Multimedia

CSEP 510
Lecture 8, February 26, 2004
Richard Anderson

Announcements

- Lectures
  - Monday, March 1
  - Thursday, March 11

Outline

- Information capture
  - Classroom 2000
- Note taking analysis
- Tutored Video Instruction
- Offline video
  - Browsing video
  - Video review

Classroom 2000

- Capture the classroom experience for later review
- Experiment in Ubiquitous Computing
  - Instrumentation and capture
  - Working in a real environment

History

- July 1995
  - Feasibility study
- Initial prototype
- Deployment
- Name changed to eClass

System description

- Audio video capture system
- Export to web
- Stream Weaver for replay
- Electronic whiteboard with projection
  - Initially tablet based delivery (ClassPad)
  - Later whiteboard delivery (ZenPad)
- Student notetaking (StuPad)
- Extended whiteboard

Process overhead

- Archiving was the driving motivation for the project
- Stages
  - Pre production
  - Live Capture
  - Post production
  - Access
- Automation is essential
- Getting pieces to work together is very challenging
- Still a long way from the BIG RED BUTTON

Note taking

- Note taking received lowest student response
- Students not using student devices rated them higher than those that did
- Students who always used the note taking devices gave them the lowest rating
- Reduction of note taking observed in class with captured data

Note taking analysis

- Grudin's Law of Reciprocal Benefits
  - Who does the work?
  - Who gets the benefit?

Note taking types

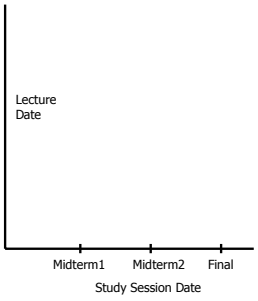
- Literal 35%
  - Instructor's speech and writing
- Copiers 30%
  - Instructor's writing
- Outliners 17%
- Listeners 4%
- Other 14 %

Survey results (n = 132)

	Agree			Disagree	
The technology made the class more interesting	34	37	18	7	4
Captured notes helps students pay better attention during lecture	27	41	18	10	4
I prefer a course that uses Classroom 2000	43	39	11	3	3
Audio was valuable to me	22	41	24	9	3
Video was valuable to me	12	20	42	17	10
Printing slides was valuable to me	31	37	24	7	1
Classroom 2000 encourages you to skip class	9	30	34	23	32
Availability of notes made me less worried about missing class	12	50	18	15	5
I expect to access notes in the future	15	30	34	16	5
I trust captured notes will be available after every class	23	52	19	6	0

Review Behavior

- Some students reviewed lectures regularly
- Many students reviewed prior to midterms (two midterms)



Lessons learned (from Abowd)

- Ubiquitous Computing
  - Importance of motivating application
  - Address some notion of scale
  - System should be subject to everyday use
- Classroom 2000
  - Fast prototyping of UbiComp solutions
  - Structure of evolving system matters
  - Cost is not a limiting factor
  - Capture is meaningless without access
  - Understand difference between a demonstration prototype and an evaluation prototype
  - Simulate automation with manual effort, but only for a short time

Classroom Deployment

- McGill Deployment of Classroom 2000
- More emphasis for managing in class activities
- Technical issues
- Difficulty for instructors in starting the class

Winer, Cooperstock Computers & Education 38 (2002)

While the prime motivating factor for the development of our Intelligent Classroom was to make the professor's interaction with the technology as transparent as possible, there is unfortunately, no getting away from the inevitability of technical difficulties.

Technical failures, stemming, for example, from an overheated projector, or a loose video cable connection, still arise.

While an unannounced change to our network switch configuration last year had a similar effect, this failure was a human error far more than an architectural problem.

Windows NT failed to release the video frame grabber device after recording a lecture. . . Moving our recording software to Linux corrected this problem but introduced: the whiteboard software would spontaneously freeze for no obvious reason. These problems were certainly unhelpful in building instructor confidence in the augmented technology.

Note taking study

- Motivating problem
  - Suppose that you integrate a presentation system (Classroom Presenter) with a note taking system (e.g., OneNote), how much value is there for the note taker in having the instructors ink?
  - Conjecture – writing and diagrams are useful, attention marks are annoying

Background study

- How do students record instructor ink?
  - Slides with no ink
  - Slides with writing but not attentional ink
  - Slides with all ink

CSEP 505 GROUP A Addition

- To add *x* and *y*, apply *succ* to *y x* times
  - Key idea: *x* is a function that, given a function and a base, applies the function to the base *x* times
    - "a number is as a number does"

    plus " $\lambda x.\ \lambda y.\ x\ succ\ y$

    plus two three fi_b^*
    two succ three fi_b^*
    succ (*succ three*) = *five*
- Multiplication is repeated addition, similarly

CSEP 505 GROUP C Addition

- To add *x* and *y*, apply *succ* to *y* *x* times
  - Key idea: *x* is a function that, given a function and a base, applies the function to the base *x* times
    - "a number is as a number does"

plus = λx. λy. *x succ y*

succ three

two ≡ λs λz. s (s z)

plus two three $\Rightarrow_{fi_b}^{*}$
two succ three $\Rightarrow_{fi_b}^{*}$
succ (*succ three*) $\Rightarrow_{fi_b}^{*}$ *five*

- Multiplication is repeated addition, similarly

CSEP 505 GROUP B Addition

- To add *x* and *y*, apply *succ* to *y* *x* times
  - Key idea: *x* is a function that, given a function and a base, applies the function to the base *x* times
    - "a number is as a number does"

plus = λx. λy. *x succ y*

succ three

two ≡ λs λz. s (s z)

plus two three $\Rightarrow_{fi_b}^{*}$
two succ three $\Rightarrow_{fi_b}^{*}$
succ (*succ three*) = *five*

- Multiplication is repeated addition, similarly

Data analysis

http://www.cs.washington.edu/homes/aliu/hw7a/

- Can you find any interesting patterns in the data?
- Are there differences between notes taken in case A, B, and C

Approaches

- Quantitative
  - Measure ink used in A, B, and C
  - Count events
- Qualitative
  - Look for interesting events
  - Oh! That's interesting

Questions

- Are any attention marks copied for A or B?
- How often is the writing copied on slides 3 and 5?
- How often are annotations made on writing on B and C?
- Are there particular events that many people recorded?

Flaws in experimental protocol

- Doing a good experiment is hard!
- The errors are the fault of the experimenter – not the subject
- Discarded data
  - 6-up slides
  - Slides taken with media player
- Material – foreign or already seen?

Offline use of video

- Tutored Video Instruction
  - Viewing recorded lectures in a group
- Lecture Browsing
  - Individual use of video material

Asynchronous Education

- Students separated in time from instruction
  - Many reasons to do this

Technology

- Digital technology has radically changed the costs in capturing and playing back lecture experience
- Many independent advances

TVI Theory

- Collaborative learning using archived lecture materials
- Base on replay of recorded classroom materials
- Group discussion to reinforce understanding and clear up difficulties

TVI Implementations

- Stanford (1977)
- Chico State (1995) / Distributed TVI
- UW and Community Colleges (2000)

Gibbons, Science 1977

In the early 1920's, shortly after radio broadcasting was proved economically feasible, Robert Hutchins is said to have predicted that this new technology would undoubtedly have a dramatic impact on education. . . . In the early 1950's instructional television was introduced with a similar fanfare. However, with a few notable exceptions, its potential also failed to materialize. It seems that more recent innovations such as computer-aided instruction and satellite-based educational delivery may come to a similar fate. Why is it that these technological aids to education seldom seem to live up to their potential?

TVI Classic

- Stanford CS Master's Program
- Engineering courses offered at HP Santa Rosa
- Video tapes of live classes
- Watched in small groups
- Facilitator to encourage questions

Evaluation

- Careful comparison of performance
- Analysis to cover different backgrounds
- Results consistent over several courses
- TVI Students outperformed Stanford students

Factors for TVI success (Gibbons)

- Personality of Tutor, neither overqualified or under qualified
- Group size – at most 10
- Educational objective (e.g., Stanford degree)
- Live videotapes with active discussion
- Charismatic instructor on tape
- Logistical support

Distributed TVI

- Desktop based
- Hollywood squares display
- Positive results reported from Chico State experiments
- Experiments with and without Tutors

UW TVI

- Offered TVI courses at Community Colleges over a period of two years
- Community college instructor served as course facilitator

Project goals

- Understand whether or not Tutored Video approach is viable for CS education
- Develop methodology for export of university courses
- Make it possible for a wider range of schools to offer introductory programming
- Address Community College articulation issues

Community College Offerings I

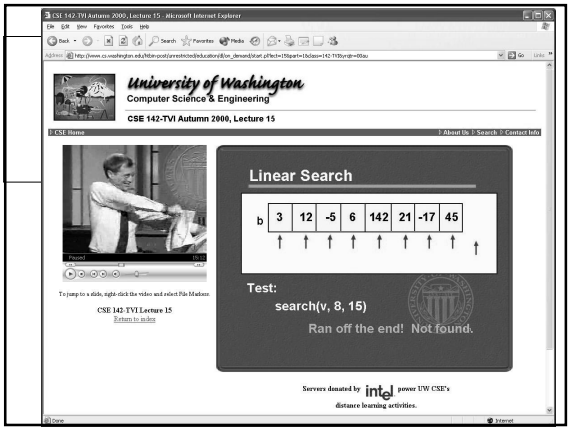
- Offered CSE 142/143 using UW materials at community colleges.
- Two quarter sequence of intro programming course using C/C++
- Recorded versions of UW lectures
- UW Homework and Exams
- Material graded at UW, credit given by CCs, but accepted for UW Transfer credit

TVI class offerings

- Autumn 1998
  - CSE 143: NSCC
- Winter 1999
  - CSE 142: Highline, NSCC, UW on-campus sections
- Winter 2000
  - CSE 142: Green River, Shoreline, Centralia
- Spring 2000
  - CSE 142: Centralia, Green River, Highline, CWU
  - CSE 143: Shoreline, NSCC, Green River
- Summer 2000, Autumn 2000, Winter 2001
  - CSE 142: Green River (unofficial)

Implementation details: lecture materials

- Lectures recorded with single camera on instructor
- PowerPoint transparencies synchronized with presentation
- Goal: low impact on classroom instructor
- Lectures viewed with Windows MediaPlayer
- CC instructors downloaded lecture in advance (as opposed to using over internet)



Implementation details: course mechanics

- Course used UW homework and exams
- Exams and homework used from quarter the lectures were recorded
- Material graded at UW
  - Electronic submission of homework
  - US Mail submission of exams
- Reasons for centralized model
  - Remove grading authority from tutor
  - Consistency for evaluation of experiment
  - Support wider range of tutor

Evaluation

- Mixed
  - Some sections successful
    - Positive teaching evaluations
    - Similar distribution of grades to UW offering (on same materials)
    - Positive comments and anecdotes
    - Repeat instructors
  - Some sections unsuccessful
    - Low grades/evaluations
    - Grumpy students

Numerical data

- Large amount collected, but . . .
- Several major issues were clear without statistical analysis
- A very large number of variables would make analysis difficult
- Many in-course corrections
  - Educational experience vs. experimental clarity tradeoff

Student reactions

- Negative reaction to low quality materials
  - Lost writing on transparencies
  - Inadequate projection facilities
- Concerns about missing aspects of UW course
- Did not appreciate the TVI model ("just watching TV")
- Some students bonded with UW instructor

Facilitators

- Community college instructors
- Wide range of backgrounds
  - Some instructors had background to offer course
  - Some instructors from other areas with little background
  - Varying degree of facilitator buy in
- Facilitators developed a wide range of styles in using the TVI materials

Conclusions from experiments

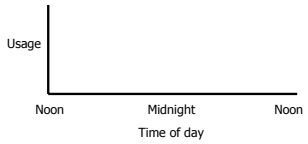
- Abandon centralized course administration
- Use higher production value materials
  - Students complained about material not captured on in-class video tape
  - Much of the in-class time is irrelevant to the TVI audience
  - Lack of clarity of in-class tape did not generate discussion
- Solution: Studio produced lecture materials
  - Substantially shorter (13.2 hrs for 10 week course!)

Offline Usage

- Browsing behavior
- When, why, how much?
- Feature use
- User goals

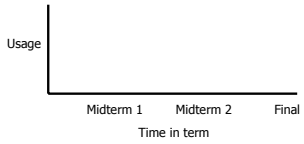
MIT 6.001

- MIT Intro class
- Lectures recorded with slides + audio
- Students "required" to watch lectures before recitation session



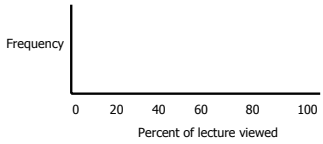
Georgia Tech Classroom 2000

- Lectures recorded for student review
- Slides, audio, video available
- Low bandwidth



Microsoft Research Lecture Archive

- Research seminars recorded for later viewing
- View from the web



Time compression

- Video speedup
  - Drop a fraction of the frames
  - Increase the display rate
- Audio speedup
  - Lower sampling rate increases pitch
  - Discard segments (33ms every 100ms)
  - Smoothing can improve output signal

Pause removal

- Remove audio and video corresponding to gaps in speech

Compression performance

- Speedup of a factor of 2.0 is tolerable
- Training allows even greater speedups
- Most studies show speedups of about 1.4 when viewers have the choice
- Word rate may be the limiting factor

Video browsing behavior

- Basic
  - Play
  - Pause
  - Fast-forward
  - Seek
- Enhanced
  - Speed up:
    - Time compression
    - Pause removal
  - Textual indices
    - TOC, notes
  - Visual indices
    - Shot boundary
    - Timeline
  - Jump controls

MSR Video Skimmer

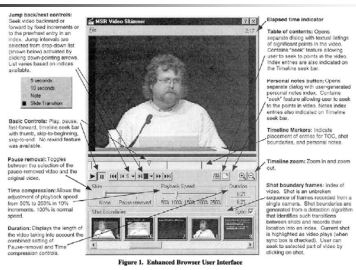


Figure 1. Enhanced Browser User Interface

Study methodology

- Observe participants viewing behavior
  - View video under time constraint
    - 30 minutes for 45-60 minute video
  - Scenario given based on video type
- First with basic browser
- Then twice with enhanced browser

Scenarios

- Classroom
  - Review lecture before a test
- Conference
  - Summarize conference talk for co-workers
- Sports
  - Find highlights in a baseball video
- TV Shows
  - Review missed show before watching final episode of series
- News
  - Summarize news show to family
- Travel
  - Identify interesting segments in a travel video

Results

- 5 viewers per scenario
- Survey to rank features
- Measure number of operations used
- Determine percentage of videos watched

Results

- Different behavior on basic and enhanced
  - Increased viewing percentage
  - Did not use seek / fast forward
- Substantial differences based on scenario
  - Information audio-centric
    - Classrooom, Conference
  - Information video-centric
    - Sports, Travel
  - Entertainment
    - Speedup not desirable

Lecture summary

- Classroom 2000
  - Impact of technology and process
- Lecture Note Study
- Tutored Video Instruction
  - Social process for technologically supported instruction
- Video browsing
  - Technology and scenarios