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