Research in Educational Technology: Expanding Possibilities
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Research in Educational Technology
• How can computing technology enhance education?
  – Focus on classroom instruction

• Challenges:
  – Extending reach of education
  – Increasing interaction
  – Addressing problems of scale
  – Facilitating expression of ideas

Past and Current Research Projects

Research Approach
• Deployment driven
  – Classroom use
  – Technology development and promotion

• Goals and success criteria
  – Adoption of technology and methodology
  – Influence educational practice

• This is a model that has been working for us
  – Target specific deployments that are innovative in some dimensions

Today’s Talk
• Significant point of time for the project
  – Substantial number of completed projects
  – Formation of Center for Collaborative Technologies
  – Deployment of Classroom Presenter 3.0
  – Opportunity to develop classroom technologies that will have a broad impact

• Summary of educational technology projects
  – Lessons learned and remaining challenges

• Future projects

Video Conferenced Teaching
• Multi-site internet based audio-video conferencing

• UW PMP Program
  – Site-to-site courses between UW and Microsoft since Winter 1997
  – www.cs.washington.edu/education/dl/course_index.htm
  – Master's level courses
  – Goal: interaction across sites

  – Approximate single classroom
  – Various technologies have been used since the program was introduced

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CSE 519
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Video conferencing in the PMP

  - Polycom + Netmeeting for PPT and SmartBoard
- MSR DISC Project
  - Target: UW, CMU, UCB, Brown graduate class
  - Spring 2002
- MSR ConferenceXP
  - Since Spring 2003
    - UW, MSR, UCB, UCSD
    - Ed Lazowska, Steve Mauer

DISC (PMP spring 2002)

- What went wrong
  - Technology and systems failures
  - High cost of interruptions
  - Loss of trust
  - Room configuration issues
  - Lack of control of lecture room
  - Production quality
- Meta lesson
  - Learn more from failures than from successes

How to Fail at VideoConferenced Teaching
- Microsoft Faculty Summit 2002
- Anderson & Beavers

ConferenceXP

- Target: High bandwidth internet video conferencing
- Technology: Multicast networking, Internet2
- Vision: Single machine deployment, ease of use
- Designed as extensible platform
  - Integration of other information channels
    - Slides and Ink
  - Source released by MSR as shared source
- Production use in UW PMP since Spring 2003

Projects related to distance learning

- Working with archived lectures
- Large library of recorded lectures available
  - Autumn 2006 Algorithms class recorded with close talking microphone
- Lecture indexing – support text search of speech (and slides and ink)
  - Language modeling necessary (train on algorithms or CS content)
- Lecture summarization
  - Classify lecture episodes
    - Support for lecture browsing
    - Feedback to the instructor
- Lightweight lecture capture

Center for Collaborative Technologies at University of Washington

- UW center funded for continued work on ConferenceXP Platform
  - http://cct.cs.washington.edu
- Extend functionality of ConferenceXP
  - Diagnostics, Security, Remote management, HDTV integration, ...
- Build community of users and developers
- Deploy ConferenceXP in new scenarios
  - International education
  - Developing world
Classroom Presenter
• Support electronic slides and digital ink
• Initially developed for whiteboard integration of DISC
  – “PowerPoint sucks the life out of a lecture”, EDL
• Tablet PC application
  – Digital ink overlay on slide images
  – Feature set aimed at lecture presentation

Ink based presentation
• Tablet PC Inking on images
• Simple pen based controls
• Whiteboard, slide extension
• Multiple views – instructor/display
  – (dual monitor)
• Multiple slides decks with filmstrip navigation
• Instructor notes

Ink usage

Classroom Presenter Deployments
• Adoption in wide range of subjects and institutions
• Many of the key ideas have been generated by users
• Emphasis on simplicity of UI and application

Ink Based Presentation
• Challenge in developing UI to support presentation
  – Low attention UI
  – Introduce a richer set of operations without compromising usability
• Inking behavior very complicated
  – Post processing instructor ink
  • Lecture summaries and visualization

Tablet PC Project: Analysis of Handwritten Notes
• Note taking
  – Many applications exist for taking notes, but the real value of TPC notes (over paper) is being able to work with them digitally
  – Notes vary greatly in structure and are often messy
  – Search: Find “dynamic programming”
  – Type search: Find all phone numbers
  – Classification: Find all pseudocode
Classroom Interaction Systems

- Integration of electronic devices into the classroom to support instruction
- General motivation is to involve students in ways that achieve specific pedagogical goals
  - E.g., Classroom networks have been demonstrated be very effective for science instruction

UW CSE Work on Classroom Interaction Systems

- Tutored Video Instruction
  - Activities to support the facilitator
  - Classroom Assessment Techniques (Angelo and Cross)
- Classroom Feedback System
  - Student response system associated with lecture slides
- Structured Interaction Systems
  - Steve Wolfman’s thesis
  - Rich activity model built into slides

Student Submissions

- Simple model for activity taking advantage of digital ink
- Students write answers on slides, send them to the instructor
- Instructor previews results and selects slides to display to the class

Classroom Presenter

Activity Examples
Deployments
• Algorithms, Digital Design, Software Engineering, Data Structures, Environmental Science at UW
• Outside UW: Physics, Calculus, Ethics, Biology, Electrical Engineering, Introductory Programming, . . .
• Used at all levels
  – High School, Community College, University

Classroom goals
• **Active Learning**
  • Encourage students to contribute in multiple ways
  • Promote engagement in the class
    – Interest
    – Alertness
  • Demonstrate that all students have important opinions
  • Peer interaction
• Feedback – classroom assessment
• Collection of ideas
  – Collective brainstorm
• Student generation of examples
• Discovery of a pedagogical point
• Gain understanding of an example
• Show misconceptions

Impact
• Instructors successful at achieving classroom goals
• Significant participation by students
• Change in classroom dynamics
• Negative: deployment overhead

Tutored Video Instruction
• Video recorded lectures shown with facilitator
  – Original model: lectures stopped by students for discussion
  – Peer tutors
• Developed by Jim Gibbons at Stanford University
• Positive results reported in Science [1977]

UW TVI Projects
• Introductory programming
  – Address community college articulation
  – Experiment with alternate approaches to introductory computing instruction
• UW – Beihang Algorithms course
  – Offering of CSE 421 in China
• Digital StudyHall
  – Primary education in rural India

UW – Community College
• Lectures recorded from UW Intro Class
• Shown at CCs with local instructors as facilitators
• Project lasted 3 years, involving 9 CCs
• Phase I
  – Materials from live lecture, centralized grading, management from UW
• Phase II
  – Studio created materials, CC grading
Lessons Learned

• Results were mixed
• Complicated institutional relationships
  – CC students concerned about competition with UW students
• Facilitation model
  – Did not achieve peer facilitation
  – Co-teaching a more accurate description
  – Facilitators wanted external support (e.g., classroom activities)
• Program helped with instructor development

Results

• Offering successful
  – Technology, institutional relationship
• Cross-cultural issues
  – English language materials were comprehensible
  – Classroom discussion primarily in Chinese
• Facilitation model
  – Significant support for facilitators
  – Classroom activities successful (and popular)
  – Facilitators innovative and reproduced some of the instruction
  – Interactive and informal classroom atmosphere

What we’ve learned from all of this

• Value of electronic materials in the process of classroom instruction
• Tools for teaching
  – Teacher and students drive the process
  – Flexible and unpredictable use
• Structured Interaction model
• Broader context – interplay of technology and other issues

UW-Beihang CSE 421

• Materials captured from live classes
  – Slides, talking head, digital ink
• Classroom Technology
  – Students used Tablet PCs to participate in classroom activities
  – Tablets PCs used both at Beihang and UW

Digital StudyHall

• Affiliated Project
  – Randy Wang, Paul Javid (MSRI, Bangalore)
  – Richard Anderson, Tom Anderson (UW)
  – Tutored Video Instruction for primary education in rural India
  – YouTube + Netflix

Deployment Driven Research

• Development and deployment of educational technology
• Internal
  – Working with our own classes
  – Opportunity to innovate
  – Pressure to make things work
• External
  – Broad range of ideas
  – User suggestions
  – Feedback on ideas
Fan mail

To: Richard Anderson
Subject: UW CSE Web: Classroom Presenter FAQs
Dear Mr Anderson,

I am Eddy from Jakarta, Indonesia. What a great software I found, made by UW CSE.

To: Richard Anderson
Subject: UW CSE Web: UW Classroom Presenter
May I take a moment to say, once again, THANKS for creating CP! I've used it during a conference presentation and in all but one of my classes this year.

To: Richard Anderson
Subject: CSE Home Page: Classroom Presenter FAQs
Dear Dr. Anderson,

So, I think you can say I am trying out CP for the first time. I really thank you for your enormous effort to provide such an excellent tool.

To: Richard Anderson
Subject: Re: TP Mode
Richard,

Thanks again for your support of this great product. Seriously, I would not be lecturing with my tablet pc without it. Powerpoint was way too restrictive and made me REALLY nervous.

Classroom Technology Challenges

• Make it universal
• Deepen level of interaction with materials
• Expand the reach

Broader Access

• Critique of Classroom Presenter
  – . . . but students don’t have Tablet PCs
  – High overhead in deployment
  – Many different costs
• Sustainable deployment
  – Student owned devices
  – Heterogeneous deployment of devices
  – Value to all participants

The next steps

• Electronic, slide based lecture supporting flexible instructor control
• Extend device and interaction models
• Wide range of interaction models available
  – Polling, Group Scribbles, Multipoint, shared whiteboard, student submissions
• Challenge
  – Maintain focus and simplicity

Richer content support for slide based lectures

• Slide model: static content or build slide animations
• Challenge: provide a richer model of content for dynamic presentations
  – Particular domain of interest: mathematical content
• Starting points
  – Instructor notes
  – Structured Interaction Presentations (SIP) [Wolfman]

Facilitation for Tutored Video Instruction

• Teaching with recorded materials
  – Peer discussion vs. co-teaching
• Regular interruptions for active learning
• Beihang class
  – Facilitators made substantial use of Classroom Presenter
  – Activity structure was successful
• Projects
  – Develop integrated TVI replay, presentation and classroom interaction tools
  – Refine methodology for combining active learning with TVI
  – Replay tools for DSH scenarios
Classroom Accessibility

- Opportunities in electronic classroom for greater accessibility
- Classroom capture and archiving
- Real time interpretation
  - Captioning/Screen reading
- Input
  - Instant messaging, shared whiteboard, custom input facilities
- Collaborative work with Richard Ladner

Enabling Access to STEM Education

- Richer Feature Set
  - Display Control
  - Classroom Interaction
- Quick Poll
- Expanded interaction models
- New classroom activities
- Additional source content
- Performance
  - Scalability in wireless classroom

Center for Collaborative Technologies

- Development of ConferenceXP Platform
- Establish as a shared source project
- System enhancements
  - Multicast diagnostics
  - Security
- Deployments
  - Collaboration with Microsoft sponsored Latin America Virtual Institute
  - UW Professional Master’s Program

Domains of Special Interest

- Higher Education
- International Courses
- Developing World
- Global Health

International Education

- Multi-site classes with ConferenceXP
- Challenges
  - Networking issues (firewall, multicast)
  - Identifying cases where interactivity is needed
  - Time zones
    - West Coast US (6:00 pm) & China (9:00 am)
- Short term
  - Pilot tests with Chinese Universities
  - Latin America Virtual Institute
  - International guest lectures for UW CSE PMP Class (spring)
Developing World

- Tremendous challenges faced in education in the developing world
- Technology supported instruction that is cost-realistic and sustainable
- Digital StudyHall
  - India, Bangladesh, Eritrea...
- Interactive, Facilitated Video Instruction
- Low cost multi-person interaction
  - E.g., Multimouse
- Deployment issues
  - Lack of power, network connectivity

Global Health

- Strong regional opportunity
- Distance education to support medical education
- Alternate models of video based instruction

For more information

- Richard Anderson
  - anderson@cs.washington.edu
- Classroom Presenter
- Center for Collaborative Technologies at UW
  - http://cct.cs.washington.edu/
- Digital StudyHall
  - http://dsh.cs.washington.edu/
- Other contacts
  - CCT: Fred Videon (fred@cs.washington.edu)
  - Digital StudyHall: Paul Javid (pjavid@cs.washington.edu), Tom Anderson (tom@cs.washington.edu)
  - Classroom Accessibility: Richard Ladner (ladner@cs.washington.edu)

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