

An Experiment with Web Based Streaming Video Lectures “On Demand” in Physics Education at UCSD

Conducted in Winter 2003

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Read

hepweb.ucsd.edu/~vsharma/streaming.pdf

hepweb.ucsd.edu/~vsharma/2d_video_comments.pdf

Curiosity : Video on Demand in Education?

- The recent years have seen explosive growth in high speed networking and its availability in university dormitories and average income household. Similarly, digital video recording and transmission capability over the web has matured and become relatively simple and cheap to deploy. With these advances, a new paradigm for learning that has never before been a part of our educational environments is coming to form and is called “**video on-demand**”.
- Web based “video on-demand” technology radically expands the ability of the students to access information presented by instructors in class room lectures, discussion and problem solving sessions **round the clock** from any network enabled location at the university (such as libraries) or dormitory/home.
- Video-on-demand technology has the capability of becoming a very useful modern tool in effective transmission of knowledge to a large body of students.

Objectives Of This Experiment: Proposal to IIP

- Set up a system to capture class room lecture & discussion on digital video and stream it over the web for the student's benefit as video-on-demand from the class web site using existing and mature commercial technologies.
- Provide, over the web, high quality streaming videos of the lectures and discussions within hours of the classroom session, as a resource for student learning.
- **Intellectual Impact:** Providing students with a round the clock access to class lectures and providing students with the ability of “fast forwarding” and “rewinding” to review a specific segment of a lecture (that the student had difficulty absorbing during class) has the potential of making an enormous impact in their understanding of the concepts, the extent of which we wish to measure by this experiment.

Disclaimer

- The objective of this experiment was NOT to find ways to replace real lectures with video, rather as a supplement to lectures
- I am just a physicist, not a trained professional in Education
 - I have no professional skills in “testing” and I did nothing (time !) to research other’s experience in this kind of technology deployment nor in testing methods
 - Its all a physicist’s “seat of the pants” approach
 - I am not an expert in Digital Video Streaming
 - Had to learn every thing from scratch
 - Make technology choices within 2 weeks
 - Tried to test various options
- I have no “hidden agenda” (must succeed) in this project
- Just did the experiment and tried my best to gather objective data → Will pass on info to IIP or other educational units at UCSD

What defines Success ?

- Can we video stream reliably (24/7) and on time
 - Multiple quality of service issues
- Can wide body of students use this feature at home or at UCSD computer labs?
 - Students live within large range of computing environments at home/university → technical issues
 - This feature should not be economically discriminating
 - Making sure UCSD computer labs/libraries capable
- Does it aid in learning concepts ?
 - As measured by student response
 - As measured by their performance in weekly quizzes
 - Does the average score improve
 - Does the distribution shrink
 - As measured by “drop in lecture attendance”

Attempt Objectivity in Testing : How?

- Target a course for which prior testing data exists
 - Have taught Modern Physics for Scientists & Engineers (physics 2D) since 1998
 - Have weekly Quiz results for 98, 99,01,02
- Use same text & teaching format (discussion, problem solving, weekly quizzes)
- Use same quality of TA for course:
 - A good or bad TA can be a big factor in student learning, so need to make serious attempt at nullifying this factor
 - I always screen TA's and graders, must pass a high standard of teaching capability and enthusiasm
 - Nevertheless no 2 TA's are alike → Systematic error in measurement
- Calibration data → Years 98-02
- In 03, keep all else same, add this new feature → see what happens

Preplanning Activities

- Picking a Suitable Class for this experiment (minimize “noise”)
 - Physics 2D (Modern Physics: Relativity & Quantum Mechanics)
 - Large lower division course (210 students in W’03)
 - “veterans” of the 2 Series (seen 2A,2B etc)...Mature
 - EE,ECE,CSE students majority in class (rest CHEM)
 - Familiarity with computers and computing
 - » Can debug their computers/ software
 - » Know how to give accurate technical feedback
 - » Can help take collective ownership in solving technical problems
 - Subject material not intuitive, students have in the past often said “ Gee, Wish I could review lecture material again” before quizzes

Eventual Collaborators In Deployment

- Initial plan as proposed to IIP:
 - Just me and Kevin Smith (UCSD Physics Admin computing) + undergrad help for video encoding
- Eventual collaborators who made deployment successful
 - Simple pre-deployment inquiries on campus led to a feeling of strong enthusiasm within the “foot-soldiers” at UCSD. All the technical resources were in place, people seemed to be waiting for some Prof. to add content to the setup
 - Media Services (Sherman George, Don Olliff....)
 - Instructional WWW Development Center (Christine Bagwell et al)
 - Some physics faculty who helped with “screen tests” in the fall quarter + moral support from physics dept.

If you build it, they will come ? Homework before Deployment

- They wont come if (a) cant access Steaming video (b) material not presented in an interesting & useful way
 - Formed informal focus group of past 2D students: see what they want in such deployment
- **Weeks of testing, testing, testing !**
 - Sampling computing environments & resources at UCSD computing labs:
 - Personally visited every major computer lab and tested setup
 - Most computer labs were ill prepared for video streaming
 - Feedback to ACS → CLICS , Geisel Tunnel computers equipped
 - Recruited faculty/staff with DSL/Cable Modem to try to stream test lecture from different computer configuration (Mac, Windows, Linux) and locations (SD, SF, NY, Rome)
 - Identified Firewalls as a single major point of failure (UDP/HTTP traffic channeling) and then learnt enough to fix such problems
- **Set technical performance goals for Day 1 onwards (Jan 4)**
 - Constant feedback between Media Services, Kevin and I to review performance of entire system
 - Worked from the first day to last (Mar 15) without a glitch !

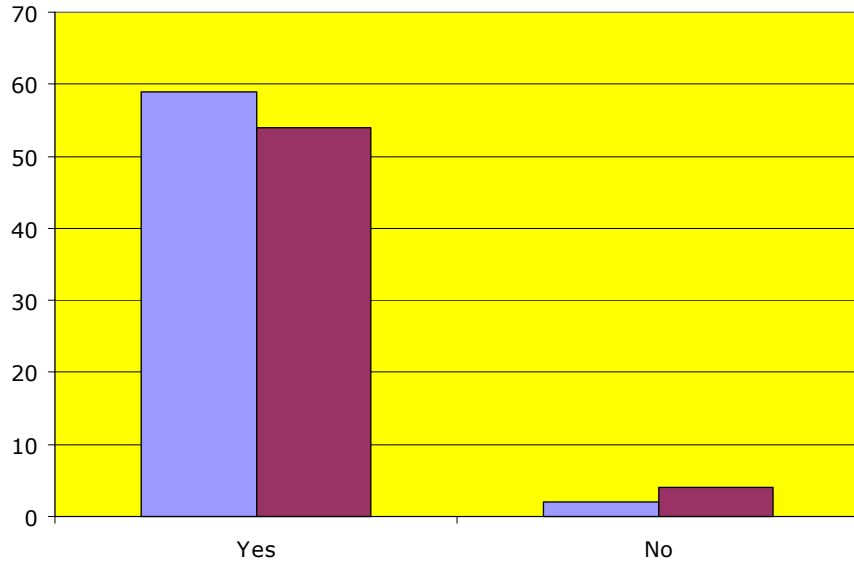
Enough Said, See the Web Streams

- All streaming video located at class web page
 - hepweb.ucsd.edu/~modphys/2dw03
- TA (Brian Wecht) Video ...Example of Blackboard based instruction
- Lecture Video : Synchronized lecture slides, video & audio.

Results of Anonymous Survey of Students in Week 10

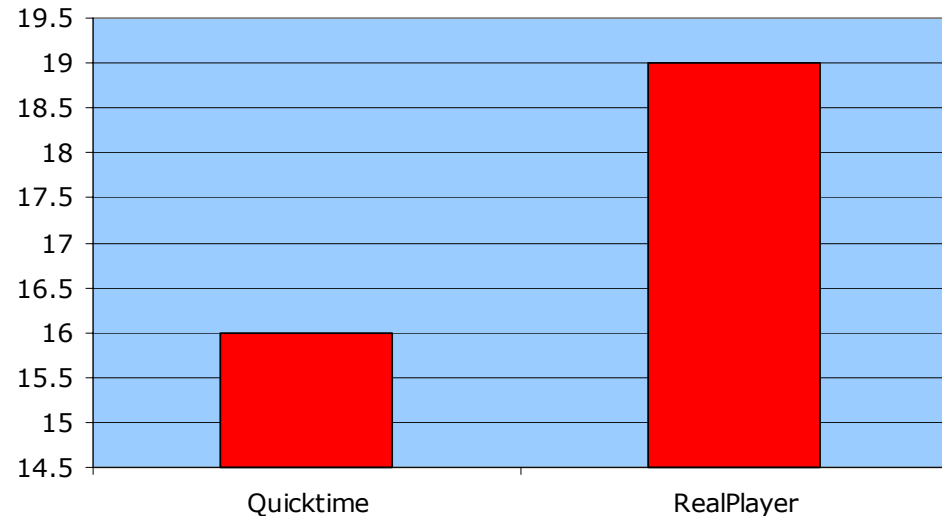
Broadband Access at Home?

Used high-speed to view
Access to high-speed



I waited till end of course to do the web based Survey: Response was "ok" (1/3) of class
Could have been better if I had done this in Week 7

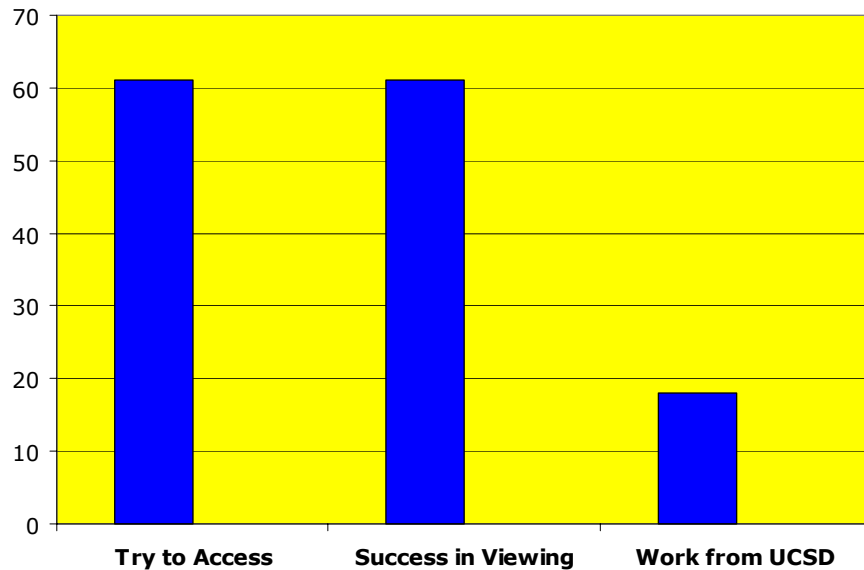
What Video Player Do You Usually Use ?



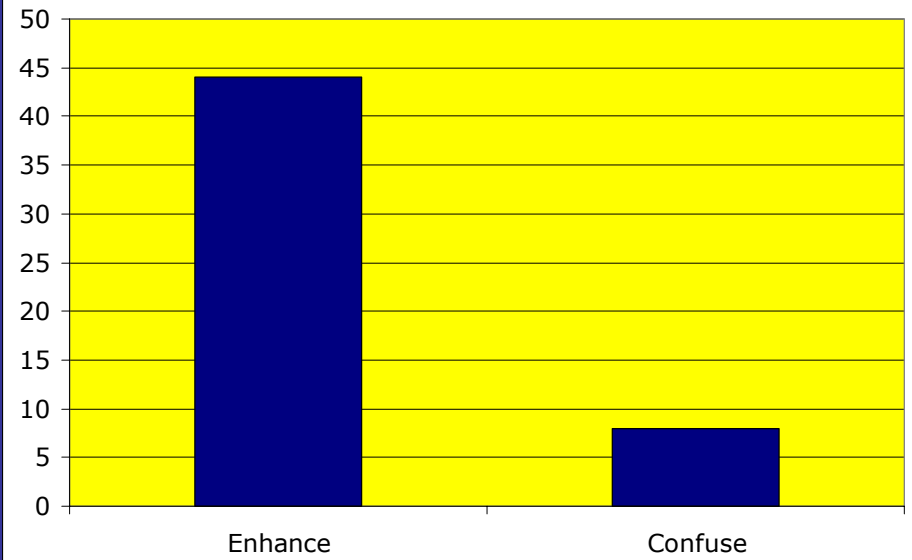
Results of Anonymous Survey of Students in Week 10

NOT A SCIENTIFIC SURVEY !!

Did you Manage to Access Video On Demand?

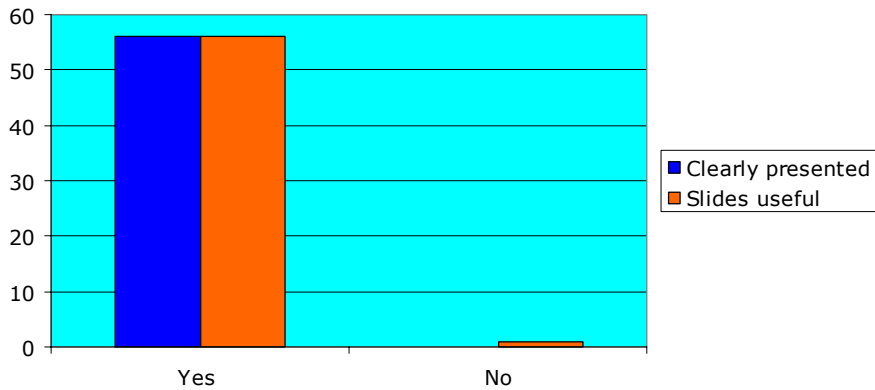


Multiple Window Format of Video & Slides useful?

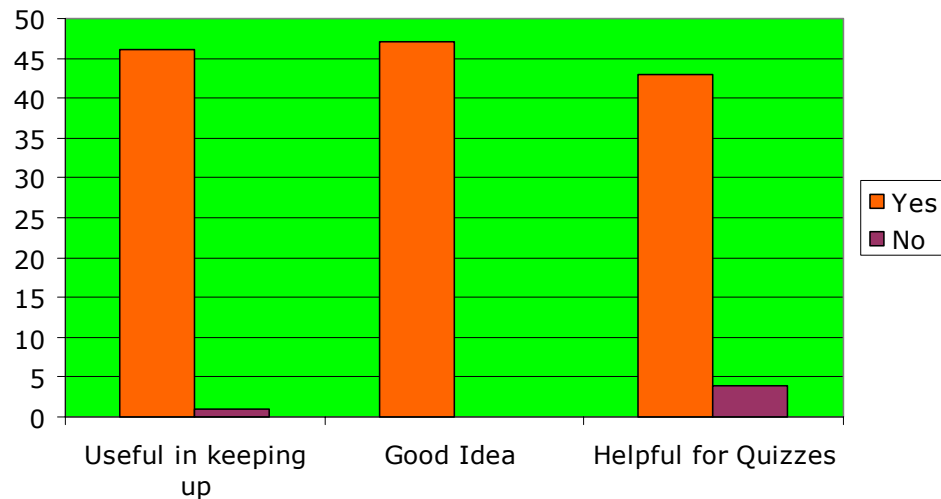


Results of Anonymous Survey of Students in Week 10

Was The Lecture Material Clearly Presented? Were Lecture Slides Useful?

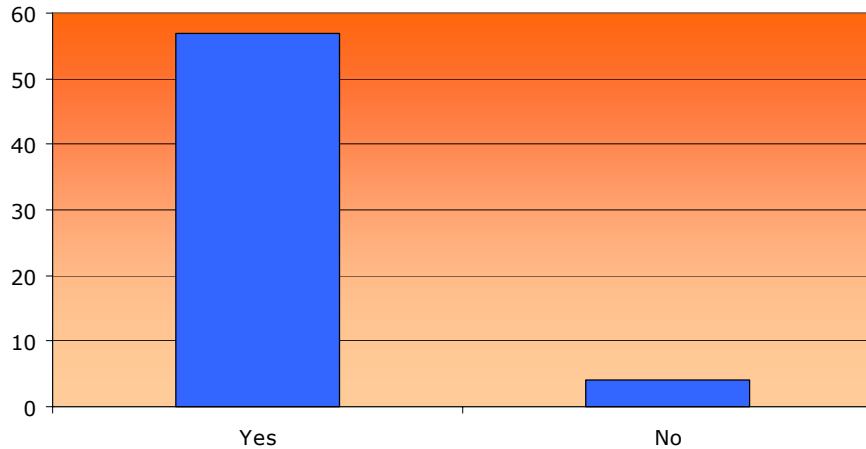


Streaming Video Useful to Keep up with Class ? Good Idea for learning ? Helpful in preparing for Quiz

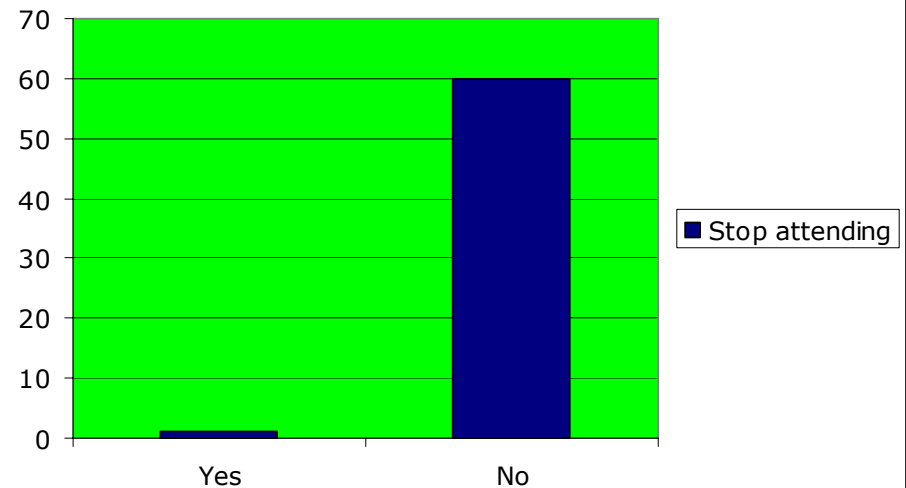


Results of Anonymous Survey of Students in Week 10

Plan to view past discussion/lectures in prep for 2D final exam?

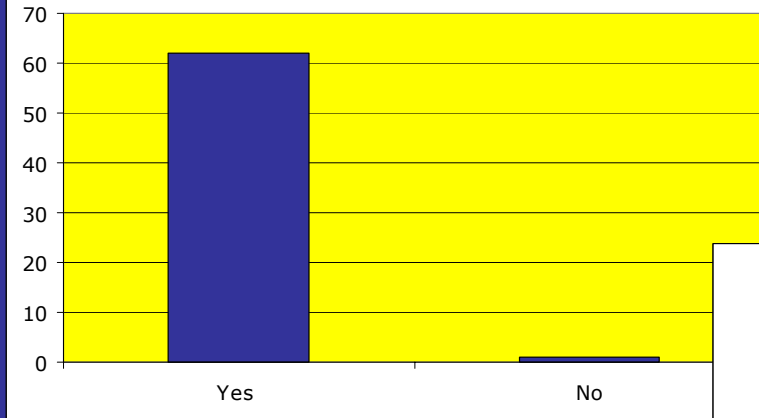


Did You stop attending lecture/discussion because of easy availability of Streaming video ?

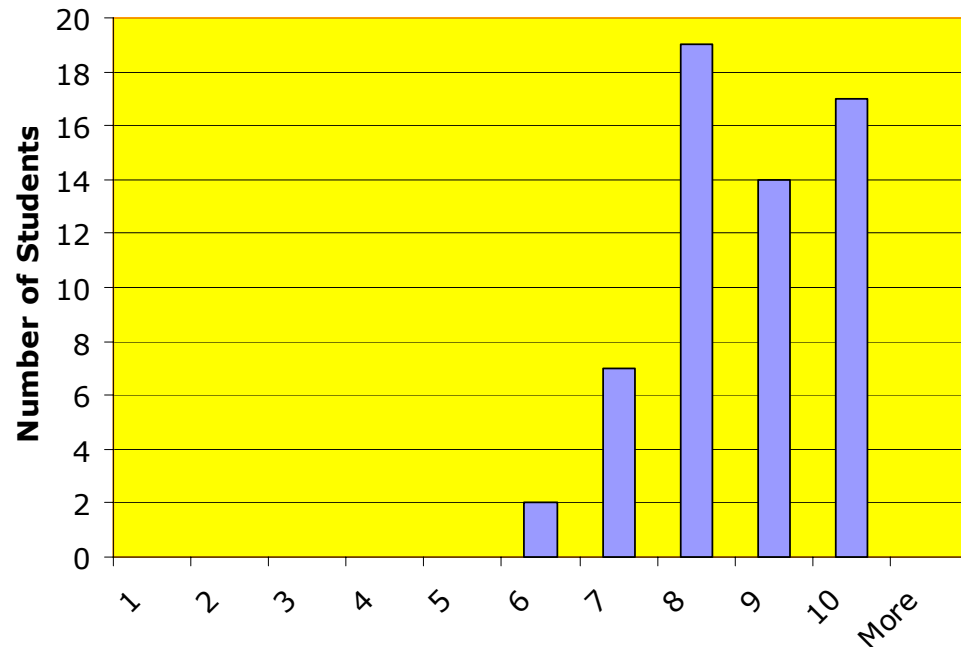


Results of Anonymous Survey of Students in Week 10

Would You like to see Streaming Video extended to other UCSD courses despite cost?



Pl. Rate The Usefulness of Streaming Video In Your Learning of Modern Physics

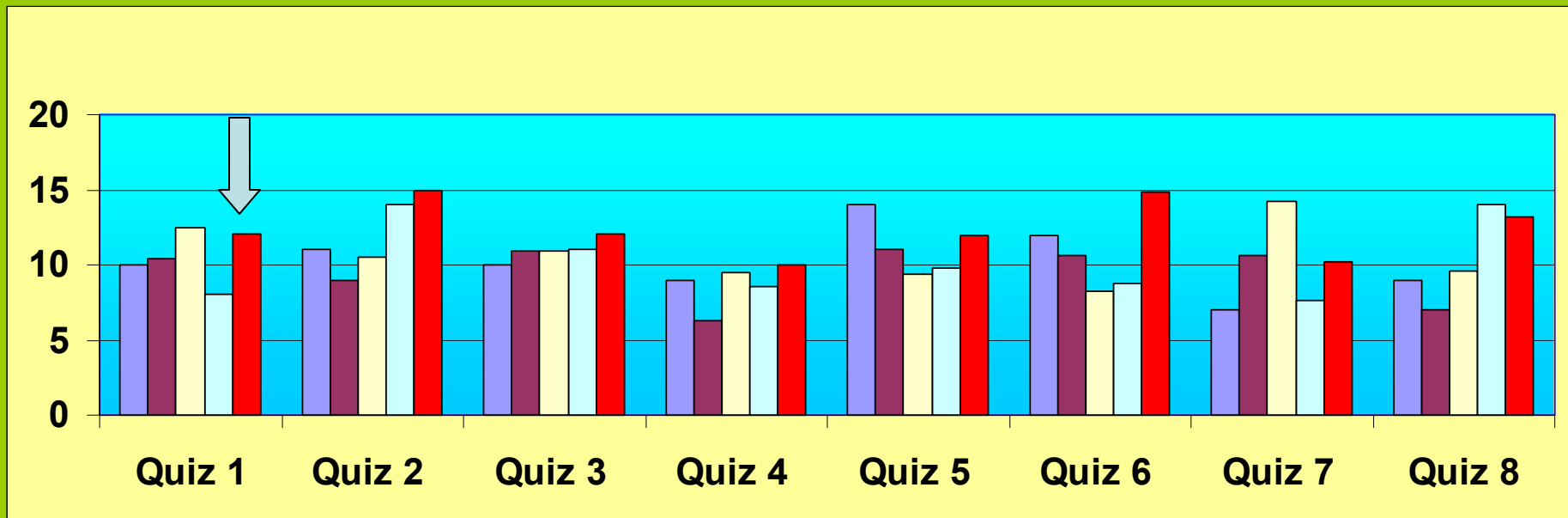


Top 10 comments from Students (Web Survey)

- 10...its really cool how (lecture) slides are synchronized with video
9. I fast forwarded just to the part I thought would be on quiz
8. Think success of video streaming is largely because of Brian (TA) ..a good TA would make this project worthwhile
7. Lecture video does not always sync with slides. Slides important part of sharma's lecture videos
6. did'nt watch lectures as much as TA discussions
5. when I missed something Sharma or Brian said, I went and watched video...great to have resource that lets me go back
4. Video helps when you miss class for some reason..(particularly) towards end with so many diff. equations running around ..without this resource I would not have done as well as I have in quizzes
3. We have a group together which are going to watch...for final...I am going to have a 10 hour discussion video fest
2. I was sick for a week, the videos saved me. Do it for ECE/Science courses
1. (this is only useful) if teachers & TAs were screened. It would NOT be helpful if we didn't have such good lectures. Don't even think of streaming that prof from ECExx

Performance in Weekly Quiz : Winter 03 Vs Historical performance of students in same 2D setup: Material students were tested on was similar but questions were different

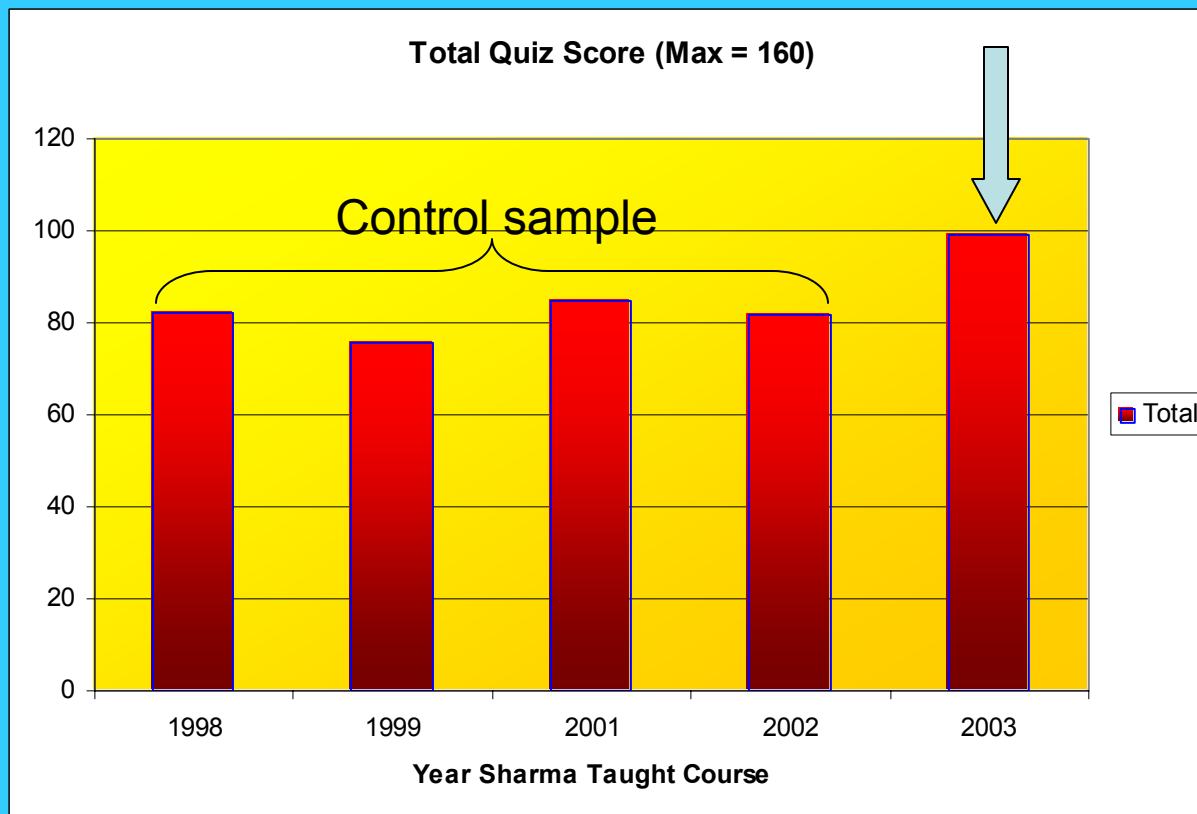
Winter 03 data in **RED**



Performance in Quiz : Winter 2003 Vs History

Note only about 1/3 of class used Video and most did not start Using this tool In week 1

About a 20% overall improvement



Now my subjective opinions on this experiment

- Learnt a lot : technology, UCSD, student psyche
- danger of screwing up kept me on my toes !
- What went right:
 - We streamed 3000 minutes of lectures & discussions effortlessly. I consider this an outrageous success
 - Quality of transmission (~330 kb/s) well suited for DSL/Cable/T1 viewers
 - No serious bandwidth congestion on Thursday night (before Quiz on Friday)
 - Video format (FF/RW buttons, synced slides, DVD style “chapters” very useful for students who wanted to do a quick review, not watch the whole lecture

Post Mortem

- What needs to be improved
 - Quarter goes fast. Inertia issue from students in using this feature
 - Students thought it was too good to be true or had no idea if this was useful enough for them to invest effort
 - I did not push strongly since experimental effort
 - Believe > 50% of student body could benefit if this deployment becomes routine
- Testing of student learning with this tool was incomplete due to short term of deployment
- Kept testing with different Video capturing technology to make eventual choices of format
 - Associated learning process shows in video (slide synching e.g.)
- Lecture rooms need better lighting, sliding BB...bunch of logistic issues....
- Make it more seamless to make it work automagically (not all lectures are tech-savvy)

Who should consider Streaming Video ?

- Not suitable (yet) for universal deployment
- Cost effective resource for high enrollment classes
 - Target classes with EE/ECE/CSE/Chem types
- Needs commitment of time & effort from lecturer
 - Very important to prepare well organized lectures
 - Good, clear (electronic) slides very important companions (harder for Science courses with many formulae)
 - Lecturers should be comfortable with the idea that we make mistakes during lectures
 - Be prepared that the whole world can see it !
 - Need to be a bit thick skinned
 - These videos should be “rough cuts”, studio room quality too time consuming and perhaps not worth it
 - “static” lecturers have little advantage
 - Lecture rooms have to be carefully picked (lighting, board)

Cost of Streaming Video For Physics Department

- Thanks to IIP and collaboration with Media Service, project cost was less than 5K for ~200 students (hidden physics manpower cost)
- This will NOT be the case for future deployment unless a new policy is made on subsidizing Web streaming
- Need to drive the total cost of video streaming down to about \$50/lecture
 - We have experience now & I think I know how do to this
 - Cameraman+ Encoding Expert → morph in 1
 - Streamline activities & remove human intervention as much as possible

Possible Future Directions

- The first phase of experiment is over but need to accumulate more data & experience
- Now it is for others on campus to judge cost/benefits. Input would be useful. Physics department very interested if it does not break bank
 - Need help: IIP (original sponsor)
 - I would like to deploy streaming video again in Fall & winter 04 and try to streamline/finalize this process (serve a real product, not an experiment and do a correct testing of learning improvement)
- **Possible future experiments:**
 - Use in lower division lab courses : how to do the experiments after they have been done by students (cooking lessons!)
 - Use as a infrequent tool for course reviews, special seminars etc
 - Target specialized Graduate courses, which are rarely offered due to small enrollment
 - produce streaming video a la this course
 - Write it to DVDs, offer to grads for free
 - In the next years DVD players will be on every desktop