Tablet PC's and the Electronic Classroom

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Background

- Department of Computer Science and Engineering, University of Washington
  - Since 1986
- Experience
  - Phd., Stanford University, 1985
  - Post doc, Math Sciences Research Institute, Berkeley
  - Visiting Professors, IISc, Bangalore, 1993
  - Visiting Scientist, MSR, 2001
- Research Interests
  - Educational Technology, Pen Based Computing, Computing for the Developing World

Integration of Student Devices in the Electronic Classroom






What will the classroom look like . . .

- If all students have computational devices
  - Laptops, Tablets, Ultra light tablets, PDAs, Smart Phones, Gameboys . . .
- If the devices are all connected
- If the devices are all integrated into classroom instruction

Wide range of potential classroom applications

- Presentation
- Demonstration
- Simulation
- Accessing external resources
- Note taking
- Feedback
- Active learning
- Peer communication

The Slide Based Lecture

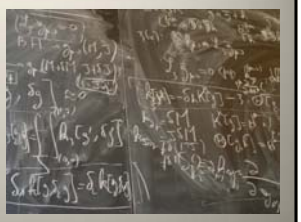
- Widely used in higher education
  - But often criticized
- What are the good points?
  - Provides structure for class
  - Sharing materials and persistent across course offerings
  - High quality diagrams and pictures
  - Mediating artifact for discussion

What do good teachers do with PowerPoint?

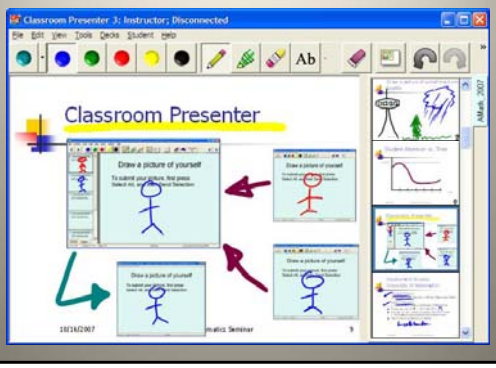
- Use technology to leverage teaching skills
- Maintain interaction with audience
- Adjust presentation based on audience feedback
- Use other mechanisms for altering displayed material

Ink in the Classroom

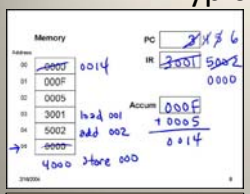
- Flexibility to create content
  - Rich expression
  - Symbolic and diagrammatic languages
  - Show process
- Classroom Presenter
  - Integrate digital ink and electronic slides on Tablet PC

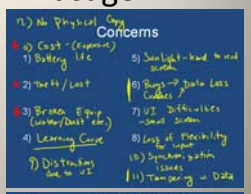


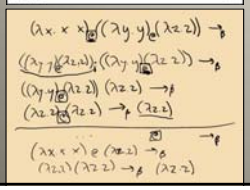
Classroom Presenter

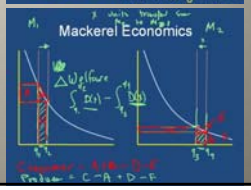


"Typical ink usage"

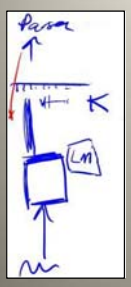


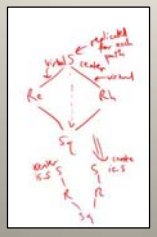


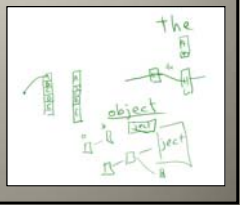




Diagrammatic Ink



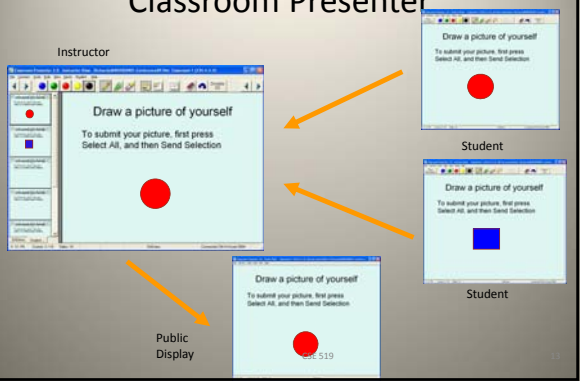




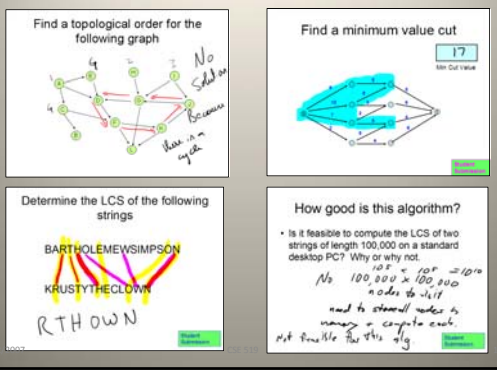
Activity Based Lesson

- Active Learning
  - Student based activities integrated into lesson
  - Supported by many different educational theories
  - Group work, feedback, reinforcement, peer learning, constructivism, engagement

Classroom Presenter



Activity Examples



Classroom goals (atmosphere)

- Encourage students to contribute in multiple ways
- Promote engagement in the class
  - Interest
  - Alertness
- Demonstrate that all students have important opinions
- Peer interaction

Classroom Goals (specific activities)

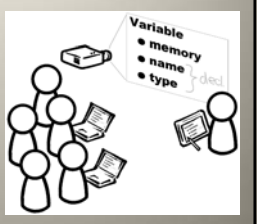
- Feedback – classroom assessment
- Collection of ideas
  - Collective brainstorm
- Student generation of examples
- Discovery of a pedagogical point
- Gain understanding of an example
- Show misconceptions

History of Classroom Presenter

- Initially designed as presentation system for distributed classroom
  - Ink and slides for flexibility in distance learning presentation
- Stand alone presentations
- Integration with student note taking
- Active learning with annotations from students
- 2001-2002 Project started at MSR
- Code released to UW to allow continuation of project
  - Integration with ConferenceXP
  - MSR license
  - Multicast networking
- 2006, CP3 released
  - Improved network communication
  - BSD Open source license

Classroom Presenter as a distributed application

- Designed as distributed application for distance learning
- Enables many scenarios
  - Mobility
    - Walking and talking
  - Sharing materials with students
    - Note taking
  - Classroom interaction
    - Student submissions



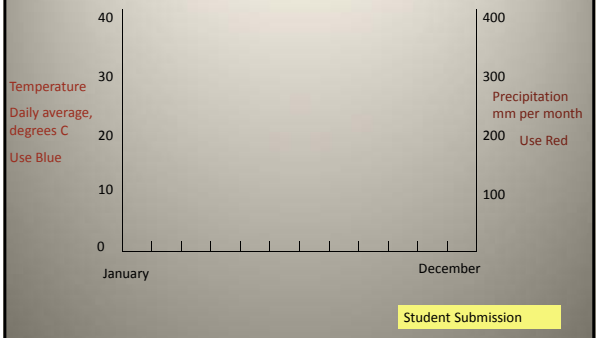
Basic Usage, Higher Education

- Initially targeting Computer Science Classes
- Picked up by a wide faculty in a wide range of disciplines

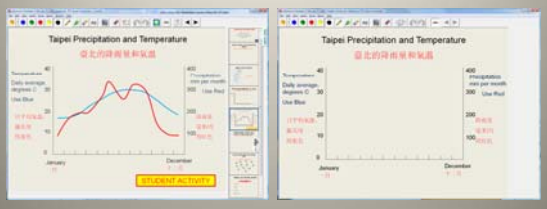
Discussion Artifact

- Use student generated example to explore different aspects of a topic
- Assess overall understanding
- Diagnose misconceptions

Taipei Precipitation and Temperature



Aside: Instructor Notes



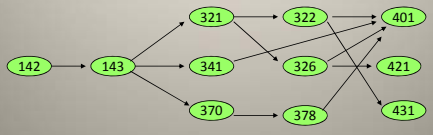
Text that only appear on the instructor's screen

Discovery Activity

- Have students derive a concept from an example

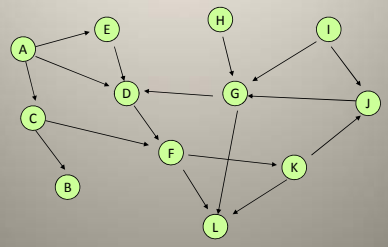
Topological Sort

- Given a set of tasks with precedence constraints, find a linear order of the tasks



- Label vertices with integers 1, 2, . . ., n
  - If v precedes w, then l(v) < l(w)

Find a topological order for the following graph



Collective Brainstorm

- Generate student ideas for discussion
- Build a list of ideas
- Analyze and evaluate responses

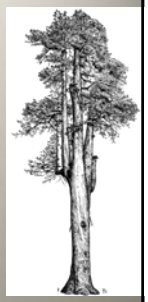
Special problem: Large Size

- List at least three problems trees must face (& solve) because of their large sizes.

1.

2.

3.



Problem Introduction

- Have students explore an instance of a problem before topic is introduced

Determine the LCS of the following strings

BARTHOLEMEWSIMPSON

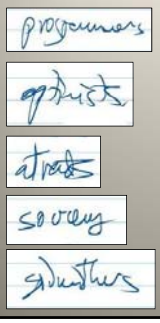
KRUSTYTHECLOWN

Submissions

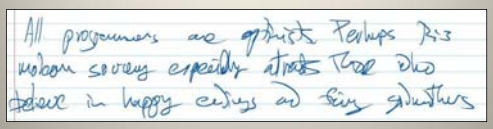
Challenge problems

- Competition in getting solutions
- Simultaneous work
- Submission and discussion

Handwriting Recognition: Identify the following words



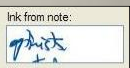
Recognition results



Converted text:

All. propounders are oppugns). Perhaps 2-3 motion sorcery especially attracts Those oho believe in happy adios of Sais godmothers

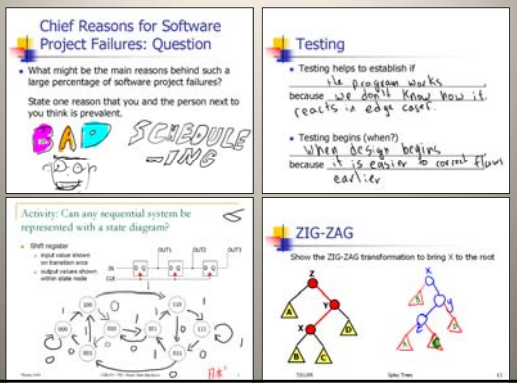
Ink from note:



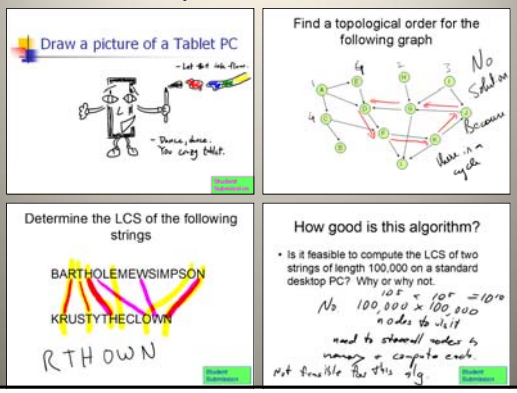
Alternative:

oppugns).
optimists.
optimists,
oppugns).
opuses),
opuses).
optimist.
optimists

Example Submissions



Example Submissions



Interesting Case Studies

- Synchronous Distance Education
- Tutored Video Instruction
- Elementary School

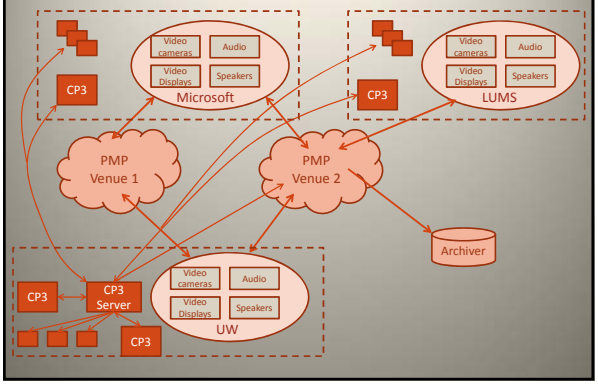
ConferenceXP Project

- High quality, low latency video to support interactive classes
- High bandwidth internet video conferencing
  - Internet2
  - Multicast
- Collaboration between UW and MSR
- Distance learning support for UW Professional Master's Program
  - Distance courses between UW and Microsoft

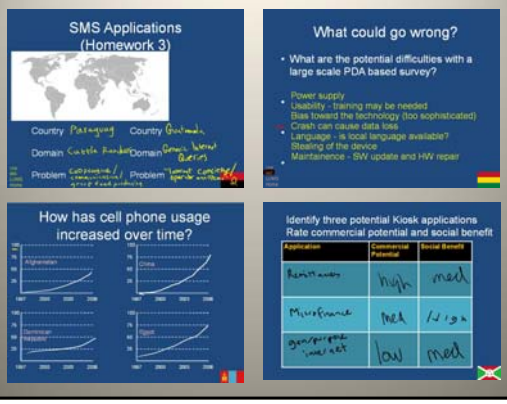
Masters class, UW - Pakistan

- Masters class
  - University of Washington
  - Lahore University of Management Science
  - Microsoft
- Computing for the Developing world

3-way setup for UW, MS, LUMS



Classroom Activities

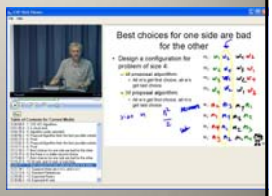


Tutored Video Instruction

- Recorded lecture materials
  - Generally based on live classes
- Class model
  - Lecture playback alternating with facilitator led discussion
  - Facilitation models
    - Gibbons: Peer instruction
    - Active facilitation

UW-Beihang, Algorithms course

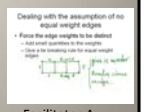
- Offer course based on UW course in Beijing
- UW Instructor could not give the course in Beijing
- Scheduling prevented live course offering
  - 1:30 pm Seattle, 4:30 am Beijing
  - Materials captured from live classes
- Tutored Video Instruction
  - Slides, talking head, digital ink

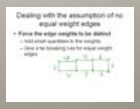


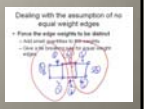
Facilitation

- Support provided for facilitators
  - Lecture notes
  - Activities
- Facilitators invested a larger effort in preparation
  - Studying videos
  - Planning how to cover content
- Active facilitation
  - Worked through lecture examples
  - Led activities
  - Asked questions to students
- Example: facilitators working through example from lecture slides


Instructor

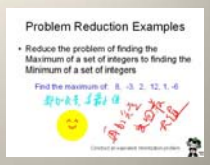

Facilitator A

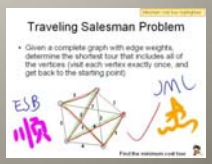

Facilitator B


Facilitator C

Classroom Activities

- Tablet PC supported activities
  - Student submission model
  - Used for every lecture
- Technology generally successful
- Considered very positive by students
  - High rate of participation
- Provided a structure for active learning





Classroom Environment

- Contrast to traditional large lecture class
- Highly interactive class
  - Interaction episodes measured by observation logs and videos of Beihang classes
  - Average of 13 interaction episodes per class, 10 with students speaking
  - UW class averaged about 20 interaction episodes per equivalent length of time
  - Beihang episodes averaged a greater number of rounds of communication
- Class atmosphere was informal

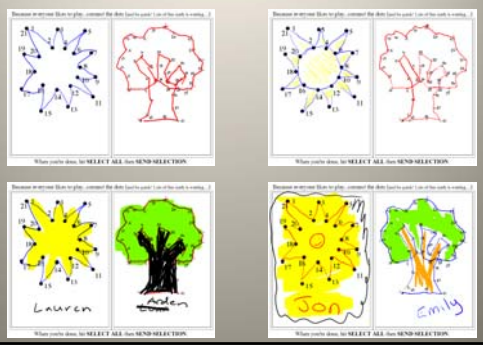
Results

- 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

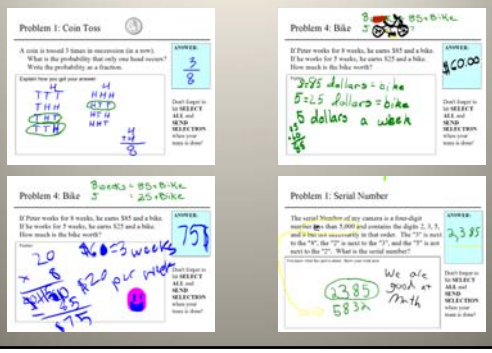
Elementary School

- Classroom visits with Tablet PCs
- Seattle Public School
  - 4th grad
  - After school math club
- Massachusetts Public Schools
  - Kimberle Koile
  - Classroom Learning Partner

Introductory activity



Sample Math Problems



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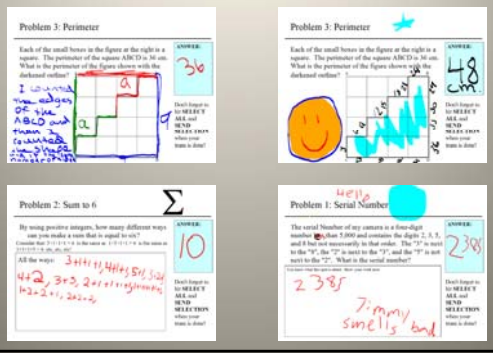
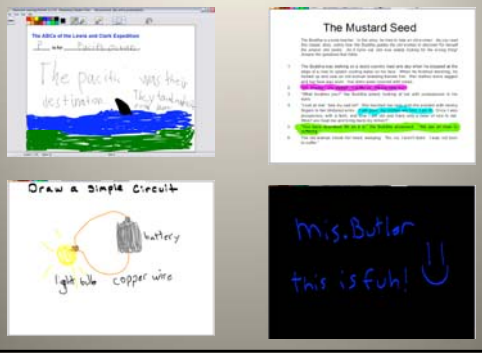


Classroom Learning Partner



School Summary

- Activity model worked very well
- Positive Aspects
  - Student engagement
  - Showing work on public display
  - Visible process
- Negatives
  - Student distraction, excessive drawing
    - Feature request – limit access to highlighter
- Students master technology instantly
  - Teachers may take longer
- Fits naturally with elementary school pedagogy
- Technology must be robust and easy to use

Classroom Presenter: Going Forward

- Distribution Model – Academic Freeware
- Establish Electronic Classroom Initiative
  - Consortium of industrial and educational institutions
  - Advisory board
- Classroom Presenter 4
  - Improve performance (scale to large classes)
  - Cross device compatibility
  - Platform for others to extend (open source)
  - Expand to K-12

For more information

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