Transforming Technology Management Courses for Web Delivery

Wayne Wakeland
Systems Science Ph.D. Program
Portland State University
Using web technology to teach technology management

• Esp. computer modeling and simulation
• What works, and what doesn’t
• Web technology supplants lectures
  – with self-paced materials and lab exercises
  – enabling students to take courses remotely and asynchronously
• Exams are also web-delivered
Is the Web going to Transform Technology Mgmt. Education?

• Yes…but exactly how is not yet obvious
• Questions abound:
  – Is the web best used simply as a more flexible and visual vehicle for delivering course materials?
  – Is it possible to effectively assess student learning in a remote, asynchronous environment?
  – How do we ensure the quality of instruction in web courses?
Not a Research Paper

• Rather, it is a reflection on 3 years of using web technology
  – To improve computer modeling & simulation courses
• Possibly of interest to other educators
  – Who are using or considering web technology
• And to serve a springboard for scholarly research
  – To address questions being raised about web-based instruction
Use of Web Technology

• Lectures replaced with self-paced reading materials (web notes plus text)

• Plus activities (labs) conducted in a computer lab
  – Students work at their own pace
  – “Labs” reinforce key concepts in the readings
  – And prepare students to do the graded exercises
  – The instructor and a lab assistant are available
  – Students may do the labs at another location and/or at another time if they so choose
  – Labs are not graded
Assessment of Learning

- Projects
- Examinations
- Graded exercises
  - written up and submitted by the students
- Self-test (non-graded) quizzes are also available to the students.
Taking Courses at a Distance

• Potentially, yes

• Only a few have done so

• Most students attend the lab sessions
  – especially those who find the material challenging

• Some opt out of labs, or do them on their own
  – Due to their strong prior background
  – Or because they find the concepts easy to understand
Why Web-enable Courses?

• To improve course quality
• To make courses more learner-directed
• To improve efficiency
  – from the perspective of student and instructor
• Distance-enabling courses was not the driver
The Courses

• Computer Modeling & Simulation
  – How to use the tool (the simulation language)
  – And the process for conducting a simulation-based study
  – All courses meet once a week in the evening
    • to increase accessibility to local professionals

• Continuous System Simulation
  – System Dynamics (STELLA)

• Discrete System Simulation
  – General introduction, emphasizing the interpretation of simulation results using statistics (Arena)
  – Process modeling and simulation (Extend)
  – Manufacturing system simulation (ProModel)
Traditional Approach

• Students read the test
• Instructor lectured from handwritten notes
  – Using the chalkboard to outline/clarify ideas
• Students were expected to take their own notes
  – This was believed to add value
• Sometimes, typewritten notes were provided
  – To complement or update the text
• Examinations were open notes & open book
  – An incentive for students to take good notes
Evolution of the Courses

• 1997
  – Notes put into html on the web
  – Non-graded “test your knowledge” quizzes provided
  – Detailed roadmap for the course provided
    • Excel spreadsheet w/hyperlinks to notes pages, assignment sheets, and quizzes
  – Major improvement over the previous approach (?)

• 1998
  – Classrooms equipped with video projectors and web access
  – The instructor could simply lecture from the web notes
  – No less effective than the previous approach, but
  – It became clear that such lectures added limited value

• A new pedagogical approach was needed
Active or Student-directed or Inquiry-based Learning

- Prestigious universities were exploring these new approaches to learning
  - Incl. Harvard & MIT

- The ideas seemed reasonable:
  - Create materials that require the student to do more than simply read and listen
  - Have them work in teams to solve problems, do research, create presentations, etc.
  - Have students check their own comprehension as they learn new concepts
Active Learning

- Views education not as a passive transmission process, but rather as an active process
  - With ample opportunities for clarifying, questioning, applying, and consolidating
- Tools for active learning include
  - Group discussion
  - Problem solving
  - Case studies
  - Role-playing
  - Journal writing
  - Structured learning groups
- Having students work in pairs is recommended
Web materials (Nelson Baker)

• Web materials help students learn more quickly
• Some students also learn the subject better
  – lower quartile students, for example
• However, initial increases in motivation fade
• The web’s increased visual impact is important
  – Simply putting text onto the web may not be of much value
• Effective web pages for teaching should
  – Be well organized, easy to navigate, and globally integrated
  – Include samples of previous student work & discussions
  – Provide collaboration mechanisms to maintain community
Cohesive Web Design (Campbell)

• The key interactivity

• Cognitive science research indicates that humans learn better by experimenting with the real world rather than memorizing lists of rules (Schank and Cleary)

• Campbell also presents the notion of *anchored discussion*
  – developed by the Cognition and Technology group at Vanderbilt
  – Students explore and resolve complex, realistic problems
  – Video materials serve as anchors or macro contexts
More from Cognitive Theory

• Important concepts include:
  – Experiential learning
  – Situated learning
  – Lateral thinking
  – Social development theory
    • That social interaction is the key to cognition

• Teaching architectures (Shank & Cleary):
  – Simulation-based
  – Learning by Doing
  – Incidental Learning
  – Learning by Reflection
  – Case-based Learning
  – Learning by Exploring
Learning Frameworks (Bruner)

- Multiple Representations of Reality microworlds)
- Authentic Tasks
- Real-World, Case-based Contexts
- Fostering Reflective Practice
- Knowledge Construction
- Collaborative Learning
Continued Evolution of Courses

• The subject lends itself to active learning
  – The objective is for students to learn how to build models
  – And then to use these models to generate insights, and inform decisions

• Students build several models of increasing complexity, with decreasing levels of assistance
  – Addressing a real world problem completes their learning
  – Reading books and webnotes plays a support role
Conversion to WebCT

• Webnotes moved easily
• Quizzes were a challenge
  – Short essay → multiple choice
• Self-paced modules
  – vs. schedule with specific due dates
• SW demonstrations during labtime
  – To labs done by the students
Exams on the Web

• Multiple choice vs. short essay
  – Good multiple choice questions are hard to write!

• Needed to make exams “closed notes”

• Time constraint concerns
  – To limit web-searching to find answers
  – Fairness to foreign language students?

• Trust concerns
  – Is the student following the rules?
  – Who is actually taking the exam?
  – Proctor the exams?
Student Surveys

- Was lecture/lab time used effectively?
- Was using contact time for labs effective?
- Were the labs were useful?
- Did the labs take too much time?
- Were self test quizzes useful?
- Were the web notes useful?
- Was the multiple choice Midterm OK?
- Can this material can be learned as well or better via well-designed web course?
- Did taking course remotely and asynchronously work?
- Was access to WebCT a problem?
- Did it work for you to rely on the WebCT Bulletin Board for important course info.?
Survey Results 1

- Neutral about the usefulness of the lectures
- Somewhat enthusiastic about the lab sessions
  - Useful; not overly time-consuming
- Some students appear to miss the lectures
- There is much room for improvement regarding use of contact time
- Self-test quizzes were equally useful when converted to WebCT
Survey Results 2

- Curiously, the usefulness of the web notes dropped from “strongly agree” to “agree”
- Multiple-choice midterm worked fine
- Most students indicated having a good experience with using the web
- Students relying on the web-based bulletin board indicated mixed results
Preliminary Conclusions 1

• The courses are getting better
  – Creation of web notes, self-test quizzes, labs, etc.
  – The web simply provided the impetus and made the materials easier to deliver.

• But, there is much room for improvement
  – The materials are still quite static and “beg” to be made more dynamic
  – Self-test capability needs to be more complete
  – The glossary capability needs to be better exploited
  – Student interaction during the labs needs to be improved
Preliminary Conclusions 2

• Some amount of “lecture time” may need to be re-incorporated
  – In order to maximize student learning and satisfaction

• The experience for remote students is inferior
  – This will not be easy to remedy
Future Research 1

- Data is needed regarding both the quality and efficiency of web-based learning
  - For different subjects
  - For learners of varying ability
  - For different aspects of web instruction
- This will not be easy
  - Web course software may help to some degree
- Comparing the quality of learning
  - Same exam given in similar courses, one delivered traditionally and one web-based
  - May require the cooperation of instructors at multiple institutions
Future Research 2

• Comparing efficiency data between web and traditional classes will be even more difficult
  – Since there is no mechanism in traditional courses to track of how long students spend reading, doing assignments, etc.
  – This will require the cooperation of the students

• Despite the difficulty, this research is needed
  – To learn when to use and when not to use various types of web-based instruction
    • What subjects
    • Which students