received assistance designed to enhance receptivity toward technology use. During Residency, preservice teachers were paired with supervising teachers for their student teaching experience. A select group of supervising teachers (N=15) participated in specialized training dedicated to creating classroom appropriate technology products for use and evaluation in the classroom setting.

University instructors. Each year, a volunteer sample of university instructors (N=20) agreed to participate in professional development sessions. Two primary training goals included (1) the introduction of LINKS standards and resources and (2) support for instructor delivery of web-based courses as models for future teachers in their classes. The goals were implemented through a series of technology-training sessions including both whole-group professional

development sessions geared to broad topics and hands-on professional development sessions specializing in specific areas for remediation or advanced work.

Data sources

Implementation data came from reviews of project documents, attendance records, evaluation forms, information on LINKS-related web sites, and interviews with project staff. Additionally, the LINKS project evaluation measured the progress of project participants at various phases and assessed the utility and effectiveness of the LINKS training and resources. As shown in Table 2, data collection involved a variety of measures and varied among the three populations.

Table 2
LINKS Project Evaluation Measures

Measure	Acronym	Preservice Teachers	Supervising Teachers	University Instructors
Self-Evaluation Rubrics				
a. Basic Computer Use	BCU	✓	✓	
b. Advanced Computer Use	ACU	✓	✓	
c. Internet Use	IU	✓	✓	
CBAM: Stages of Concern Questionnaire	SoCQ	✓		✓
Level of Use Questionnaire	LoUQ			✓
Training evaluation questionnaires		✓	✓	✓

Note. CBAM=Concerns-Based Adoption Model (Hord, Austin-Huling, Rutherford, Hall, 1987).

Preservice teachers. Pretest and posttests were administered to all preservice teachers to assess changes in technological proficiency and use, as well as attitudes and concerns. Measures included: Self-Evaluation Rubrics for Basic Computer Use (BCU), Advanced Computer Use (ACU), and Internet Use (IU), Stages of Concern Questionnaire (SoCQ) and the Level of Use Questionnaire (LoU). Parametric paired-sample t-tests assessed differences across semesters. In addition, preservice teachers completed evaluations at the end of each semester to assess the utility and quality of their experience.

Supervising and mentor teachers. Both supervising and mentor teachers completed training evaluations to assess the quality and utility of training. In addition, supervising teachers also completed instruments to assess technological proficiencies, attitudes, and use. Supervising teachers completed Self-Evaluation Rubrics for BCU, ACU, and IU at the end of their semester as supervising teachers. Quantitative results were compared with those for preservice Residents. Qualitative analyses were conducted for open-ended items on questionnaires completed by email and on session evaluation forms by both supervising and mentor teachers.

University instructors. Data were collected on instructors' stages of concern, levels of use, and perceptions of the utility and quality of training. The Concerns Based Adoption Model (CBAM) was used to assess university instructors' progress toward the use of Blackboard courseware. Pretest and posttest data were collected for the SoCQ and Levels of Use. Parametric paired-sample t-tests assessed differences across time. Qualitative analyses were conducted for open-ended items on session evaluation forms.

Findings

Preservice Teachers. Findings reported represent the experiences and perceptions of approximately 110 preservice teachers in cohorts 2 and 3 who progressed through LINKS experiences during the fall 2000 and spring 2001 semesters. Results for preservice educators revealed that participants considered themselves more technologically proficient after experiencing LINKS project activities, with statistically significant pretest and posttest differences for all domains of the BCU, 10 out of 11 domains on the ACU, and all domains on IU. Preservice teachers moved toward higher impact concerns and relatively low self-concerns as measured by the SoCQ. Qualitative analyses revealed generally positive acceptance of and comfort with technology, as well as confidence in curricular integration of technology. Major findings are as follows.

Preservice teachers at TWU experienced a broad array of technology activities. Over three semesters, preservice teachers progress from initial orientation and skill building as Intern I(s) toward increasing emphasis on classroom integration of technology through field-based experiences as Intern II(s) and Residents. Activities allowed preservice teachers to acquire competencies related to technology foundations, connectivity, productivity, and integration through coursework, desktop conferencing, lab learning opportunities, and distance learning via TechTrek and documented through the Technology Passport.

These students became increasingly positive about their technology experiences as they progressed over three semesters of coursework. During their introductory semester, Intern I(s) provided lower quality and utility ratings for LINKS activities. Their reactions suggested that some preservice teachers were initially uncertain about the value of integrating technology. However, as preservice teachers progressed to Intern II, they were more positively disposed toward building proficiencies and using technology, and they had a better understanding of integrating technology into instruction. As students advanced to Residency, they maintained their positive opinion of their own technology abilities and the helpfulness of LINKS activities.

Gains were reported in knowledge and skills, abilities, confidence, and awareness. Regardless of student cohort or level of experience, preservice teachers indicated that LINKS activities contributed to improved technology knowledge and skills, gains in ability to integrate technology in a variety of forms, increased confidence using technology, and awareness of the availability and importance of technology resources.

As preservice teachers' level of experience increased, their concerns regarding technology changed. Over the three semesters, as preservice teachers acquired technology proficiency and became increasingly involved in field-based experiences, they were less concerned about their personal knowledge and skills and ability to integrate technology

effectively in the classroom and more concerned about resource quality and availability and time constraints on technology use.

As a result of LINKS activities, preservice teachers became significantly more proficient technology users. On all BCU dimensions (e.g., operation, file management, word processing, and spreadsheet), statistically significant gains emerged in preservice teachers' perceived proficiency. The strongest improvements were from Intern I to Intern II, but Residents also made significant gains. Preservice teachers also became more proficient Internet users. Intern I(s), Intern II(s), and Residents showed significant gains on all eight IU domains over time (e.g., basics, search tools, obtaining and using files).

Residents attained higher proficiency levels in advanced computer use. Consistent with BCU and IU results, significant gains were evident for Residents on all ACU dimensions (e.g., instructional software use, modification of instructional delivery, assessment of student performance), except education program individualization.

Preservice teachers technology concerns, as measured by the SoCQ, were related to their level of experience. Intern I(s) initially had high informational and personal concerns about technology as well as rather intense consequence and collaboration concerns. As students progressed to Intern II, awareness and informational concerns decreased significantly and impact concerns intensified. As preservice teachers moved from Intern II to Residency, self-concerns (awareness, informational, personal) diminished and impact concerns (consequence, collaboration, refocusing) intensified, although not significantly.

Mentor and Supervising Teachers. Approximately 30 mentor teachers participated in specific technology training through the LINKS project, and 15 supervising teachers who were paired with Residents during their student teaching experiences participated in intensive technology seminars. Interestingly, supervising teachers indicated less technology proficiency

overall, and scored lower than Residents on all domains on the self-evaluation rubrics for BCU, ACU, and IU. Qualitative analyses of open-ended items indicated that supervising teachers were generally positive about technology integration, and being paired with a Resident appeared to be a supportive factor. Concerns related to time, resource quality and availability, and personal skill proficiency. Major findings are summarized below.

Mentor and supervising teachers were generally positive about LINKS training and reported personal technology growth. As a result of LINKS training, mentor and supervising teachers reported improvements in technology knowledge and skills and their ability to integrate technology in the classroom. This group's primary concerns with technology related to time, resource availability, and personal proficiency. Teachers expressed personal and management concerns with the time required to learn about and use technology, limited access to classroom computers and the Internet, and their general lack of technology proficiency. Preservice teachers appeared to positively influence classroom teachers' disposition toward technology. Compared with mentor teachers who interacted only occasionally with interns, supervising teachers who were paired with Residents for the student teaching semester expressed more motivation to use technology and more confidence in their ability to integrate technology.

Compared with their supervising teachers, Residents consider themselves more proficient technology users. In every domain, Residents' BCU mean ratings (both before and after student teaching), exceeded those of their supervising teachers. In most ACU and IU domains, supervising teaches reported lower proficiency levels than Residents. Overall, it appeared that well-trained preservice teachers have the potential to positively influence the curricular integration of technology as they enter the Texas educational system.

University Instructors. The LINKS project provided a wealth of training opportunities for TWU faculty volunteers relative to the teacher preparation program and to online course

development via Blackboard. The project introduced a diverse group university faculty members to the LINKS project and resources, and supported instructor delivery of web-based courses as models for future teachers. Volunteers from 10 university disciplines contributing to teacher education at TWU participated in LINKS training. Personnel from various campus departments collaborated with LINKS staff to deliver staff development for instructors. This included personnel from Information Technology Services, the Distance Education Support Team, Library Services, and the University Blackboard administrator to deliver training. As the result, the training model supports the institutionalization of LINKS activities.

Descriptive statistics and profiles for the SoCQ suggest that instructors' self-concerns declined while task and impact concerns heightened. The majority of participants moved toward higher levels of technology use. Qualitative analyses of open-ended evaluation items revealed concerns with their own ability, the time needed, and the applicability of their new learning. The following are key findings.

LINKS training was tailored to accommodate instructors' broad range of technology abilities. LINKS supported instructor development through whole-group sessions geared to a variety of topics supporting instructors' proficiency for web-based course delivery and hands-on sessions for skill remediation or advanced work. Fourteen sessions were available throughout the year, and all training materials were available on a "class" Blackboard web site. Training encouraged meaningful learning by converting faculty's own course materials to the electronic medium and by providing one-on-one assistance from LINKS staff on request.

Implemented activities raised university instructors' awareness of technology proficiencies needed by future Texas teachers. The introductory LINKS training session oriented university instructors to the required technology proficiencies for preservice teachers preparing to enter Texas classrooms, activities designed to build proficiency, and the processes used to

document student growth. This early orientation was an important component in building awareness of the faculty member as to the state and national expectations for technology integration standards.

The training positively impacted university instructors' motivation to use and capacity to integrate technology as the participants reported increased motivation to use technology and enhanced capacity to integrate technology into their courses. Faculty participation varied by session, and university instructors who participated in more advanced sessions in the spring semester were more motivated to use technology and believed they could use technology more effectively compared to participants in fall training sessions. Instructors' most important learning usually coincided with session topics (e.g., logistics of Blackboard, Internet search engines, HTML). Instructors also noted heightened awareness of technology resources (online library and database resources) and gains in their knowledge of the LINKS project and its benefits.

Instructors' main concerns centered on time, personal skill proficiency, skill retention, and resources. Instructors frequently mentioned a need for time to learn, assimilate information, practice skills, and adapt course materials. Typical concerns about technology proficiency included lack of familiarity, personal inadequacy, learning terminology, and retaining technology skills. Instructors also expressed concern with the availability and quality of resources, their ability to integrate technology, and a need for continued technology support after sessions concluded.

Instructors' concerns with Blackboard implementation, as measured by the SoCQ, changed over time. SoCQ outcomes suggested, that as a result of training, instructors' initial awareness and information concerns had decreased significantly by spring 2001. Management, consequence, collaboration, and refocusing concerns intensified, although not significantly.

These types of findings are consistent with an individual who is progressing through the change process.

Progress toward higher levels of Blackboard use varied for particular instructors. Results for 13 instructors with pretests and posttests on the LoUQ showed that individuals could typically be categorized into three implementation groups. (1) novice Blackboard users who progressed toward higher levels of use, (2) mechanical Blackboard users who made strong developmental growth, and (3) individuals who showed limited growth in Blackboard use, remaining at the same level of use over the two semesters. Progressive instructors generally had low informational, personal, and time management concerns, while stable instructors reported extremely high personal concerns as well as high consequence and collaboration concerns. Five university instructors reported limited developmental growth from pretest to posttest as measured by the LoUQ. When examining instructors' concerns regarding Blackboard, mean SoCQ ratings showed these instructors had very high personal concerns as well as important concerns with the consequence for students and collaboration with colleagues. In contrast, they had very low informational and management concerns. All in all, it seemed that instructors who considered the personal costs for using Blackboard too high (e.g., time and technology proficiency building) remained uncommitted to Blackboard implementation.

These findings provide support for the underlying theoretical foundation of the LINKS project endeavor. That being, change is a process, not an event and that in order to ensure true adoption of an innovation, it is necessary to understand the level and stage at which an individual operates while acquiring new skills. Within the scope of this project, this information was utilized by the LINKS team so that those considerations were part of training development and implementation.

Institutionalization of Technology Initiatives. Evaluation findings for year two as well as information collected from project staff indicate that the LINKS PT^{3}grant has moved TWU toward the infusion of technology into the teacher education program and the University as a whole. From project inception, LINKS considered ways to institutionalize grant activities. Research shows that one grant or one university entity cannot support technology integration in teacher education. Instead, integration relies on a combination of people and departments working toward elements of a strategic plan. The strategic plan at TWU, which was used as a guide for the LINKS PT^3 proposal, aims for students to be exposed to technology in all courses. Thus, LINKS staff collaborated with other university departments to deliver training for university instructors, and university participants were drawn from various disciplines contributing to teacher education. Presenters from various campus departments delivered training and informed participants on available resources. This approach allowed participants to explore TWU's unique distance learning issues, promoted the concept of "university without walls," and supported the transfer of information through a variety of technological mediums to everyday learning with students.

LINKS resources have been integrated with other university initiatives and external and internal funding. LINKS applied for and received an Intel Teach to the Future Pre-Service grant in the amount of $40,000 to support the training of four university instructors and 289 preservice teachers. Each instructor received a laptop computer, a $2,000 stipend, training materials for 75+ students, and attended technology integration workshops on the Intel Teach to the Future curriculum. Participating faculty then redelivered training to preservice teachers within their respective classes. This project enabled LINKS to systematically train faculty to utilize the concept of technology integration into the curriculum as part of their teacher preparation coursework, thus ensuring learning "with technology" instead of "about technology" within a

more meaningful context. In addition to the Intel project, LINKS collaborated with TWU to provide summer training institutes for faculty in online course development. A cost-sharing plan involving TWU ($32,000) and LINKS ($19,000) provided $4,000 stipends for instructors from a wide range of disciplines to develop technology integrated courses as a part of a planned online curriculum.

A growing cadre of university instructors have been oriented to the technology needs of preservice teachers and introduced to online course delivery via LINKS training and activities. Through year 2, more than 50 university instructors have either participated in LINKS training or received support from the LINKS center. An additional 23 instructors will be trained during year three. Disciplines represented by participants include Biology, Chemistry and Physics, Family Sciences, Health Studies, Kinesiology, Performing Arts, Philosophy and Psychology, Reading, Teacher Education, Visual Arts, as well as other university disciplines. This aspect is highlighted to indicate the importance of placing responsibility for the education of the preservice teacher within the University setting rather than only within the College of Professional Education.

The final goal of institutionalization will be supported in four major ways: (1) required technology courses included within basic certification sequences, (2) ongoing professional development provided for faculty and focusing on integration of technology in pedagogy and learning, (3) expanded technical support for preservice teachers by LINKS personnel, and (4) appropriately designed teacher stations in large classrooms serving preservice teachers.

During the third and final year of the LINKS project, preservice teacher activities have been redesigned as integrated technology courses as a part of the university teacher education requirements. Beginning in fall 2001, preservice teachers completed a sequence of courses and requirements designed to support technology integration. A three-course sequence included Education (EDUC) 3001—Integrating Technology for Effective Learning, EDUC

4001—Integrating Technology into Instruction and Assessment, and EDUC 5131—Technology in Assessment and Instruction. These course were taken as co-requisites with associated teacher preparation coursework. This approach, rather than a separate methods course, was implemented to encourage technology integration. Prior to taking these courses that begin in the junior year, students must (a) pass a computer literacy test, (b) pass a computer methods course designed for teacher educators (offered through Math and Computer Science), and (c) pass an information literacy course designed for teacher educators (offered through Library Information Science and the Department of Reading). This revised format involved extensive interdisciplinary collaboration for the education of the preservice teacher between the Colleges of Professional Education and Arts and Sciences and offers a wide range for student skill development over time.

LINKS activities have been extended to the post baccalaureate teacher preparation program (i.e., preservice teachers who have received a degree and are seeking initial teacher certification). In year 3, six university instructors will design and implement online technology infused methods courses for post baccalaurate students. Through a unique mentoring approach, experienced faculty from the Library of Information Science will function as mentors and expert facilitators of curriculum development to each of the six identified Teacher Education faculty.

Lines of communication sustained by LINKS staff during a change in university leadership supported project success. During the first implementation year of the PT^3 grant, TWU made changes in university leadership. LINKS staff met with the new president, provided an overview of project initiatives, and suggested ways to align university and grant initiatives. Staff also worked with the new Dean of the College of Professional Education to raise awareness of technology integration needs. These communication efforts resulted in increased funding for years two and three of project, administrative support for technology integration, alignment of

the LINKS initiative with university efforts and, ultimately, support for institutionalization efforts.

Summary

This study's purpose was to describe changes in TWU's institutional processes as well as changes in behaviors and attitudes of faculty, mentor and supervising teachers, and preservice teachers. Specifically, the study addressed these questions: (a) how did LINKS support technology infusion in teacher preparation, (b) to what extent did preservice teachers build technological skills and understanding, (c) how did mentor and supervising teachers build technological skills and serve as guides of technology integration, (d) to what extent did university instructors build proficiency for web-based course delivery and model technology integration for preservice teachers; and (e) what progress was made toward infusion of technology into classroom courses across disciplines, education courses in particular, and the university overall?

Five findings summarized and related to the associated study questions are as follows:

a. LINKS infused technology into the teacher preparation program with a three pronged approach: training for students, mentor teachers and supervisors, and university faculty. Each group was supported in multiple ways including to the Technology Passport for Students, TechTrek, and LINKS web page resources.
b. Preservice teachers (N=110) evidenced statistically pre and posttest differences on all domains of BCU and on 10 out of 11 domains on Advanced Computer use.
c. Mentor teachers (N=30) participated in on-campus LINKS training designed to enhance receptivity to technology use. A select supervisor group (N=15) came with their Resident for training dedicated to development, implementation, and evaluation of a classroom

technology project. Supervising teachers indicated less technology proficiency overall than their Residents.

d. Faculty volunteers (N=20+) for LINKS training were supported in their development of web-based course delivery using Blackboard. The faculty involved included members from the College of Arts and Science as well as those from the College of Professional Education.

e. Overall, the infusion of technology across disciplines as well as in the College of Professional Education is evidenced by the integrated structure of the undergraduate program, the distance education delivery of the new post-baccalaureate teacher certification coursework and the new Masters in Art Education which includes extensive amounts of technology integration in relationship to both the learning process and course delivery. These unique projects were begun by faculty who participated in the LINKS project which provides evidence to support the assumption that the LINKS training enhances faculty ability to model effective utilization of technology in teaching and learning.

Educational Importance

Findings regarding the implementation and effectiveness of the LINKS project have implications in at least three specific areas. First, in demonstrating how university professors can be supported as effective models of technology use in web-based course delivery and electronic communication with students. Next, in demonstrating how technology proficiencies of entry-level teachers can be increased to address state and national expectations, and finally, in modeling how other universities might undertake similar changes in teacher preparation programs. The LINKS web site contains a number of project-related resources, such as the Technology Passport, that are available for use by other institutions. Documentation of learner-

centered standards for preservice teachers through the Technology Passport provides a much-needed model to monitor and assess changes in preservice teachers' technological proficiencies in relationship to the Texas Education Agency's Learner-Centered Proficiencies for Texas Schools.

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Pre-Service Teacher Training and Implementation in the Classroom: Considerations

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Key words: teachers, technology and classroom implementation survey

Abstract

Pre-service teacher training should offer the future teacher necessary skills for employing technology to teach a curriculum in creative and effective ways, and the awareness of the possible dichotomy to be faced in the schools between what can be done and what should be done in using technology in teaching. This paper describes both such a pre-service teacher technology training course, and a survey of technology use by the students of the course during actual service in the classroom. Although the course encouraged future teachers to focus on the potential of the computer to develop problem-solving in the classroom, survey results indicated that in reality, such use was limited. Questions are proposed for consideration in defining the steps to be taken in narrowing the gap between what can be done with technology in the classroom and what should be done with technology in the classroom.

Recently, the development of the World Wide Web and the Internet has presented an unprecedented challenge to educators. As communication becomes more instant, paradigms shift, especially in areas of teaching/learning, assessment/evaluation, skills/curriculum, and teacher education (Flake, 2001). The challenge is to ease the conflicts that arise from these paradigm shifts, especially the conflict existing in widely disparate levels of comfort between teacher education students and the classroom students they will teach (Flake; Levine, 2002). The present study describes skills learned in a required pre-service teacher course, and a subsequent survey of their use of technology once in the classroom. Forty-two undergraduate pre-service teachers in a large southeastern university participated in an online survey that gathered specific information. This information indicates various factors in the equation for successful implementation of technology in the schools.

The Course

The pre-service teacher course "Technology and Learning for Elementary and Middle School" was designed to guide the students in using the World Wide Web to develop an electronic teaching portfolio, using basic HTML. In the development of these portfolios (individual Home Pages), students would not only learn about the future directions of the Web, but also acquire new knowledge in meaningful contexts. Students were to incorporate skills learned in such applications as Powerpoint, Hyperstudio, Gif Animator, and Word, and they were required to use the web pages in their Field Experience, a two-week internship in the local schools.

Course objectives responded to guidelines developed by several organizations such as the National Council for Accreditation of Teacher Education (NCATE) and the International Society for Technology in Education (ISTE) that recommended:

- Focus on learning with technology, not about technology
- Emphasis on content and pedagogy, and not just hardware.
- Evaluation and use of computers to support instruction
- Exploration, evaluation, and use of computer-based materials including application and educational software.

The four course objectives were:

1. to develop and use skills in the computer and other technologies and reflective thinking concerning the learning process as tools for life-long learning;
2. to identify and use problem-solving/power learning/creativity/ student-centered learning applications for computers and other technologies;
3. to make use of the World Wide Web and other telecommunications capabilities for developing a social community (including navigating, searching for and retrieving information, publishing and building a foundation for life-long learning), as well as building integrated learning in the elementary classroom; and
4. to identify and discuss computer education issues and emerging technologies as related to the development of problem-solving processes and power learning.

The course was a 3-hour semester course taught by a professor and two graduate teaching assistants. The prerequisite course was an introduction to educational

technology. However, this prerequisite course was not taught uniformly in all schools, therefore, there was a wide disparity in level of computer expertise among the students.

The main assignment, on which the students would work throughout the semester, was to create a personal web page. During this time, students could consult with the instructors both during and outside of class. Students were initially instructed in using basic HTML code, although the use of web page editors such as Microsoft Word, Front Page or Dreamweaver or other html editors was acceptable. These web pages were the course's final product, an Electronic Portfolio which would be evaluated. In creating their personal web pages, students were encouraged to relate their work to other courses in their teacher preparation curriculum. For instance, in creating a theme for the page, a student could use subject matter from another course, for example, art history or poetry.

In an assignment entitled, "Pulling It All Together," students researched three web sites dealing with educational change. These three initial assignments were to compare the issues described in the assigned websites to their own educational experiences. In addition to these sites, the students were directed to the managing professor's website, which contained extensive resources for the students to explore (website of Dr. Janice Flake, http:// http://mailer.fsu.edu/~jflake).

The students were required to include certain applications in the design of their web sites. Each student created a Powerpoint Presentation and a Hyperstudio picture which was posted on the web page. Extra credit was given for posting an original animation on the web page, and experimentation with other computer applications was encouraged.

During a two-week internship halfway through the semester, students were to integrate their web pages into the classroom instruction, both through the curriculum and as enrichment for the children. For instance, each page had a unique theme that was related to the classroom (internship) teaching experience. Students presented their theme-centered web pages, and planned activities related to their web pages. After their internship, students brought back drawings, poems, or other products from the schoolchildren, and could choose to scan those images onto their web pages.

Throughout the semester, students submitted weekly emails to the instructor, reflecting on their experiences with technology. These reflections were then used by the student to compose a Final Reflection at the end of the semester. This Final Reflection emphasized what the student had learned about both his/her own learning, and the learning of the students in the schools where they interned for a two-week period during the semester.

An assignment entitled "Field Experiences" was a two-week long internship during which trainees assisted regular teachers in the elementary and secondary classrooms to which they were assigned. During the internship, the trainees submitted regular journal entries, using e-mail, to the instructors of the course. Students were required to describe the degree to which technology was being used in the schools where they interned, to describe the interactions that they had with the schoolchildren through the technology, and to describe how the children used the Internet, if at all. The students were also asked to reflect on how they would use technology to teach and to reflect on their observations about the development of their own learning and the learning of the schoolchildren who were observed. At the beginning of the course, there was a wide

range of computer experience evident in the teacher candidates themselves. From their accounts of conditions in the classrooms, there was a wide range of experience among the current practicing teachers.

Students were required to familiarize themselves with and review three educational software programs (available in the College of Education computer lab). Examples of such educational software are: KidPix (painting), Algebra Animator (math), Coin Critters (money), and Reader Rabbit (reading). Factors to consider in evaluating software included:

1. Software allows for experimental learning, including explorations, investigations, and building hunches
2. Software is conceptually based
3. Software contains underlying structure of the content to be explored
4. Software allows major cognitive restructuring and the facility for students to construct meaningful knowledge
5. Software allows students to generate feedback from which they can judge the efficacy of their methods of thinking
6. Software is intrinsically interesting enough for students to want to discuss alternative strategies with other students about explorations, hence allowing social constructions
7. Software facilitates reflective abstractions
8. Software is easy to get started.

This requirement provided students with practice in using the computer, and an introduction to professional development and the need for teachers to know and understand what is available in computer programs.

At the conclusion of the semester, students presented their web pages to the class, illustrating the diverse possibilities of using the Internet for teaching. End-of-semester comments from students expressed their positive feelings about what they had learned during the semester, and many expressed their intention of continuing to work on their web page and integrating technology into their teaching and learning.

The survey

The course described was taught for several semesters. To measure the impact that the course had on pre-service teachers' subsequent use of computer technology in the classroom, an online survey was administered within a year of the last semester of the course described. Therefore, some of the students were "closer " to the course than others Some of the respondents were still undergraduates. Of the 42 participants surveyed, 28.6% had completed the undergraduate program and were teaching in the schools. Participants were contacted initially either personally or by email to obtain consent. Results of the survey were automatically emailed to the researcher, and compiled in a spreadsheet.

The following questions were asked on an online survey:

1. Currently, in what semester of the Elementary Education program are you enrolled?

2. In your EDE 4341 class at FSU, you were encouraged to use technology during your field experience. In general, how often do you use information you learned?
3. Since that first semester class, please describe the experience you have had using technology in the classroom.
4. Do you personally use the Internet?
5. Do you use the Internet in your classroom?

(5a) If yes, please indicate which applications you use?

6. How would you describe the effort you made on the personal web page you made in the class?
7. Have you continued to update your personal webpage?
8. How important do you feel technology (computers) is to education?
9. Have you received additional training or other support in the use of technology?

In Question 3, respondents overwhelmingly (26.2%) reported that they used computers in the classroom only for self-use. Of the other uses of technology in the classroom, 7.1% did not use a computer in the classroom, 2.4% used "other" technologies (such as overheads), 2.4% used computers for a variety of tasks, including for resource work, and word-processing, 7.1% reported that computers were not used because there was not enough time in the school day, and 4.8% commented that the school did not support use of technology. However, 4.8% and 16.7% reported that computers were used constantly for CCC and Accelerated Reader, respectively.

In Questions 4 and 5, the majority of respondents used the Internet for personal use (85.7%), with 57.1% using the Internet in class. When the Internet was used in the classroom (Question 5a), it was employed as an instructional tool (9.5%), information tool (38.1%), personal webpage for students (7.1%), and other uses (11.9). Whereas (Question 6) 57% reported that they had "worked steady" on their web page during the course, with 19.0% reporting working "beyond requirements," and 23.8% reporting "minimum" work, 76.2% (Question 7) reported *not* maintaining their web page. Finally, although a majority, 59.5%, reported in Question 8 that they felt that the computer was "very important" to education, in Question 9 only 21.4% reported that they were required to have training by their school, whereas another 21.4% sought additional training voluntarily, and 57.1% had received no additional training in using technology since the course.

Such results highlight the gap that exists between conceptualization and implementation of effective use of technology in education. In spite of general agreement that teachers and staff should be trained in the use of technology (Pettenati & Giuli, 2001; Willis & Raines, 2001), teachers are evidently not receiving adequate support from their schools--whether is procedures, resources or time. Certainly there are other factors that enter into the equation, such as emphasis on test-preparation over lessons, reflected in the number of respondents reporting the use of computers, for example, test-preparation programs (CCC and Accelerated Reader).

What are some questions to be answered that might narrow the gap between what is happening in the schools and what should be happening in the area of technology and teaching/learning? Perhaps in the roundtable discussion, answers can be suggested:

1. How can teachers be guaranteed the time to prepare lessons on the computer, so that skills learned in a pre-service program will "bear fruit"?

2. How can the challenge of re-educating veteran teachers be accomplished?

3. How can the Internet be most constructively used to supplement classroom teaching, considering not only the great variety of resources available (both acceptable and unacceptable to educators) but the need for training in viable search strategies?

4. What is the most effective staff-development scenario that will guarantee a fair and acceptable level of computer use? (see #1 and #2)

For those readers interested in suggesting questions and answers, please send your comments to me by email, using the subject "NECC tech roundtable"--I look forward to seeing you at NECC!

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Digital Video/Multimedia Portfolios as a Tool to Develop Reflective Teacher Candidates

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Abstract

The International New Teacher Assessment and Support Consortium (INTASC), and the National Council of Accreditation of Teacher Education (NCATE) have set standards that call for teacher candidates to not only be "reflective practitioners" but also to demonstrate the ability to reflect. (NCATE, 2001) If reflection, as Kitchener (1983) and others (Bowen, 1989; Brabeck, 1984; Mines, 1980) have argued, entails cognitive development and the assumptions a person makes about knowledge, then what teacher educators are assessing in candidates portfolios is their level of cognitive development and not necessarily their mastery of the program competencies.

This research examined the effects of a process of digital video editing used to create multimedia portfolio has on the quality of teacher candidates' critical reflections. The target population was Northwestern Oklahoma State University teacher candidates. Subjects were 22 student teachers in the Fall 2001. Subjects were randomly assigned to one of three groups: control, experimental – reflection, and experimental – reflection with multimedia production. The instrument used to measure the dependent variable, teacher candidate's critical reflections, was based on a 7-part framework developed by Sparks-Langer, Simmons, Pasch, Colton, & Starko (1991).

The data were analyzed using 3 separate t-tests for independent samples. Although the difference between each of the pairs of groups was not significant the large difference between the control group and the experimental group (reflection/video ed) is encouraging.

Digital Video/Multimedia Portfolios as a Tool to Develop Reflective Teacher Candidates

New standards set forth by the International New Teacher Assessment and Support Consortium (INTASC), and the National Council of Accreditation of Teacher Education (NCATE) expect teacher candidates to not only be "reflective practitioners" but also to demonstrate the ability to reflect. According to NCATE, targeted performance indicators for teacher candidates include the ability to "reflect on" and "justify their own practice", "collect data on student learning, and analyze them, reflect on their work, and develop strategies for improving learning", and "work collaboratively with other candidates and clinical faculty to critique and reflect on each others' practice and their effects on student learning with the goal of improving practice." (NCATE, 2001)

Although the usefulness of reflection in teacher education appears to be well established, teacher educators may want to consider the fairness and appropriateness of its use before the conclude its validity and advocate mandating this requirement. Requiring teacher candidates to reflect on their activities may not be "developmentally appropriate".

If reflection is viewed as a form of critical inquiry, then what is asked of teacher candidates may be conceptualized as a metacognitive approach to problem solving. This approach is a systematic technique that can and probably should be taught to teacher candidates. On the other hand, if reflection, as Kitchener (1983) and others (Bowen, 1989; Brabeck, 1984; Mines, 1980) have argued, entails cognitive development and the assumptions a person makes about knowledge, then what teacher educators are assessing in candidates portfolios is their level of cognitive development and not necessarily their mastery of the program competencies. Critical thinking skills may be necessary for the development of higher-level thinking but are not in themselves sufficient to guarantee that development.

The purpose of this research was to examine the effects of a process of digital video editing used to create multimedia portfolio has on the quality of teacher candidates' critical reflections.

The objectives of the study were to:

1. Determine whether teacher candidates' use of digital video editing to create multimedia portfolios has an effect on the development of the candidates' ability to reflect and justify their own practice.
2. Determine whether teacher candidates' use of digital video editing to create multimedia portfolio has an effect on their ability to collect and analyze data on student learning.
3. Determine whether teacher candidates' creation of multimedia portfolios has an effect on their ability to develop strategies to improve learning.

Method

Participants

The target population was Northwestern Oklahoma State University teacher candidates. Subjects were 22 student teachers in the Fall 2001. Subjects were randomly assigned to one of three groups: control, experimental – reflection, and experimental – reflection with multimedia production. Subjects were 4 males and 18 females. The mean GPA for all coursework was 3.239 and the range was from 2.52 to 4.00. The subjects ranged in age from 21 to 48 with a mean age of 27. The students were primarily white, Anglo-Saxon, with only four Native American students and no Hispanic or African American students.

Procedure

During the student teaching seminar course, student teachers met on Thursday to receive instruction in portfolio preparation. Portfolios are a state mandated requirement for certification. The control group received no instruction during the treatment, but rather, worked in the computer lab on their portfolio. The two experimental groups met for a single 1-hour and 45 minute session. Instruction for the group was presented first by

querying students regarding their current understanding of the purpose and process of portfolio development and reflection using a Socratic method of instruction. Particular emphasis was placed on criteria for evaluating reflection. Hatton and Smith (1995) noted that providing candidates with the criteria for evaluating their reflection "may even impose a particular construction of text". We question whether this serves only to create students who appear to be "higher-level-reflectors" rather than actual reflective practioners but perhaps this alone is a significant improvement. This was followed by explicit instruction in reflection using a traditional lecture and question/answer session.

The subjects in the reflection and multimedia production group received field-based (on site) one-on-one instruction in video editing using I-Movie ® editing software. Although this instruction included explicit instruction in the technical aspects (steps) of the process of video editing, the underlying purpose of instruction was to provide what Zeichner (1992) referred to as an "enlightened version of the practicum." This inquiry oriented instruction focused on the process of understanding and improving one's teaching by using video as a tool to facilitate critiquing performance. Teacher candidates in the reflection and multimedia group were encouraged to use editing video of their teaching as a tool to examine multiple perspectives and identify a rationale for alternative solutions (Yost, Sentner, and Forlenza-Bailey, 2000). Teacher candidate's videos served as a stimulus-rich visual/auditory diary of their teaching activities and provided a concrete artifact to aid reflection as candidates engaged in the following "technical skills" related to the process of video editing:

1. Searching for video clips to illustrate specific, pre-determined standards.
2. Verbal description of the teaching episode using the second audio track (voice over).

3. Voice-over reflective comments in which candidates explored: (a) personal reactions to things that happen in the classroom, (b) questions or observations about problems that occur in teaching, (c) descriptions of significant aspects of lessons or school events, and (d) ideas for future analysis/things upon which to take.

Materials

The instrument used to measure the dependent variable, teacher candidate's critical reflections, was based on a 7-part framework developed by Sparks-Langer, Simmons, Pasch, Colton, & Starko (1991):

1. No descriptive language
2. Simple lay person description
3. Events labeled with appropriate terms
4. Explanation with tradition or personal preference given as the rationale
5. Explanation with principle or theory, given as the rationale
6. Explanation with principle, theory, and consideration of other factors given as the rationale
7. Explanation with consideration of ethical, moral, and political issues

Teacher candidates were asked to select the competency they wished to have evaluated. This ultimately would result in candidates being evaluated based on their response to different competencies. Although this might adversely affect the validity of the study we felt that selection of the competency was part of the reflective process and therefore it was essential that candidates be allowed to decide this part as well.

Teacher candidates' written reflections accompanied each artifact in their portfolio. For the purpose of this study, one competency was identified by the candidate for evaluation

using the 7-part framework identified above. All subjects' written reflections for this self-identified competency were examined. Five different raters who were independent of the study assessed reflections. An average rating was computed for each subject. Subjects' ratings in the three groups were analyzed using a t-test for independent samples.

Results

Data was collected during the fall semester and statistical analysis was ran using SPSS in December 2001. The data were analyzed using 3 separate t-tests for independent samples. The first test assessed the difference between the average rater score for Group 1 (control) and Group 2 (reflection). The mean of 63.19 for Group 2 was not significantly larger (p = .718) than the mean of Group 1(m = 59.22). The second test looked for a difference between Group 1 and Group 3 (reflection/video ed). The largest difference was between these 2 groups (Group 1 m = 59.22; Group 3 m = 70.96) which is what we anticipated. However, the difference was not significant (p = .17). The third test assessing the difference between Group 2 (m = 63.19) and Group 3 (m = 70.96) also found no significant difference (p = .53).

Discussion

Although the difference between each of the pairs of groups was not significant the large difference between the control group and the experimental group (reflection/video ed) is encouraging. Discussions among teacher education faculty indicated that many individual professors include instruction on reflection in their courses. Students included in this study may have had unequal amounts of instruction and, therefore, developed varying levels of reflective skills that would tend to skew the results. Also, this study was conducted during the last semester of the candidates'

program and instruction in reflection using video editing was brief. We feel that given more instruction and a longer period of time to use the techniques of video editing in developing the portfolio will likely result in higher reflection scores and thus greater differences between candidates who use the techniques and those who do not. Conversely, the results may support the contention of some researchers (Kitchener, 1983; Bowen, 1989; Brabeck, 1984; Mines, 1980) that what teacher educators are assessing in candidates portfolios is their level of cognitive development and not necessarily their mastery of the program competencies. Nonetheless, this research attempted to answer the imminent question of how technology can make a difference in education. Our hypothesis was that multimedia portfolio development not only will provide a richer format for documenting individual candidate's skills and verifying that state and national standards are met for NCATE folio review, but more importantly, will increase the teacher candidate's critical reflections. If you have ever watched a video of yourself, you most likely found yourself critiquing your performance - in fact, it is almost impossible to avoid reflecting on what you wish you would have done and what you would do differently in the future. This is the art and heart of teacher candidate reflection and multimedia technology as a systematic metacognitive approach to preparing portfolios using video editing methodology can enhance the quality of teacher reflection.

Future Research

We recommend that future research explore whether teacher candidate's creation of multimedia portfolios has an effect on their ability to critique and reflect on each other's practice. Also, it is vital that educators attempt to answer the question of whether the use of technology such as having teacher candidate's create multimedia portfolios has an effect on students' (K-12) learning with the goal of improving practice. Future studies should also take into consideration students level of cognitive development prior to receiving instruction of reflection and monitor the amount and extent of the instruction to determine if the instruction is indeed helpful in producing reflective teachers.

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Authentic Assessment of Student Understanding in Near-Real Time!

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Abstract

While most would probably agree that the ultimate success of an educational system should be graduates who are able to evaluate, synthesize, analyze and apply what they have learned, routinely assessing such understanding in students has proven difficult, for a variety of reasons, using most traditional methods. Recent developments in cognitive science, information technology, and analytical tools, however, have provided educators and researchers a means to overcome many of these barriers. This paper explains how high school teachers and educational researchers worked together to apply these developments to successfully implement and assess case-based problem-solving in a typical high school chemistry curriculum. We conducted a quasi-experimental study with 134 first-year high school chemistry students using the Interactive Multi-Media Exercises (IMMEX™) computer based learning and assessment tool to solve qualitative chemistry problems. The students' teacher constructed the problem for her students using the same tool. The results of this study show a strong and significant correlation between computer-aided measures of student understanding and the teacher's manual evaluation of student understanding using her own rubric. Moreover, while both measures demonstrated that content knowledge was important, neither proved just a surrogate measure of content knowledge. In addition, neither measure demonstrated gender, ethnic or socioeconomic bias. The results suggest that the data collected by this tool not only allows for valid inferences of a student's content *understanding*, but allows such assessment to happen in a classroom setting in near real time.

Background

The assessment of student learning continues to occupy a prominent place in the debate about the efficacy of American education. As of January 2002, each of the 50 states and the District of Columbia had instituted some program of comprehensive student assessment (Olson 2002), and the most recent reauthorization of the federal Elementary and Secondary Education Act (ESEA), dubbed "The No Child Left Behind (NCLB) Act of 2001," significantly increases the stakes of these state tests by predicating federal funding to the states on improved student test results. Although many of these tests are not currently aligned with the specific standards guiding actual classroom instruction, in every case the results of such testing are intended to measure student learning and to ensure accountability (Goertz and Duffy 2001). While these two ends seem to justify the need for some form of external assessment, the consequences of current tests have nonetheless sparked controversy. In fact, some feel strongly that these consequences alone can adversely affect the validity of the interpretations made from the data produced by such testing (Messick 1989). For many teachers, these consequences include the amount of curricular time devoted to student testing (academic, administrative and reporting), the content that will appear on such tests, and the fact that these tests are added to, not integrated with, the curriculum. Since the late 1950's, there has also been a growing consensus that students must be able to do more than just recall concepts. According to Codding and Rothman (1999), "decades of research on student learning suggest that instruction should begin with clear expectations of what students should know and be able to do, and should provide students with opportunities to demonstrate their understanding in increasingly complex ways until they meet those expectations"

(pg. 15). If, as researchers from Bloom (1956) to Busching (1998) suggest, the goal of education is to teach concepts which students can then evaluate, synthesize, analyze and apply to solve new problems in often unanticipated contexts, our assessments of student learning must not only overcome the problems described above, but must also be able to assess how well a student *understands* the concepts taught in America's classrooms. Nevertheless such higher order thinking skills have been difficult to measure, especially if classroom teachers are not encouraged to propose novel problems for which students have not already memorized the answers (Stiggins, Rubel et al. 1988). As a result, most educators and educational systems have been constrained to evaluate student academic ability almost exclusively by measuring the quantity of knowledge a student can recall (Bloom 1956; Wiggins 1993). As Resnick and Resnick (1992) put it, "What is easy to measure gets measured."

Unfortunately, as Alberts (2002) so aptly notes, "Memorization is not understanding." Limiting the determination of student ability and the measure of school effectiveness to how well a student recalls specific facts can have serious negative ramifications for both student learning (Resnick 1987) and instructional quality (Corbett and Wilson 1991; Viadero 2000), can leave serious foundational misconceptions intact among students (Mestre 1991), and encourages students to verify "expected" outcomes instead of learning (Rudd, Greenbowe et al. 2002). Moreover, because of working memory limitations, when students merely memorize concepts rather than form rich relationships between them, students are less likely to solve problems using these concepts and are unlikely to show the ability to transfer these concepts to other problems (Gabel and Bunce 1994). Arguably, these consequences are amplified when test results are used to make high-stakes decisions (Corbett and Wilson 1991; Shepard 1995).

In an effort to overcome these limitations, many have advocated the use of assessments that require students to not only learn important concepts, but to actually apply these concepts to solve realistic problems indicative of what they might encounter outside of the classroom (see for example USDoEd 1983; Rutherford and Ahlgren 1990; USDoEd 1993; NRC 1996; NRC 1999). Such "authentic," case-based scenarios have been used for some time in medical and business schools (Elstein 1993), and they are now gaining increasing popularity among undergraduate, secondary, and even primary educators (e.g. Libarkin and Mencke 2002). While such assessments can provide evidence of the higher order skills explicated in Bloom's taxonomy (1956) and may hold the promise of improving education, many of the same barriers that make more traditional assessments difficult to implement can also be barriers to such "authentic" assessments as well. Authentic test items can entail logistic (Quellmalz, Schank et al. 1999) and pedagogical hardships (Lowyck and Poysa 2001), have been difficult to validate (Barton 1999), and can complicate both individual student and system-wide evaluation. In fact, many have cited good standards and rubric development as two of the most difficult obstacles to credible performance-based assessment (Raizen 1990; Arter and McTighe 2001). Recent developments in cognitive science, information technology, and data analysis tools, however, suggest that educators, researchers, and policy-makers now have the tools to conquer these barriers.

As educational assessment has become increasingly informed by developments in the field of cognitive science, the focus of such assessments has shifted away from the specific items and tasks a student must perform to the constructs necessary to understand what a competent performance in a domain looks like (Pellegrino, Chudowsky et al. 2001), p. 344). Fischer (1997) suggests that in order to take advantage of this progress and improve our assessment of student understanding, we must capture the skills and context of the diversity of human problem solving and find order in that diversity. A static student model is insufficient to account for the variability inherent in such performances and, as Wiggins (1993) has suggested, patterns of student performance will emerge when data is collected using a variety of means. In fact, federal statues expect the use of such multiple measures as well (Goertz and Duffy 2001). One benefit of moving from the more static Piagetian states to dynamic models of development has been our ability to find order in student diversity.

While the large amounts of detailed data required for such a process were difficult to collect and analyze before the age of information technology, recent developments in information and computer science now offer the tools necessary to create more dynamic and valid representations of student problem solving inexpensively and in near-real time. By using such tools, teachers and educators can determine not only what a student answered, but also how the student went about arriving at such an answer. The information provided by these types of assessments allows both for new insights into how a student conceptualizes a problem space and, as will be shown, for more valid inferences about student *understanding*. In addition, "stimulating and engaging assessments improve student learning, not just measure it, by providing students with opportunities to perform tasks that challenge them to use their knowledge and by providing teachers with examples of the kinds of performances students can produce in their classrooms day after day." (Tucker 1999, p. 38). "Whatever the project or problem," says Roberta Furger (2002), "well-crafted performance assessments share a common purpose: to give students the chance to show what they know and can do and to provide teachers with the tools to assess these abilities."

Concurrent with developments in the field of human cognition, advances in computer technology have also made possible more advanced data analysis tools. Specifically, new pattern recognition algorithms (both statistical and adaptive "artificially intelligent") make it quick and inexpensive to discern recurring problem-solving strategies that students use in a particular context. In addition, such tools overcome inherent human limitations on the amount of information we are able to process and remember, and thereby increase the number and types of classifications student performances can be separated into (Miller 1956). Furthermore, these advances have now afforded us the ability to fit cognitive models to the student a posteri and not constrain a student to some pre-conceived model a priori. The real significance of these developments, however, is not just that we can observe students as they change the types of strategies they employ to solve problems in various contexts, but that we might very well be able to identify when specific interventions would be most appropriate to improve the understanding of individual students, and even what those interventions might be. Hartley and Bendixen

(2001), for example, argue that it is this use of testing that will ultimately improve teaching and learning in our schools.

The purpose of this paper is to explain how high school teachers and educational researchers worked together to apply these developments in order to successfully assess the understanding of individual students based on the performances of these students solving case-based problems in a typical high school chemistry curriculum.

Methodology

We conducted a quasi-experimental, time interrupted sequence study on a group of 134 first year high school chemistry students to assess how well they understood a curricular unit on qualitative chemistry. The students lived in a largely middle to upper-middle class suburban community in Southern California. Student grade point averages, first semester grades, and student demographic data suggest this population is typical of student populations at suburban American high schools (NCES 1996) with the exception that African American students were under represented and Asian American students were overrepresented in this group. We have, however, found trends similar to those reported here in student groups where African American students were overrepresented and Asian American students were underrepresented in the study cohort. Nevertheless, the small number of students in specific non-white ethnic groups in these studies made it impossible to investigate the statistical relationships between particular ethnic groups and other variables in this research. Consequently, this study considers ethnicity to be a dichotomous variable.

As anticipated from the work of Gardner and others (Crouse and Trusheim 1988; Gardner 1993), pre-treatment data suggested that the best predictor of a student's future grade or overall teacher ranking of student ability was previous grade. Consequently, we first investigated correlation between various grade measures to determine if these metrics were consistent in their measurement of student ability.

As part of the post-treatment phase of this study, the students also took the Stanford Achievement Test, 9th edition (SAT-9). The SAT-9 taken by these students was a norm-referenced, content-based, multiple choice achievement test (Harcourt Educational Measurement 2001). The science and math portions of the test were entirely multiple-choice and were, at the time of this research, the primary vehicle used by the state of California to measure the math and science proficiency of its high school students. The results of this statewide assessment of math, science and reading allowed us both to compare evaluations of student ability as determined by grade with this assessment, and to compare the metrics of understanding with these same results. Because written, forced-choice items were used almost exclusively to evaluate these students, we suspected that these tests might not be fully measuring what a student *understood* and could apply in solving problems within a specific domain.

Consequently, we have used a new tool, the Interactive Multi-Media Exercises (IMMEX™) to develop strategy-based assessments of student understanding. The

IMMEX software consists of three modules: a problem authoring module, a problem presentation module, and an assessment module that unobtrusively records a student's progress through the problem space for later analysis.

Teachers use the IMMEX authoring tools to develop problem sets that address their pedagogical and curricular needs, and the contextual learning goals in their individual classrooms or courses. The authoring module can also be used to adapt or expand existing problem sets to meet the needs of different students, teaching styles or instruction contexts. At a minimum, each IMMEX problem set consists of a scenario and enough information to solve that scenario in multiple ways. Together, these define a problem space. By making small changes to the problem space, authors can easily create numerous similar but distinct versions (cases), each with different information and a different solution, in a matter of minutes. Educators design problem sets based on real world tasks that require their students apply curricular content to solve the problem. As such, scenarios are flexible enough to allow students the opportunity to approach problem solving in a way that makes sense to each individual student (Hurst, Casillas et al. 1997). The qualitative chemistry problem used in this study (called *Hazmat*) has 23 such cases and all cases share an identically structured problem space.

The IMMEX presentation module delivers *Hazmat* cases as a series of web pages via the worldwide web. Initially, IMMEX presents the student a statement of the problem they are required to solve. The teacher of the students involved in this study designed the scenario in each of the 23 *Hazmat* cases around a hypothetical earthquake which caused a number of chemicals, some of which were hazardous, to fall off the stockroom shelf. Since the labels are no longer with the spilled chemicals and time is of the essence, the school hired some of its chemistry students to identify the spilled chemicals. In each *Hazmat* case, the student then has access to the results of conducting up to 11 different physical or chemical tests on the unknown substance and to nine general reference items, which s)he can use to identify the unknown substance. As students form various hypotheses about a solution to the posed problem, they can access any of these items of information, in any order, to validate their hypotheses. The software presents the results from each test to the student graphically – as still or video images – audibly, or as text.

After the student has either successfully solved a case or has exhausted his or her available attempts at a solution (two for these students), IMMEX provides the student and teacher multiple performance measures. While some of these metrics measure problem solving efficiency or proficiency (for example, cases performed or % correctly solved), a more detailed description of student performance is available to assess understanding. The IMMEX assessment module provides a graphical representation of a student's performance in which each information item in the problem space is represented by a unique rectangle. As a student solves an IMMEX case, by moving from one information item to the next, the assessment module records each of these steps and it builds a unique graphical representation of the student's path to a solution. The resulting artifact is termed a Search Path Map (SPM). A student can access their SPM any time after finishing a case, and the student's teacher can view this map at anytime during or after the student performance. Initially, the SPM consists only of a "Start" box, but the

assessment module adds a new rectangle to the map each time a student views a new piece of information. In addition, IMMEX also inserts a line between each rectangle indicating the order in which a student selected each piece of information and adds a graphical timeline to the SPM representing the relative amount of time the student spent viewing each item.

When one examines student search path maps, two characteristics quickly become evident. First, the student either solved or did not solve the problem. Second, a student either gathered enough information to solve the problem or they had viewed insufficient information with which to do so. In this research, we term a student that both had the necessary information and actually solved the problem to have demonstrated an *understanding* of the concepts required to solve the case. We used this dichotomous metric as one measure of student understanding. While the process will eventually be automated, for this study researchers used this metric to manually score the SPM generated by each of the students during their end-of-chapter performance assessment. All 134 search path maps were scored in less than one hour.

For this study, each student also completed written worksheets as they solved each *Hazmat* case. The worksheets were not a roadmap through the problem space, but were designed to allow students to record the results of each test they conducted, their interpretation of the information the test provided, and their logic at arriving at an answer. Prior to the study, the students' teacher had also created a rubric to score the degree of student *understanding* demonstrated on each worksheet. Ultimately, the teacher assigned each worksheet a grade of from one to five points according to the following scale:

- Five points: A performance explicitly shows the logic behind the student's correct answer. The student clearly had eliminated all other possible answers. Full understanding.
- Four points: A performance shows the logic behind the student's answer, but the logic required the student to guess between at least two possible answers.
- Three points: A performance gave the information necessary to solve the problem, but the student appeared unable to interpret that information and arrive at a conclusion.
- Two points: A performance in which the student began a series of tests (i.e. identified part of the unknown compound) or made only one or two initial observations.
- One point: A performance that was apparently random or showed little logical direction.

This rubric served as a second measure of student understanding since it required students to provide a written explanation of their activity. Consequently, we hypothesized a strong and significant correlation would exist between the researchers' evaluation of student understanding and the teacher's evaluation of each student's understanding using her rubric.

A possible limitation of this study was that most students only performed one case under examination conditions so we were concerned that the performances might not have been

representative of the more global dimension of student understanding. Consequently, we used the demonstrated pattern recognition capabilities of artificial neural networks (see, for example, Principe, Euliano et al. (2000)), to cluster the performances of these students into groups that represented similar problem solving strategies. These neural networks cluster performances into similar groups based on the items a student selected. Accordingly, each group represents a particular item selection *strategy* which describes how the students within that group solved *Hazmat* cases. We have published details of this procedure and of its validity elsewhere (Stevens and Najafi 1993; Casillas, Clyman et al. 2000; Vendlinski and Stevens 2000; Vendlinski 2001). The resulting strategies often differ in at least two very important ways. First, different strategies often rely on different amounts of information. For example, one common guessing strategy is to immediately guess at the solution to an IMMEX case. Obviously, this strategy needs no menu items to implement. Conversely, another common strategy used by students is to view each and every available menu item before solving. Accordingly, these strategies fall into two distinct groups. Another characteristic that distinguishes various strategies is their effectiveness. Some strategies consistently produce high solve rates, while others seldom result in the correct identification of an unknown. A distinct pattern emerges when the amount of information used by each strategy is plotted against the strategy's solve rate. Students who access few or no information items seldom solve the case they are working on. Similarly, students with unfocused searches often view large amounts of information but, like their more penurious peers, seldom correctly solve the problem. On the other hand, students using more focused strategies view only enough information to reach a single, logical and, more often than not, correct conclusion. Individual strategies, therefore, may be further classified into more general strategy types termed "Limited," "Prolific," and "Efficient," respectively.

Results

As suspected, the overall GPA of the students in this study correlated strongly and significantly with both first semester ($r = .673$) and second semester ($r = .757$) chemistry grade. Furthermore, the correlation between the two semester chemistry grades were just as strong and significant ($r = .747$). All three correlation coefficients were significant at the $p < .001$ level. All other math and science grades were similarly correlated suggesting to us that grades consistently measure the same attributes of these students. Based on the literature and for the reasons we now address, however, we do not believe that these attributes fully assess how well students *understand* the concepts they are taught.

On average, the students in this study scored at the 60th percentile in science, at the 67th percentile in math, and near the 56th percentile on the reading portion of the SAT-9. All three tests showed a strong and significant correlation with GPA and first semester chemistry grade, but the SAT-9 science test was the only test that did not significantly correlate with second semester chemistry grade. While a significant correlation between student grade measures and each of these tests was expected, that the largest correlation would be between grades and SAT-9 reading was not. In fact, the students' SAT-9 reading score was correlated more strongly than either of the other SAT-9 tests with almost every math and science grade the students had received in high school. Moreover,

SAT-9 reading scores showed a strong and significant correlation with ethnicity (_^{2} = 20.83; df = 3; $p < .001$). White students overwhelmingly scored above the mean on this test, while non-white students overwhelmingly scored below the mean. These results suggest to us that the largest variability in a student's grade might result from their English language literacy rather than the content knowledge of the course a student is studying.

Because both of the understanding metrics described previously were arguably measuring the construct of understanding, we expected them to produce highly correlated evaluations of this trait in each student, even though the methods used to arrive at such a conclusion were very different. Moreover, we expected that neither would share the same degree of correlation with the traits measured by grades and standardized testing.

As Table 1 illustrates, the two metrics seem to be measuring the same construct.

		Teacher Classification				
		Rubric Score "1"	Rubric Score "2"	Rubric Score "3"	Rubric Score "4"	Rubric Score "5"
IMMEX Classification	Understanding	0	1	2	9	37
	Did not fully understand	1	23	16	18	8

Table 1. This table is a cross-tabulation of the score a student received on the notes s)he made to support his or her answer on the *Hazmat* assessment problem versus how the same student's performance was classified using their IMMEX performance data alone. The chi-square statistic (_^{2} = 52.38; df = 4; $p < .001$) suggests that the distribution did not occur by random chance.

The results in Table 1 suggest there exists a significant statistical relationship between students classified as understanding based on their IMMEX performance and those similarly classified by their teacher's rubric. The two metrics agreed on almost 83% of the student performances (95 out of 115). Both measures agreed that thirty-seven students had demonstrated understanding, and that the performances of fifty-eight students demonstrated less than full understanding (i.e. a rubric score of between 1 and 4). In fact, the actual data suggests the correlation may be even stronger than is obvious from a quick review of Table 1. In half of the eight performances that received a "5" on the teacher's rubric but were classified "Did not fully understand" based on their IMMEX performance, the student never actually attempted the problem recorded on her or his worksheet. Rather, the student merely made up a non-existent performance on paper so s)he would not have to actually work the case that was presented by the computer. In every instance, this "invented" performance replicated a successful practice performance by that student from earlier in the semester. While the large number of student performances made these invented performances almost impossible for the teacher to detect without physically matching the paper and computer records, these counterfeits were easily uncovered using the computerized tool. Furthermore, the 12 performances classified as demonstrating understanding based on the performance recorded by IMMEX, but given scores of less than "5" by the teacher usually indicated the student had actually reviewed more information in IMMEX than s)he had actually recorded on

his or her worksheet. Were reclassifications of the data made based on these facts, the two classifications of student *understanding* are in agreement almost 97% of the time. Moreover, the computer made detecting false performances simple and ensured that the teacher could see all the steps a student used to arrive at an answer, whether or not the student considered such a step important enough to report. Finally, the computer technology allowed such an evaluation to occur in a small fraction of the time the teacher would have required to physically set up such an experiment or to evaluate each performance using a rubric.

In addition to confirming that these two metrics are highly correlated and so are likely to be measuring the same construct, it is important to ensure that the measures do not correlate to unrelated traits (Cronbach 1989). Table 2 suggests that the two measure of understanding have a much greater correlation with one another than either metric has with other typical classroom evaluations such as a forced choice chapter test, or the student's self reported frequency of guessing at a solution.

	IMMEX Understanding	Teacher Rubric	Unit 12 Test	Student Self-evaluation
Teacher Rubric	.638			
Unit 12 Test	.295	.397		
Student Self-evaluation	.303	.375	.273	
Student self-reported guessing	-.302	Not Significant	-.256	-.374

Table 2. These correlations suggest that, in fact, the IMMEX and teacher measures of understanding demonstrate the highest degree of correlation, and that neither measure correlates as well with metrics measuring content or guessing. All coefficients are significant at the $p < .01$ level.

While the metrics called "IMMEX Understanding" and "Teacher Rubric" seem to be measuring the same construct, neither seems to be merely another measure of a construct like content knowledge or guessing. The correlation coefficients reported in Table 3 suggest that the same is true for these two understanding metrics and high-stakes content tests such as the SAT-9. Here again, correlation coefficients less than .638 suggest that neither metric of understanding is actually measuring only the content knowledge reputedly tested by grades and high-stakes tests.

	IMMEX Understanding	Teacher Rubric	Unit 12 Test	Student Self-evaluation	Student self-reported guessing
GPA	.283	.368	.545	.248	-.350
1st Semester Chemistry	.205*	.358	.637	.281	-.249
2nd Semester Chemistry	.246	.437	.580	.216*	-.245
SAT – 9 Reading	Not Significant	Not Significant	.456	Not Significant	Not Significant
SAT – 9 Math	Not Significant	.236	.352	.325	Not Significant
SAT – 9 Science	Not Significant	Not Significant	.437	.293	Not Significant

Table 3. This table shows the correlation coefficients between the two measures of understanding and student self-evaluation, student self-reported guessing, and other pencil and paper evaluations. Pencil and paper evaluations demonstrate the greatest correlations with measures of content "knowledge." The measures of understanding, however, show a much lower correlation with content measures. All coefficients are significant at $p < .01$, unless noted. Coefficients with an asterisk are significant at $.01 < p < .05$.

Furthermore, the lack of correlation between these measures of understanding and SAT-9 reading suggests that, unlike grade measures (see Table 4), neither measure is biased by a student's English language literacy. In fact these results suggest that these other measures are probably measuring something other than what we have termed understanding. Just as important, neither construct of understanding proposed here is significantly correlated with a student's gender, ethnicity or SES.

	GPA	1st Semester Chemistry	2nd Semester Chemistry	SAT – 9 Reading	SAT – 9 Math
1st Semester Chemistry	.673				
2nd Semester Chemistry	.757	.747			
SAT – 9 Reading	.465	.414	.311		
SAT – 9 Math	.288	.356	.237	.336	
SAT – 9 Science	.291	.363	Not Significant	.642	.540

Table 4. This table shows the large inter-correlation coefficients between grades and between part of the Stanford Achievement Test, 9th Edition (SAT – 9). These values suggest they each are measuring similar constructs. Furthermore, the moderately large correlations between grades and SAT – 9 Reading suggests that English language literacy may play an important role in grade evaluations. All coefficients are significant at $p < .01$.

To determine if the student's examination performance was representative of their overall performance, we conducted a correlation analysis comparing the student's typical practice strategy type with the strategy type a student used during their exam.

		Strategy type student used on assessment		
		Limited	Efficient	Prolific
Strategy type student used most often	Limited	12 : 5	7 : 11	13 : 17
	Efficient	4 : 4	21 : 10	4 : 15
	Prolific	1 : 8	9 : 17	41 : 26

Table 5. A crosstabulation of the strategy type a student used most often when solving *Hazmat* cases and the type of strategy a student used to solve the *Hazmat* case given on the assessment. The numbers in each cell represent the observed value : the value expected if the distribution was entirely random. The chi-square statistic ($\_^2 = 51.8$; df = 4; ; < .001) suggests that the distribution did not occur by random chance and the larger than expected values on the left to right downward diagonal suggest that students are very likely to use the same type of strategy to do assessment problems as they ordinarily use to solve other cases.

As shown in Table 5, this analysis suggests that the examination performance was, indeed, representative of the students overall performance. In fact, without pedagogical intervention, the students in this study repeatedly used the same type of strategy to solve *Hazmat* cases, even when that type of strategy was consistently ineffective. These results suggest that practice cases were, in themselves, indicators of the degree of student understanding during the course of instruction, that we can identify when a student is having conceptual difficulty in a course, and that we may be able to posit why they are having difficulty. Unfortunately, because manually rating each class of student note pages required such a large commitment of the teacher's time, it was impossible to rate each student's practice assessment and then correlate teacher and IMMEX assessments of student understanding for these performances.

Conclusion

The significant correlation between a standard measure of student *understanding* (such as a teacher using a rubric to assess written, open-ended student answers) and the automated measure (in this case the information a student used to arrive at and the correctness of an answer) suggest that this technology may allow educators to accurately gauge student understanding in near-real time. Furthermore, the low correlation between the IMMEX measure and other content and guessing metrics suggest the former and latter metrics are not simply measuring the same traits.

The results reported here suggest we can discern how well a student's actions explain their thinking, how they use facts to support an explanation, and how they apply that explanation to situations that are similar, but not identical, to situations they have practiced before. In short these findings suggest we can use the data produced by such technologies to infer if a student *understands* the content we are teaching and assessing. Moreover, these findings suggest that we now have the tools to finally begin addressing

Bloom's (1956) lament that the educational system overvalues and assesses knowledge while ignoring the more important aspects of education. Most importantly, this technology allows schools to embed the assessments within the normal curriculum, adapt their content to the curriculum students are actually exposed to, and to reduce the amount of time necessary to conduct and report assessment results.

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Online Discourse: Expansive Possibilities in the History Classroom

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Abstract: The California History/Social Science Project is using an action research model to investigate the use of online discourse in professional development and K-12 History/Social Science classrooms. There are three goals – to investigate ways of enhancing student historical thinking and understanding; to use technology to manifest methodologies and authentic activities which could not be manifested otherwise; to use action research by teachers for promoting long-term teacher change in the classroom. The results from the first year were promising. Teacher change occurred in ways that teachers think about their classroom and in the implementation of methodologies supported by technology. Student change occurred in motivation and in participation in discourse activities. Teachers believe this led to more student engagement in historical thinking and understanding at a higher level. Given these positive indicators, this project will continue to quantify these results in more detail during the next two years.

Key words: professional development; history; K-12; discourse; action research; technology; higher order thinking

Introduction and Background

The California History-Social Science Project (CH-SSP) is one of nine legislatively mandated professional development programs administered from the University of California, Office of the President. The Executive Offices are based at UCLA, and oversee thirteen local sites across California. CH-SSP's commitment to the improvement of the K-16 teaching and learning of

history-social science is done in part by working with teachers to: enhance instructional strategies in history-social science; promote K-16 professional collaboration; promote teacher and student accessibility to the discipline; strengthen content knowledge for all students (as outlined in the California Content Standards); and support the use of technology as an integral part of the instructional process.

In 1999, the Executive Office of CH-SSP made a commitment to explore methods of providing professional development to teachers withthe use of technology in the classroom to better promote student historical thinking and understanding. In 1999 and 2000, teachers were asked to write and implement lesson plans using technology to manifest methodologies and activities that could not otherwise be manifested without the technology. Formative evaluation of this project in 2000 indicated that although the teachers were using technology for student historical thinking and understanding, the thinking and understanding were not at the level we had anticipated. Additionally, teachers failed to reevaluate their teaching methodologies and classroom activities given the possibilities of technology. They continued doing what they had always previously. Consequently, we decided to shift the emphasis of the program from one that created lesson plans to one that teaches an action research paradigm.

The project's core goals are as follows: to promote student historical thinking and to understand and explore methodologies and activities that could not be manifested without the use of technology. While these goals remained the same, the process to achieve these goals changed considerably. The teachers became researchers in their classroom, engaging in questioning, development and design, analysis, metacognition and evaluation. In the first year, the results for

teacher change, and student historical thinking and understanding have been more substantive than with the previous lesson plan oriented model. An impact on student historical thinking and understanding was found primarily by those teachers who used on-line discourse tools. Students, particularly low performing and ESL students, engaged in significantly higher levels of discourse than in the traditional classroom; and they were either learning to engage in or engaging in discipline based activities ('doing history'). The teachers reported that the interaction of discourse and activities led to higher levels of historical thinking and understanding. This result was only true when the teachers provided scaffolding in the form of discipline based discourse supports.

Objectives and Purposes

The primary purpose of this project is to investigate instructional methods that support students' development of historical thinking and understanding, and to investigate using technology to support these instructional methods in ways that could not be done without technology. The action research paradigm addressed a third purpose - for teachers to examine their practices by acting as researchers. These goals were summarized as: 'History as a Way of Thinking'; 'Technology as a Thinking Tool'; and 'Teachers as Scholars in Their Classroom'

The instructional methodology investigated by most teachers is discourse. The key question most of them asked was – how can I support my students in discussing the issues relating to history at a higher level? The problem that most teachers identified was that they wanted all of their students to have a voice in the classroom. The technology they identified as being able to support implementation included: online discourse tools such as threaded and non threaded

discussion boards, bulletin boards, email, chat rooms and discussion based databases. The rationale for using these tools was that discourse will support students' historical thinking and understanding; and that technology tools provide greater access and a wider variety of discourse opportunities.

The purpose of the teachers' work as researchers was to investigate, in their own classrooms, the use of these tools. Their research work was driven by the following questions:

- Do these tools provide greater opportunities for students to engage in discourse?
- Are students more motivated to engage in discourse with these tools?
- Do the students engage in more discourse with the technology tools than they would without them?
- Does this result in more and higher level historical thinking and understanding?
- Does the type of discourse that technology provides facilitate deeper historical thinking and understanding than other forms of discourse?
- Does the use of technology based discourse affect (positively or negatively) other, non-technology based discourse activities?
- Does the technology interfere in any way with the discourse process?
- What does the teacher have to provide in the form of scaffolding tools to facilitate optimal discourse?

Perspective(s) or theoretical framework

Fundamental to how we approach the professional development is our approach to history. As part of practicing history, historians engage in discourse about the discipline and in discipline

based activities. This interaction between discourse and discipline-based activity is central. We reflect this discipline-based approach, as opposed to subject-based (Stearns, 1993), in the K-12 classroom and in the professional development. Discourse in the History/Social Science classroom supports students in externalizing thinking and in creating cultural supports for thinking (Bain, 1998). Discourse interacting with discipline-based activities provides a basis for students to 'do history' and engage in higher levels of thinking and historical understanding. We see the iterative process of engaging in historical activity and engaging in discourse about that activity as a creative process in which a shared understanding is created (Bohm, 1996). It is reflective and collaborative in nature. For this to be successful, teachers must provide social assistance (scaffolding) to the learners to support the necessary competencies through which the historical thinking and understanding can emerge and be internalized (Vygotsky, 1978). There are many kinds of scaffolding that can be used. Technology based tools, and concomitant teacher supplied supports, are one kind of assistance (Salomon, 1988). These tools are what we focus upon.

For the teachers, their discipline-based activity is the action research process. Action research provides for inquiry through reflection. It provides a medium which engages classroom teaching. It brings the unconscious to a conscious level (Schon, 1993; Hopkins & Antes, 1990). It is reflective and iterative in nature. Reflection encourages the challenging of ones existing theories and preconceived views of teaching (Kettle & Sellars, 1996). Action research involves social assistance and the use of tools. Social assistance for the teachers is provided by the teacher-facilitators, teachers who have participated in this process before). Technology based tools, in the form of an electronic learning environment, are provided.

As elements of these processes professional developers, teachers and students engage in reflection, collaboration and inquiry. Collectively the teachers engaged in authentic instruction, reciprocal teaching, making thinking and reasoning visible, active construction of knowledge, analysis of multiple perspectives and a number of other characteristics of learning environments described by Grabinger (2000) as Rich Environments for Active Learning (REAL).

Methods/Data Sources

We see our professional development model as a system of people, practices, and technologies. The human activities are served by the technology (Nardi & O'Day, 1998). Its parts consist of facilitators, teachers and students; the practices of discourse and action research; in the disciplines of history and education; and the utilizing the supporting technologies.

Logistically, the teachers engage in the following process. First, they participate in online pre-institute discourse activities. They then spend three days at UCLA engaged in discourse about history and social science, teaching history and social science, technology and becoming scholars in their classroom. They should leave UCLA having a research question in mind. When they return to the classroom, they design, develop and implement their action research plan. When they have in-class results, they analyze them and write a paper reflecting these results. This paper is then disseminated in a variety of ways to the professional community. In total, this constitutes a five to six month commitment.

The action research process for the teachers consists of six overlapping stages (adapted from

Sagor, 2000):

- First, teachers question their assumptions about the disciplines. Through online discourse before the institute and in person discourse during the institute, the hidden assumptions that they have are brought to the surface.
- Second, they pose a problem (research question). They discuss these questions with the other teachers and provide other teachers with feedback regarding their questions.
- Third,as each teacher focuses on one problem, one aspect of their teaching, the plan for the solution emerges (research plan). This plan is worked out collaboratively with other participants and facilitators.
- Fourth, they implement the action research plan in their classroom.
- Fifth, both qualitative and quantitative data will be gathered by all teachers, analyzed and shared with peers to assure the highest level of reliability and validity possible.
- Sixth, the process and the results of the action research are documented, peer reviewed and disseminated.

The first three stages of this process prove the most difficult for the teachers and require a high level of facilitation. Because of this, and based on the research from the 2001 group, a proposed discourse/action interaction process has been developed as a scaffolding tool for the teachers. Some teachers also require a significant amount of help with technical concerns. However, once they have a plan of action, implementing and following through has been less difficult.

Results - Teachers

We are looking for indications of teacher change, specifically as a result of their participation in the action research process.

Of those teachers that completed the research (20 of 28) in 2001, all but two indicated that their action research process had changed the way they thought about how they teach some aspect of their curriculum. In particular, the teachers focused on three aspects of their teaching:

- The use of scaffolding.
- The use of questioning of students and by students.
- Their classrooms becoming less teacher centered and more student centered.

All of these issues were in reference to the use of online discourse. For most teachers, participating in this project was in part motivated by a desire to create a more student centered classroom. The need to develop additional scaffolding tools and to improve questioning skills, grew from the focus on the use of online discourse in a student centered classroom. For example:

> "The initial use of a discussion board did produced disappointing results. However, the implementation of discussion boards using support tools that help students to guide their thinking increased both the level and quality of student involvement."

Another teacher wrote:

> "If discourse supports are effective in increasing student understanding of content, teachers not using discourse supports in their strategies, need to alter what they

are doing with students. If online use of discourse supports can extend those effective strategies even further, teachers need to rethink their use of the Internet."

An unexpected result in regards to teacher change was reflected in a number of the teachers discussing their sharing of the approaches they were using with other teachers. For example:

"...I showed another teacher who does not have a gifted cluster in her class the lesson and showed her how to do the computer component of the lesson. She then taught her class the same lesson and had several students from my class work with her as student aides in the computer lab. She also found that all of her students were much more interested in the geography unit than any time that she had taught the unit in the last 10 years. She felt that they came away with a much better understanding of geography in general and the geography of their local region in particular."

Other perceived changes for teachers were an increased opportunity to diagnose and correct misconceptions earlier in the instructional process, and additional opportunities for following a student's progress over the long term.

In the 2002 program, we will bexamine more closely the teachers' levels of metacognition in relationship to their classroom and their instruction. We have enough evidence to believe that using the action research paradigm increased teacher metacognition and that that increase resulted in both a reconsideration of their teaching and the implementation of different methodologies. We will attempt to quantify that belief with this year's teachers.

Results – Students

We are looking for indicators that will help us answer the questions posed above.

Do these tools provide greater opportunities for students to engage in discourse?

In all classrooms, this represented an additional opportunity to engage in discourse. Traditional forms of discourse were still used. All of the teachers created opportunities for the technology to be available to all students. No student was denied an opportunity to participate because of access to technology issues.

Are students more motivated to engage in discourse with these tools?

Before this professional development, teachers reported that approximately 15% (for a few, as high as 20%) of their students participated in classroom discourse. During the action research period, all teachers participating reported that nearly 100% of their students participated in the online discourse activities. Teachers believe that the primary reason for this was that motivation to participate in technology-based discourse activities was much higher than to participate in non-technology discourse activities. For the future, this needs to be measured in a more quantitative manner for verification.

The following were responses from one teacher's class regarding their feelings on using the discussion board.

> "It's cool!"
> "I like how we got to see each others thoughts."
> "Neat how you can write and within a minute see it posted all over the room."
> " I liked it but it could be embarrassing."
> "I like it because I can do it anytime."
> "Kinda cool. We can hear (see) what others have to say."
> "It's another way to see what others opinions are if they don't say them in class."
> "Boring"

Do the students engage in more discourse with the technology tools than they would without them?

As most teachers used the tools in addition to traditional forms of discourse, in all classrooms that used the online discourse tools, the students did engage in more discourse. In many

classrooms, this was the only form of discourse some students engaged in.

Does this result in more and higher level historical thinking and understanding?

The most exciting finding for us were in the areas of low-performing students and ESL students. Both showed showed the greatest gains in both participation and understanding. The teachers perceived that their interest in participating, their ability to express ideas and their writing skills all improved more than expectations. In addition, teacher found that a significant percentage of students used historical thinking and understanding including citing historical fact, comparing differing primary sources, questioning others' interpretations, and citing each other. This is another area where we feel a closer look is warranted.

Does the type of discourse that technology provides facilitate deeper historical thinking and understanding than other forms of discourse?

There was no strong evidence to indicate this. We suspect that student gains are due to greater involvement in discourse. The technology facilitates this in a way that could not be manifested without the technology.

Does the use of technology based discourse affect (positively or negatively) other, non-technology based discourse activities?

Teachers reported that students were participating in other forms of discourse (whole group, small group) at a greater rate than before the use of online discourse. The students referred to the online discourse discussions during other forms of discourse.

Does the technology interfere in any way with the discourse process?

Not that any teacher was able to ascertain. The only students who did not enjoy participating in the online discourse were those students who had previously participated heavily in traditional discourse. This however, did not prevent them from participating in the online

discourse.

What does the teacher have to provide in the form of scaffolding tools to facilitate optimal discourse?

As mentioned, for many teachers adapting and refining their questioning skills for this medium has become important. Additional forms of scaffolding for different levels of students and different ages also became important. This is one area that all the teachers felt they needed to consider and develop more.

In addition, many teachers had results from their research that weren't addressed in the other research studies. These included:

- Students did not adhere to 'clique' boundaries when using technology-based discourse tools.
- Students were using the tools to expand discussions beyond the classroom.

Much work is needed to verify these preliminary results. In particular, we are interested in looking at students' overall achievement in history and social science classes using these tools, particularly low achieving and ESL students. If technology based discourse is leading to greater involvement in higher level historical thinking and understanding, does this then lead to greater student achievement in history/social science? We are also interested in how the use of these tools changes the classroom and learning environment. In particular, what adjustments do the teachers need to make in their thinking about their instructional strategies to optimize the positive effects of these online tools?

Importance of the study

Discourse is an important methodology in History/Social Science classrooms. In particular,

discourse combined with authentic historical activities can be a powerful approach to learning. The traditional forms of discourse are the classroom discussion and the small group discussion. Teachers find that both of these forms are limited. The teachers who participated in this research believe that only about 15% of their students participated in these two forms of discourse. The action research these teachers conducted indicates that the use of technology-based discourse tools seems to increase both the motivation to participate and the actual participation in (to nearly 100%) discourse. The teachers perceived this to raise the level at which students are engaging in historical thinking and understanding. This increase gives the teacher a solid foundation on which to make the change from history as a subject which teachers teach and students take, to a discipline, where historical thinking and understanding are core processes.

Conclusion

This is an action research project. As such, it has yielded rich information on the use of discourse and the use of technology to support discourse for the advancement of student historical thinking and understanding in History/Social Science classrooms. It is the intention of all the teachers in this project that action research on these issues, and on the issues that these studies brought up, be continued. It is also the hope of all the teachers' that a more formal treatment of these issues will be pursued within the professional community

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Analog and Digital Video Production Techniquest in Media Literacy Education[1]

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E-Poster version of the paper… http://euphrates.wpunj.edu/courses/ciee624/e-poster/

KEYWORDS: video production, digital video, media education, media production, media literacy.

ABSTRACT
Although media production is considered to be a time consuming, difficult, and expensive process, educators are increasingly presented with opportunities to integrate media production into their curriculum. This process is generally considered valuable in order to prepare new generation for living in a media-rich culture. To do this investigation on a large scale in education requires that media production must be simple and central to the learning process rather than just being technical or peripheral.

The research seeks to promote media literacy skills through analog and digital production techniques and to draw on the natural links between media literacy education and media production.

This research focuses on the importance of learning media literacy skills through simple production techniques on a video camera versus digital editing on a computer. It describes the results of analog and digital production groups and investigates the educational experiences with media.

This qualitative and participatory research study conducted in Hingham, Massachusetts and Madison, Wisconsin from the spring of 2001 through the summer of 2001. There were three groups of 39 participants from K-12 background and they wanted to integrate video production and media literacy into their curriculum.

The study examines how participants' teaching approaches are affected by different media production activities. It addresses their response to the use of video production in developing media literacy skills in the curriculum, and documents the pedagogical experiences of these educators who want to integrate new media and technologies into their curriculum. Results address issues about how by engaging in media production activities, participants experience the difficulties and unique characteristics of media production.

[1] Electronic Poster of this paper is at http://euphrates.wpunj.edu/courses/ciee624/e-poster/

The participants were asked to produce the same technique, transition, and special effect using either a video camera or digital editing software. Their responses to the experience were evaluated with a media survey, questionnaires, and interviews. In addition, the effects of the methods were compared and evaluated through an assessment of their video projects.

The study explores three key variables in order to understand the educational experiences of participants: 1) the wide range of meanings participants associate with media education; 2) the impact of video production activities on their understanding of media; and 3) the ways in which they integrated media production in their lesson plans.

INTRODUCTION

Currently, limited research is available dealing with the effects of digital media production in the classroom. Few studies look specifically at the impact of media production in media literacy education. This study attempts to fill the gap to outline the natural links between education and communication through this medium. Especially for adults, there is no current study that approaches this subject from the point of view of the adult learners themselves.

By increasing knowledge about media literacy issues and how to integrate media production into the curriculum, this study outlines the knowledge about how to design media production activities in the classrooms, and about classroom-based research.

As an outcome of this study, the participants improved their own media literacy and media production skills as part of the learning process.

I have been teaching media literacy and video production for over seven years. First I taught analog video production to 9-12 graders. Currently, I teach K–12 educators. "digital" video production using digital editing software Adobe Premiere. In my experience, I have seen transformation in my students' responses to the media whatever the age level they are. "I cannot watch the TV the way I used to," has been a common response from my students.

In my teaching experience, I observed students feel more creative and productive while working on video production. "Seeing is Believing, Not!: Video Magic" was the name of the exercise given to the participants in order to create magic with the camcorder and computer groups produced the same techniques using digital editing software.. For instance, it is impossible to transform a penny into a hundred dollar bill in real life, but with the help of camera tricks, the participants put a penny into the palm of the person and opened up with a hundred dollar bill. Another example is with rotating the camera

to videotape someone doing a push up on the wall with one finger. It looks like the person is doing the push up on the floor.

This research investigates where the "magic touch" is in responses to the media. Is it in learning the basic techniques of the camera production, or is it in learning to create those techniques on digital editing? This research isolated the process of video production from pre-production in video camera to post--production exercises in digital editing in order to find out which part contributes what impact on media education.

Media Literacy was defined at the Aspen Institute in 1989 as "ability to access, analyze, communicate, and produce media in a variety of forms." Media literacy is more than asking students to simply decode information that they experience in the media, but they must be able to talk back and produce media. With the help of new media and technologies, students will have more access and power to communicate and produce their own projects, presentations, and portfolios and share them with other students around the world.

As Renee Hobbs states in her article "The Seven Great Debates of Media Literacy Movement", the production in the classroom is one of the seven debates in media literacy education. Although media production is considered a time consuming, difficult, and expensive process, with simple video production techniques, educators will be able to reach their teaching goals. Media production activities are an essential component of media education in the classroom. These activities can be designed based on our objectives and the resources available in our schools. In order to be considered literate one must be able to not only read but also write. Media literate person must be able to both decode (reading) and construct (writing) media. In media literacy education, media analysis needs to be integrated with media production.

RESEARCH DESIGN

The following research questions serve as a guiding principle in the analysis of the data, and they are integrated into the qualitative interview/ questionnaire structure.

1. AUDIENCE--What are the participants' personal experiences in the area of production during their education? Are there common experiences and or factors affecting their lives and academic work?
2. PROBLEMS--Do they share common problems in the area of production? Are there common themes when discussing those problems and their possible solutions?
3. SUGGESTIONS--What are their suggestions for improving the learning of the media through production? Are there common themes when discussing improvement for schools and teaching?
4. MEDIA LITERACY--What is media literacy? What does it mean to be a media literate person dealing living in a media rich culture? Are there common categories/ themes in discussing their learning experiences?
5. PRODUCTION STYLES--How does different media production approaches effect media literacy education? Which medium (analog or digital) provides better understanding of media?
6. DESIGN--Is it possible to teach media literacy skills through media production? What type of course/ workshop design will be necessary for teaching media literacy through media production? How to design it?
7. MEDIUM-- Medium is the message? What are advantages and disadvantages of the each medium (camera, computer) in media education?

METHODOLOGY

Methodology includes analysis of media survey, questionnaires, transcripts of interviews, field notes derived from on-site classroom observations, in class and online participation (blackboard.com), video production exercises, and midterm and final projects.

Computer groups (CO) and Camera Groups (CA) were given 8 video production techniques to produce in their video magic activity.

Table 1: The comparison Chart for CA and CO groups.

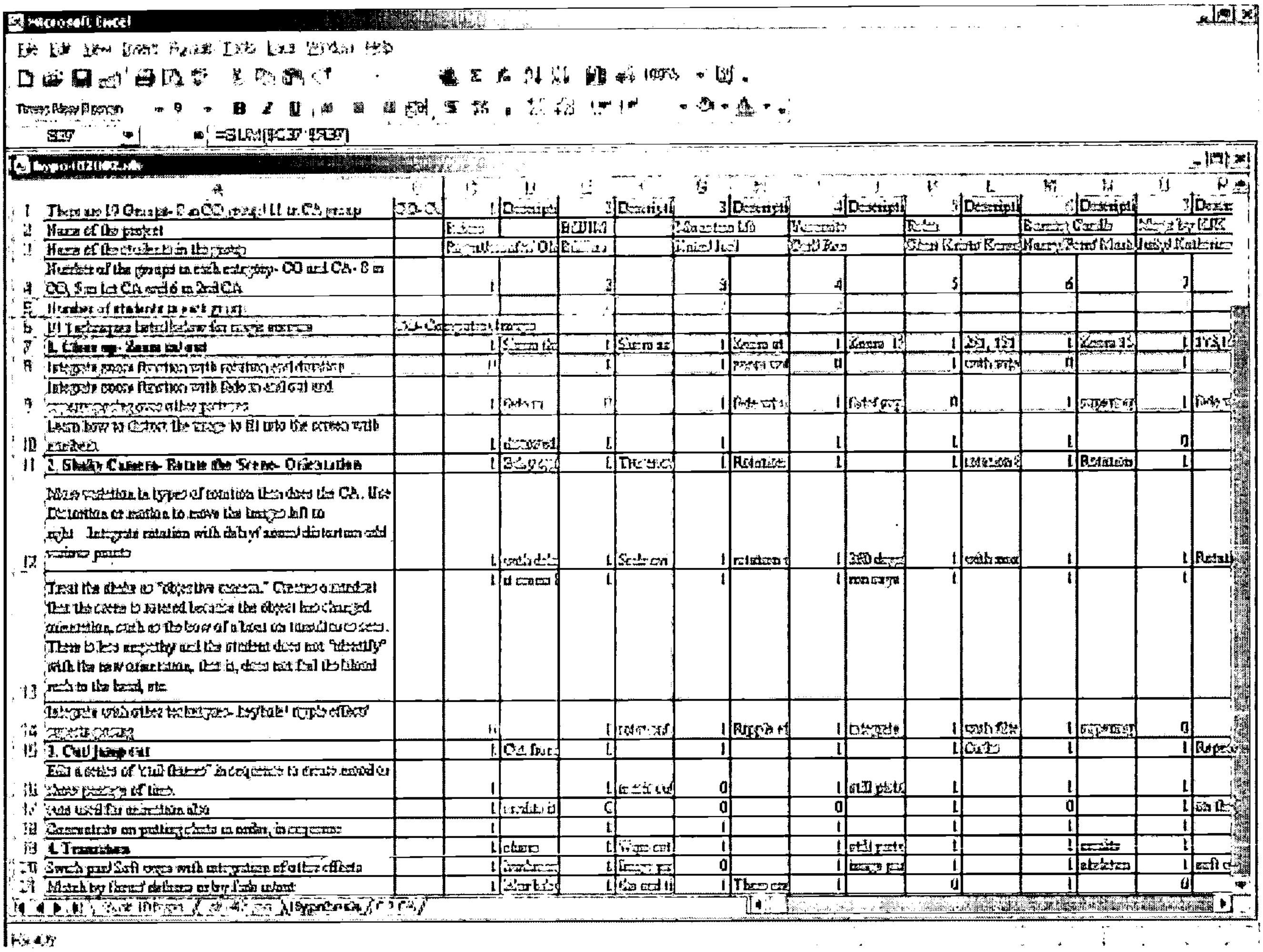
CA: Camera Group	CO: Computer Group
On video camera editing	On computer editing
Analog	Digital
On camera editing	On computer software
Used analog video camcorders only one digital camera as a digital camera.	Used digital editing software on computer. Software called Adobe Premiere.
Linear editing	Non-linear editing

For each technique, there are two or three hypothesis and predictions are generated. Participants' group projects are watched and analyzed. CA groups' projects were on videotapes, and CO groups' projects were on computer files. Their videos were each viewed based on these hypothesis and predictions. All their responses put in a spreadsheet program as seen on the following graphic. If the groups produced and integrated the techniques into their video, they have received "1" as a score. If they did not integrate the techniques, they have received "0" as a score.

List of video production techniques included in the study.

1. Using Camera Lens- Zoom in/ zoom out and Close up
2. Shaky Camera- Rotate the Scene and Change Orientation
3. Cut and Jump cut
4. Transitions-Swish pan and Soft wipe---Match action/ color/ shape/ texture by focus/ defocus and fade to black.
5. Special Effect- Filter/ Blur
6. Special Effect- Key hole- Adding Credits, Title, Graphics and Text
7. Voice Over/ Music
8. Animation

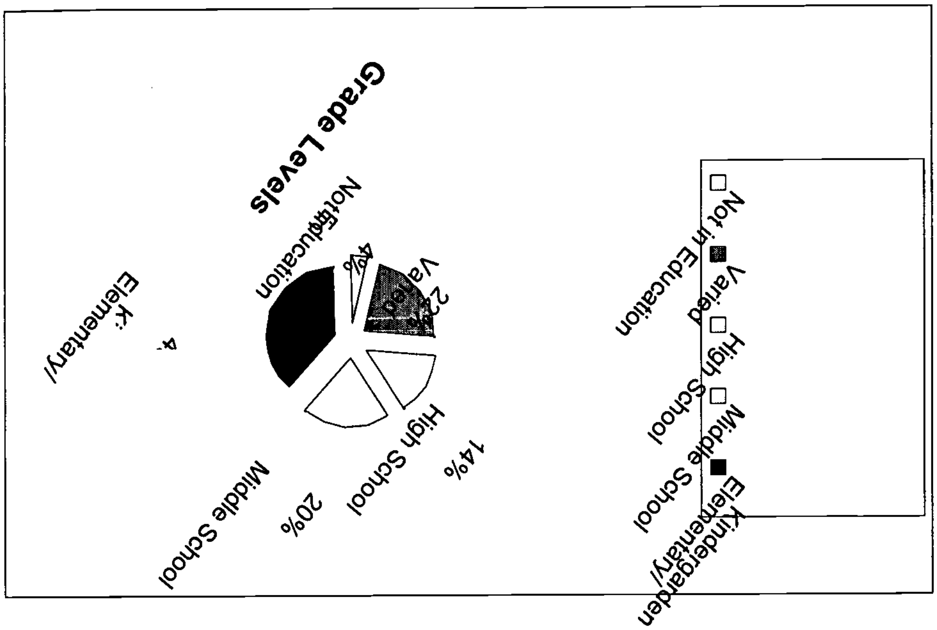
Chart 1: Sample of a spreadsheet data.



PARTICIPANTS

Among three different locations, 49 students participated the study. On camera groups, which were located in Massachusetts, totaled 29 students; 11 in group one, 18 in the other group. The third was a computer group is located in Madison, WI and there were 20 student in that group. Although the criterion for participation is a self-identification as an educator, only two students who participated the research were not working directly in the classroom.

Chart: Grade Level



As the following charts show, participants varied in terms of the years of teaching experience.

Chart 2: Teaching Experience

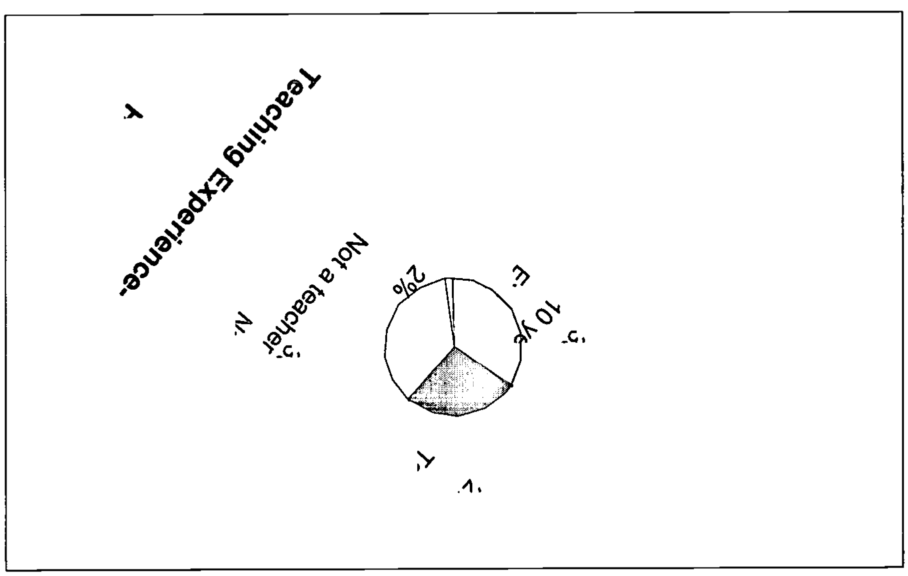
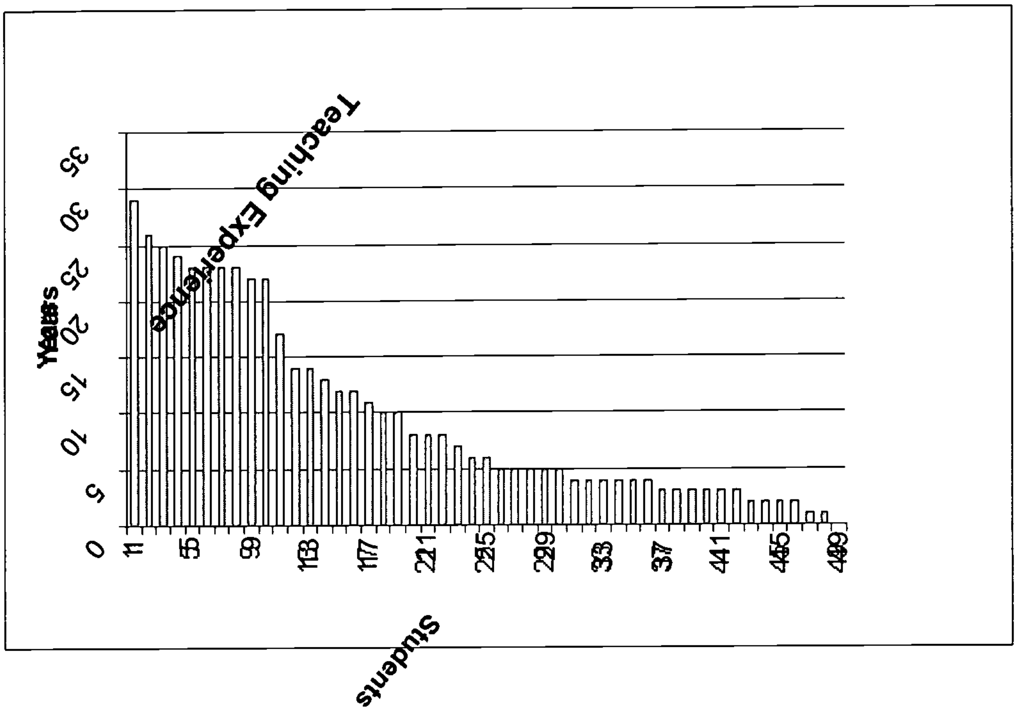
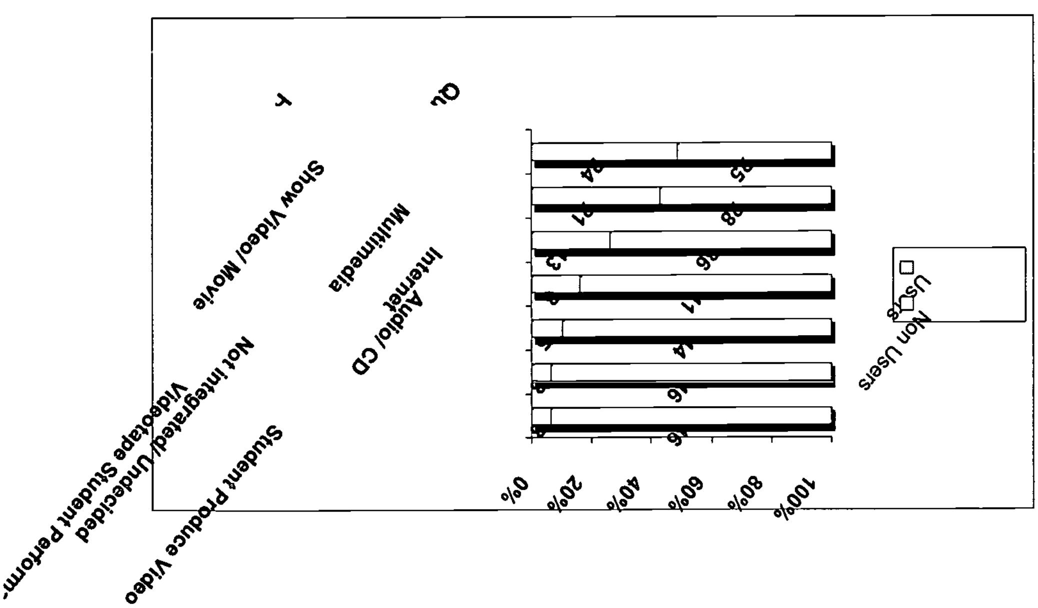


Chart 3: Teaching Experience among participants over years.



On top of print media, magazines, newspapers, the chart below shows the participants' responses to the question "How do you integrate media into the curriculum?" 50 percent of the participants show videos, movies, or news clips related with their topic.

Chart 4: Participants answer to Question 2, "How do you integrate media in your curriculum?"



Teachers in the group used video mainly for showing movies and videos related with the course content and presenting PowerPoint presentations and Internet. Twenty-four of the participants used video to show videos or movies related with the subject area. There are only three participants (two of them are technology teachers) who integrate video production in small portion of the curriculum. As one says "so my students learn to use video cameras and non-linear editing. I also use linear editing machines, but probably not for long. My students study TV commercials, then make one of their own."

46 out of 49 students are responded to the media survey. According to the students media survey results, 25 out of 46 participants expect to learn how to integrate video production into the curriculum. 24 out of 46 participants are taking this course to learn the technical aspects of video production, how to digitize a movie and edit on the computer.

Among 49 participants there were only 3 students who had a background in video/ film production. These three were also media/ technology specialist in their school. The rest of the groups had never used video cameras besides home movies or video taping student performances.

RESEARCH SETTING

The research took place during the course called "Video as Educational Technology" course in three different locations. This course has been taught in different locations in the United States. The study was conducted in Hingham and Sharon Massachusetts, in Madison, Wisconsin. Lesley University offers Master of Education Technology in Education Program on campus, regional off campus, or national off campus. Massachusetts groups were considered regional off campus whereas Wisconsin group was national off campus program. Participants were living in nearby towns but the instructors travel to the various sites nationwide.

Each site was contracted from the local schools. The first site was an elementary school; the other two sites were high schools. Every setting had access to extra classrooms, library, or a work area in

addition to the computer lab. Participants in camera group also used various settings for their videos. Example, coffee shop, pet store, playground, farm, restaurant.

The students in computer groups primarily used the computer lab. The computer lab was equipped with computers with digital editing software called Adobe Premiere, digitizing station for analog to digital, VCR, and a few digital and 8 mm camcorders.

For camera groups, there were four _ inch VHS camcorders and 4 tripods and one 8 mm video camera provided, and some students brought their camcorders for video production exercises to the class.

While all the first camera group participants stayed in the school for their video production exercises, most of the second camera group decided to shoot outside of the classroom due to the two different weather conditions.

Table 2: Three sites used for the research and their specifications.

Specifications	**Camera Group 1**	**Camera Group 2**	**Computer Group**
Location	Hingham, MA	Sharon, MA	Verona, WI
School Setting	Elementary School	High School	High School
Computer Lab	25 Macintosh computers With data projector	22 Macintosh computers With data projector	22 PC computers With data projector
Meeting/ Work Area	Library with TV/VCR Additional Classrooms	Classroom with TV/VCR	Library with TV/VCR
Equipment for the Magic Exercise	**Provided**: four _ inch VHS camcorders with 4 tripods. **Students brought**: One digital camera, one _ inch VHS camcorder and one 8mm camera.	**Provided**: four _ inch VHS camcorders with 4 tripods. **Students brought**: Two 8mm camera.	**Provided:** 20 PC computers with 128 MB RAM with internet access, and network capabilities. **Students brought**: one 8mm camera, and one _

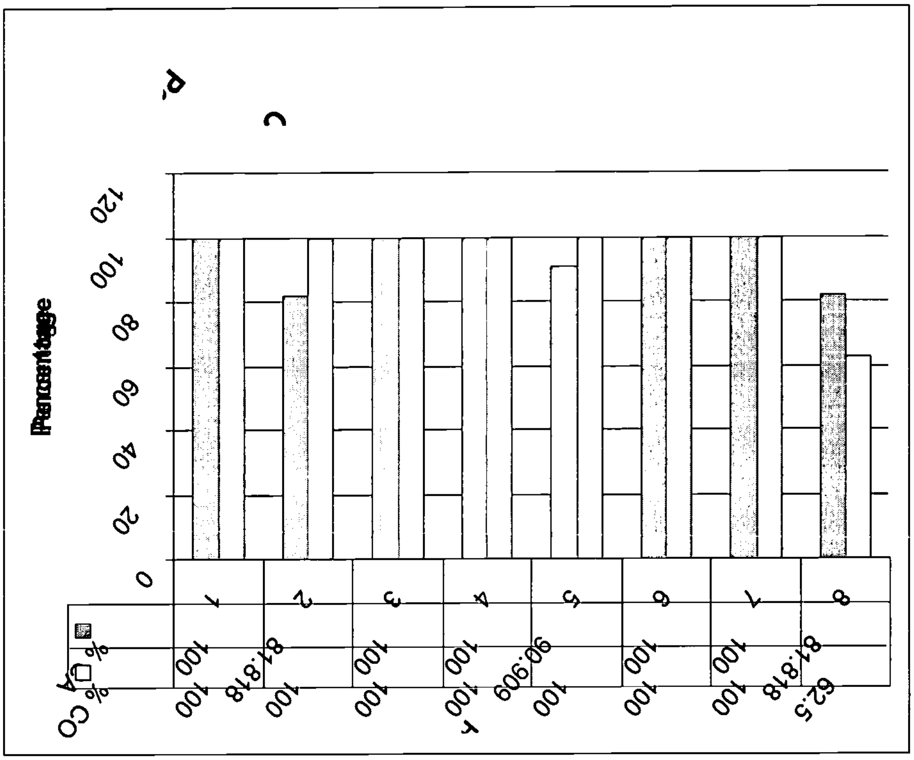
			inch camera.
Locations used for video exercise	Library, additional classrooms, hallways, computer lab, school playground.	Coffee shop, pet store, kitchen, one fast food restaurant, school track area, school office area, parking lot.	Computer lab
Timeline	April 6-8 May 11-13	June 15-17 July 13-15	June 1-3 June 29, 30- July 1

ANALYSIS OF MAGIC EXERCISES

The bar charts below are based on participants' video production activities. The first chart is based on 8 techniques. It was just showing which group integrated these techniques during the magic exercise. Based on the following chart, Camera Groups (CA) completed all of the hypotheses more than 80 percent. Computer groups (CO) completed 7 out of 8 hypothesis more than 100 percent, only the animation technique is 62.5 percent.

Each computer and camera group completes technique 1, 3, 4, 6, and 7. In addition to technique 1, 3, 4, 6, and 7, CO group also integrated 2, and 5 for 100 percent and CA group integrated technique 2, 5, and 8 over 80 percent.

Chart 5: Percentages of Hypothesis accomplished by Camera and Computer Groups



On the table below, characteristics of CA and CO groups were outlined.

Table 3: Characteristics of *Nonlinear vs. Linear Video Editing*

	On Camera Editing Analog	Non-linear Editing Digital
Capabilities of the medium	Cannot do everything Bug-free	Overwhelming, too much gadgets Programs get corrupted, bugs can be generated.
Learning Curve	It is intuitive	Takes so much time to learn
Learner	Focus on the process Spend more time on learning the subject	Focus on the product Spend more time on learning the software
Requires	Camcorders, videotapes for videotaping. TV monitor for viewing videos. Requires art materials, scissors, paper, Vaseline, etc.	Digital cameras, scanners, video card, computer, digital editing software, and RAM. Requires rendering of effects, transitions (diminished on more powerful and expensive real-time systems).
Main Idea/ Theme/ Order of the project	Stays almost the same	Changes frequently
Storyboard	It requires a good storyboard that outlines every detail.	It does not require as much pre-post-production logging and planning.
Storage	Requires videotape.	Requires large storage space to save and bandwidth to transmit.

	Videotapes hold two or more hours of footage.	Long videos require LARGE hard drives (fortunately, the cost of hard drive space has plummeted lately).
Editing	Challenging- forgetting to insert one shot requires to do the editing from the beginning. Changes are impossible, requires redo. Some shots can be lost because camcorder may roll back a few seconds during the animation or the cameraperson may not provide enough intervals between each shot and the camera may record over the previous shot.	Very easy, any shot can be inserted in any time. Changes are easy to make. Every shot can be stored separate and can be used whenever needed.
Process of editing	Linear Editing continues throughout the process. Traditional video editing, using tapes, is linear- you do edit one after another in order. Does not require an extra step. Once the video is ready, it is a final product. No need to find segments. Create segments while shooting in order.	Non-linear If the computer is down, editing stops. Digital editing on computer can be non-linear: you can do your edits in any order and rearrange them. It means that students can revise their work easily, as they would with word-processing. Requires the digitizing or capturing step (even with the DV format, material still has to be transferred into the hard drive). Finding segments is very easy.
End Product	No generation loss since everything will be done on camera. Analog videos loose their quality when copied into a new videotape. Generation loss occurs when a videotaped copied out of a copy. Videotape can be digitized into computer. Size of the videos will be longer than computer groups.	Essentially no generation loss (beyond the initial compression process in digitizing). Digital videos can be reproduced without a generation loss. Digital video file can be transferred into a videotape. Size of the videos will be short.
Quality of editing	Fuzzy shots, static, and long duration of shots occur.	Pixcellation of pictures, jumpy pictures due to compression occur.
Specification	Imagination is your limit for creating videos.	Allows endless experimentation with visual/audio elements arrangement, effects, transitions, etc.

Depending on the nature of the video magic or the capability of the medium, the groups integrated various techniques. In computer groups, popular techniques are superimposing over a picture or adding fade in and out function which is a matter creating points and changing the red lines in various directions.

It was predicted that computer group prefers "zoom in" function instead of "zoom out" more often because while zooming out image gets farther away, and shows white background. CO group learned how to zoom out or distort the image to fit into the screen. In order to fit into the screen, CO group either zoomed out of the picture or distorted the image to fit into the screen. Because of the rectangle shape of the video shot, while rotating the image or video clip, there may be white corners unless the group changes points on the distort image window area or increase the percentages of the zoom function under the motion setting window to eliminate this problem. Sometimes the quality of the image decreases when the image is distorted. On the other hand, camera groups can use both zoom in and out without any constraints of the image having white corners. While using the camera, the participants may detect the difference between the zoom in and out using the camera lens with dolly in out using the tripod or the movement of the body.

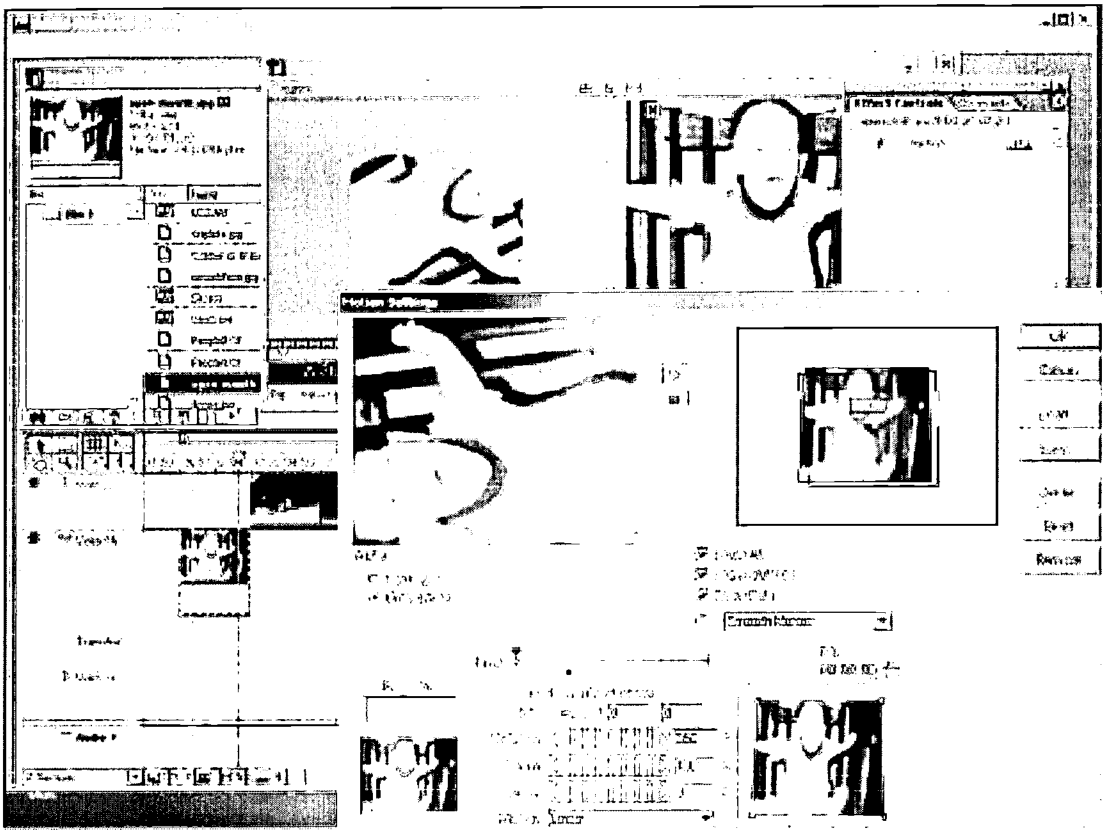
Among 8 CO groups, 6 of them used zoom in (increase the percentages) or distort the image to fit into the screen. In order to fit into the screen, they changed points on the distort image window area or increased the percentages of the zoom function under the motion setting window. 3 out of 11 camera groups seemed to detect the difference between zoom and dolly in their video production project. Until after they looked at each other's video clips, participants used the camera lens just to practice what was asked from them in the exercise. While viewing, they wished they had more time to go back and redo some of the mistakes they had in their video. Some clearly indicated that they could have done better, if they had a chance to practice with the camera.

As seen on the chart 5, Computer groups created "Shaky Camera- Rotate the Scene- Orientation technique" 100 percent and Camera Groups nearly 82 percent. Only two groups in CA group did not integrated this technique. As expected it was very hard to rotate the heavy camcorders. Only 4 out 11

groups had lightweight easy to use camcorders, others used four heavy weight _ inch VHS camcorders for their video projects.

On the digital editing software, participants randomly selected degrees for their rotation technique, tested the clip and edited the degrees easily if necessary. The rotation points and degrees were selected by specifying the end point (orientation from upright) and the speed of rotation and then the speed of the clip was automatically controlled by setting numbers. The Computer groups generated far more variation in types of rotation than did the Camera group. 5 out 11 groups integrated the rotation technique into their project. Among these five groups, only three groups rotation technique created a video magic. One group integrated the rotation and shaky camera effect in their earthquake effect. The other group rotated the camera 360 degree when one group member was reading a story through the playground equipment. And the third group rotated the camera 180 degree (upside down) and threw two balls on the floor, created an effect as if the balls were on the ceiling. The other three were just rotating the camera for 45 degree or just putting the camera upside to get a still shot of a dog.

Participants in CO groups treated the rotation and shake as "objective camera." As if the scene was rotated because the object changed orientation. For instance, one of the CO groups rotated an image of a baby for 360 degree with 35 % delay. After thc tcxt “I want to be a skier” and we see the skier video. In this case, the group chose to rotate the image to give a sense of excitement to the sequence.
Screen Capture from one of CO groups video magic project (Adobe premiere software v 5.1).



As in the following example, the CO group rotated the image 365-degree superimposing over the hand picture. Student in the group said, "We did the overlap of the burning candle and writing notes to show simultaneous feelings." They tried to show the time passing by while teachers are working hard. The added "We tried to get the metaphor of the candle transitioned to the actuality of the teacher working so the viewer would not miss the message."

Computer groups used the rotation and tried to rotate 360 degree versus Camera group had a hard time rotating the camera physically. Camera groups treated the camera shake and rotation as "subjective camera." Among 11 camera groups, 5 tried to integrate the shaky camera effect into their project. A mindset that the scene was rotated because the viewer changed the tilt of his/her hand, i.e. laying down on a bed. Participant felt the weight of the camera as "off vertical" The participant tilted his/her head to make the shot. Thus the student who used the camera in some manner "empathized" with the subject being

filmed. The effects were created by physical methods such as shaking the camera. Therefore the effects were assimilated into the purpose. The video of the feet showed "shaking" as someone was walking on a narrow wall-top. The shaking was "motivated" in the sense that one might have the sense of being out of balance if one were walking on a narrow wall-top.

Participants in CA group focused more on the storyline. They also used their storyboard more carefully. After the video production experience, some students emphasized the importance of detailed storyboarding. 8 out of 11 CA groups stayed close to their storyboard that they originally wrote whereas CO groups storyboarded as they work on their project. Successful projects in each group are the ones who had a theme or topic for their project. They were more creative when the group had a common idea or theme. For instance, one of the CA groups chose "feet" as their topic. They integrated most of the techniques into various shots of different feet.

As expected, both groups integrated transitions into their project. Although it is harder to create transitions on the computer, camera groups integrated more transitions more than computer groups.

Each group integrated at least one of the three sound options; voice over to tell the story; music from a CD; and sound effects. Voice over was a popular choice for camera groups, and music clips for the computer groups. On the other hand, CA groups integrated voice over, sound effect, or music selectively. Participants in CO groups inserted and edited sounds and deleted audio tracks on the *timeline* easily using the digital editing software. Although CA groups could not easily go back and edit their sound tracks, they still reasonably integrated audio into their project. Camera groups told their stories while filming their shots.

Camera groups integrated animation into their video project more than the computer groups. Although the camera groups who worked on animation found the animation technique the hardest, they all enjoyed creating an animation, especially watching each other's animation. A few Camera groups

experienced frustration when they spend a lot of time on their animation and ended up loosing their animation because they did not give enough intervals between shots, and the last shot erased the previous shot.

Among 8 computer groups, 3 groups did not work on animation at all. These three groups worked on motion and rotation function to move objects side to side and up and down. Animation was considered a picture moving across the screen, but the background moved with the object when they used the motion and rotation function. Apparently, it was difficult to understand animation. Some of the participants said they could have created animations if they had a camera. Almost all of the participants said they did not think of a text animation when they were to work on animation technique. For them, animation means moving unanimated objects to move.

Computer groups created animations that focused on fixing the frames, ordering and editing the shots on the timeline. Although it is easier to edit, time, and sequence the shots on computers, animation technique was more popular among camera groups. Participants who worked on animation felt more accomplished their video magic exercise than the students who could not work on the animation technique. 9 out of 11 camera groups focused on the importance of shooting the right shots in sequence. A few groups need to redo their animation when they realized some of their shots are either too long or too short for an animation. The other most important thing CA groups found out the need for keeping the camera steady while creating the animation.

Among 5 computer groups who worked on animation, 1 animated the credits, 2 animated the *gif* files from Internet, and 2 rotated graphic images. One of the rotated image is generated on the software and the other one is an imported clip art picture.

RESPONSES TO MEDIA PRODUCTION ACTIVITIES

This study describes how adult participants used video production and video editing as a medium of expression during the production process and developed a new understanding of media from a producer point of view. In each group, participants used either camcorders or computers, which force them to be media producers instead of consumers during the media production activities.

Table 4: Participants' reflections and responses to magic exercise.

	On Camera Editing	On Computer Editing
Ideas for integrating into the curriculum	"The media activities in the first weekend gave me some new ideas for teaching. I had never considered using video to teach point of view or perspective. I will be trying this in the Fall." "I want to use the video camera more often. It is motivating for the students and I can add it into my speech therapy techniques." "I hope to have students use a video camera/news clips/still shots to edit on Adobe Premier real-world applications of mathematics. I think it would be a great activity for those students who loathe math."	"I am going to use the commercial exercise that we did the first weekend before we came to class. This will be very helpful in which my students have to determine a way in which to advertise and market their product" "I am more energized to get back to media literacy. I have not done much for the last 3 years. I had classes very difficult to trust out of sight and making videos means kids have to have some autonomy. But I will have a great group next year and I can use all this stuff to get back on the ball."
Color/ light	"In general lighting is very important in mood and theme. I can't help but think of "Crouching Tiger, Hidden Dragon" and the use of color: for instance, the first martial arts fight in the streets of the ancient Chinese city was all in gray tones, lending seriousness to the scene; the martial arts scene in the bamboo trees was done with a very gentle blur against a backdrop of the green trees giving the whole scene an ethereal quality."	Students mentioned that they focused on the activity not the mood or the effect on the audience. "In general, I think the different types of lighting help determine whether something has a more realistic feel or a more lighthearted feel. It helps determine whether the production has a warm or cold, comedic or dramatic. It sets the whole tone." "This activity was done before we had any class discussions of lighting as an issue... consequently, we did not pay attention to this factor at all. We did not even think about trying to convey mood with lighting or anything else. We were focused on the activity only."
Effect on response to media	The magic exercise put the students behind camera. "Media activities have made me less of a passive viewer and more of an active viewer of media." "The effect that the magic exercise has only TV viewing is that I am more observant as to which techniques are being used and analyzing why its	"The activities made me feel like I could be more of a producer, not just a viewer. I feel more confident that I can make simple versions of the things I see on TV."

	being produced in that particular way." "Don't believe what you see on television. All these statements are untrue, after recently producing a commercial, I believe anything is visually possible with the help of fancy equipment."	
Key concept in media education Video Production	For CA media production is a key to learn media literacy. "The technical aspect of media education is the key concept. If you don't know what hooks up to what or how to work a piece of equipment, the media education experience will not be successful." "Media Education should include learning about the process of creating media as well as understanding how to utilize media effectively." "Media education should teacher students how to use the equipment, trouble shoot problems and the scientific principles behind the technology. Learning how to use the equipment should be the primary goal." "I define the goals of media education as knowing how to integrate media technology into a classroom of your students. I think the key concepts in media education are teaching the learners to use the media equipment and then to show them how to edit their pieces of work."	For CO, media production is very frustrating, time consuming. "I was very excited to learn Premier, but now I am disappointed and frustrated and need to back off. It is too expensive to set up, too time consuming to use as a busy teacher." "Premiere is not very user friendly. It is difficult to understand the different terminology used, it doesn't always work the same way twice. Having software and hardware that are out-of-date for the computer lab that we are working with takes away from the learning atmosphere and adds quite a bit to the frustration level."
Time Management/ Allocation for the video magic activity	"I did not feel that we have enough time to film and at the same time internalize/understand the process. I feel that all this was too new and I was so inexperienced that it took additional time just to get up to speed. I would do the same project much differently this weekend now that I have a better understanding from which to work."	Time is an issue but it is perceived as an ongoing issue with technical difficulties. "More time to practice using the program."
Cooperative Learning	Group Work is highly appreciated. They enjoyed exploring and learning from each other	They found the group work challenging. More than two person in the group generated problems. ".. working in my group was challenging because we all had different ideas, and we were perfectionists. Therefore, we ran out of time to incorporate all of our ideas, and to get it to look exactly the way we had hoped."
Discovery Learning vs. Trial and error	Discovery occurred while trying the various buttons on the camera. Animation is a great example.	Drill and practice- teacher presents how to and students practice. "I think that it was fun creating the magic exercise. It was frustrating at times because we had no tutorial to guide us through the process.

		But it wasn't too bad because you gave us a lot time to experiment with the Adobe Premiere Software. Learning through *trial and error* isn't so bad as long as you are given plenty of time."
Discussion	Created dynamic and productive discussions among the groups.	Generated discussions among the group but they frustrated each others editing style.
Suggestion for improvement	All of the students reflections started with I had so much fun or I enjoyed the video production activities. "I found the magic exercise a great learning experience as well as a lot of fun. The only suggestion that I would make would be to make sure that you give your students a little time to come up with an idea the previous day in order to allow them to bring in any props that they might find necessary… After all the work that was put into them, it was very satisfying to see the final product."	Almost all of the CO participants suggested more detailed instruction and tutorials. In addition to the difficulties of the software students expressed a great need for more hand on step-by-step instruction. "I did discover how to plan to create what it is you want people to see and interprete from your video, but it was sometimes difficult to figure out how to do that on the software!"
Each medium provides different dimension in media literacy. (Potter, 1998)	CA group experienced cognitive, emotional, as well as aesthetic dimensions of the project.	CO group focused mostly on aesthetic dimension of the project.
Students' Level of Technical Proficiency	It did not required technical skills, students who considered novices also excelled. Especially, the ones who considered themselves novice produced very well organized and interesting projects at the end.	Students who had previous technology skills considered themselves intermediate or expert did better on their production. Although they are the most frustrated because they came to this class hoping to learn more technical information than media literacy.
Focus	Focused more on the story "We did not use any lighting differences due to being an initial novice about the production techniques. We concentrated more on the what to do off camera then with the camera itself. "	Focus was on the production, learning the technical skills. "We wanted to experiment with the different tools. I don't recall being able to put much time into thinking about the message we wanted to convey." "I forget the camera angles we used. I remember simply experimenting with adobe premiere. So, we chose camera movements based on experimentation."
Storyboarding / Concept Mapping	Storyboards were more elaborate and detailed. Original stories stayed close to the end product. "Planning is important."	CO participants did not want to spend time on storyboarding. They feel like they needed to spend time more time on learning the software. Most ideas their ideas generated during the experimentation of the software. Initial theme or ideas changed when experimenting the software. They created the techniques based on experimentation not for a specific reason.

CONCLUSION

Media production projects are important in enriching our curriculum. A media production project generates interest to the topic being studies and includes research, writing a script, storyboarding, and involves group discussions. Students' media projects not only develop problem solving and interactive collaboration skills among students but also enhance learning providing project-based, experiential and hand-on approaches to the theory and its applications in the classroom,

'The camera never lies', 'seeing is believing,' and 'what you see is what you get' are accepted expressions. However, what we see on TV, or hear on the radio are constructions and they reflect the producers', authors', and camerapersons', journalists' point of view. By actively involving students in producing media such as PSA (public service announcement), web pages, or radio shows, etc, they come to understand the conventions of the medium. As students become the producers of their own media projects, they develop media literacy skills, and become informed consumers and citizen of the world.

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