# An Overview of Contemporary Online Education (for Civil Engineers)

A Presentation to

Dept. of Civil Engineering,

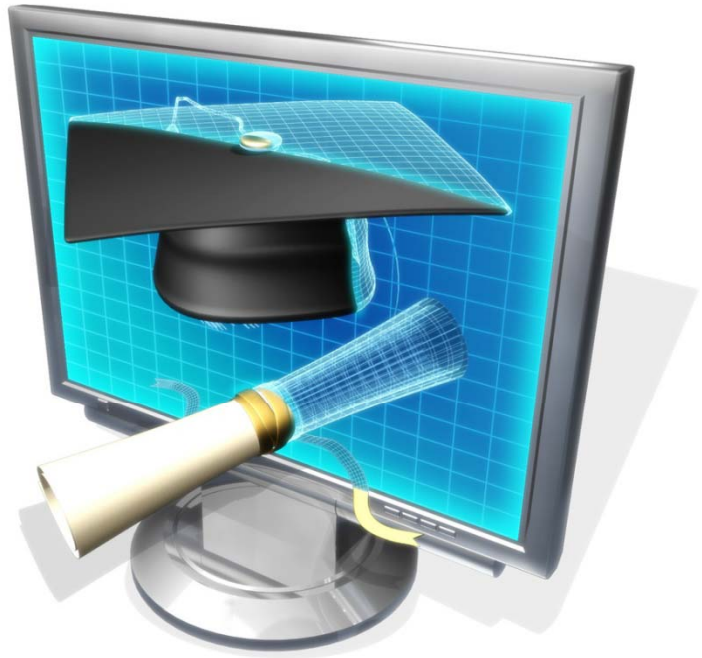
College of Engineering, K-State

Fall 2012

# Overview

- Initial concerns about online learning
- A "needs assessment" for quality online learning
- Effective design of online learning
- Required technological and content resources
- Common legalities
- Civil engineering and online learning (the state of the art)

# Late 1990s
# Concerns about Online Education



- Quality of the learning may be less than in face-to-face circumstances
  - Special concerns have been raised about laboratory learning
- Technological access and the "digital divide"
- Instructor-student relationships may be harmed
- Difficulty of authenticating online learners

# Efficacy of Online Learning

- Comprehensive meta-analysis of distance learning research found "no significant difference" between face-to-face and online modalities for college learning (Russell, 1999)
  - Null hypothesis that "Distance delivery (or, as appropriate, technology-mediated delivery) of courses *does not hurt* student outcomes" could not be rejected ["FAQs," No Significant Difference, WICHE Cooperative for Educational Technologies (WCET)]
  - Continuing surveillance of potential quality lapses; text now in the 5th edition (2001)

# Domain-Specific Comparisons

(Connolly, MacArthur, Stansfield, & McLellan, 2005)

- Quasi-experimental study in online computer science courses to detect
  - "(a) any observable difference in student performance as measured by end-of-module grades / marks; (b) any observable difference between coursework and exam performance in the technically-oriented modules; (c) any observable difference in dropout rates, student satisfaction and faculty satisfaction" (p. 345)
  - Findings: "online students consistently perform better than the face-to-face students" (p. 345)

# Effective Evaluation of Online Distance Education Programs

(Rovai, 2003)

- Need to evaluate the following aspects of online distance education programs for continuous improvements
  - Student performance
  - Program cost effectiveness
  - Quality in terms of technology
  - Quality in terms of support services
  - Course design and instruction
  - Instructor satisfaction
  - Learner satisfaction (including learner retention)

# A "Needs Assessment" for Effective Online Learning

# A Learning Community

(Rovai, 2003)

- Online learning program evaluations may focus on the following main approaches
  - Objectives-oriented (meeting instructional objectives)
  - Management-oriented (providing cost-benefit analysis for administrators)
  - Consumer-oriented (meeting the needs of online learners)
  - Expertise-oriented (focusing on the professional expertise of instructors)
  - Adversary evaluations (using structured public debates and opposing evaluators to debate the issues)
  - Participant-oriented or naturalistic strategy (bringing in all stakeholders for qualitative research)

# Considering Learners' Social Needs

- "Digital natives" have a comfort with online spaces and interacting through mediated means
- Human connections enhance learning (Howell, 2001)
- Researchers critique some poorly designed distance courses as "impersonal, superficial, misdirected, and potentially dehumanizing and depressing, and that they disrupt the interactions that create a learning community" (Rovai, 2003, p. 110)

# Seven Strategies for Faculty Success in Distance Education

(Howell, Saba, Lindsay, & Williams, 2004)

- Faculty who teach online require a range of support (based on a review of the research and university strategic plans for online learning)
  1. College and department responsibility
  2. Timely information about distance education programs and activities
  3. Encouragement to incorporate technology into their traditional classrooms
  4. Incentives to participate in distance education (pay, bonuses toward tenure); addressing concerns about workload
  5. Improved training and instructional support
  6. A stronger distance education faculty community
  7. More education scholarship and research

# Building on Faculty Strengths

## Faculty Strengths

- In-depth knowledge of the domain field (and related fields)
- Technological savvy
- Empathetic and analytical knowledge of the students and their needs
- Experiences with online learning

## Areas to Build (Varies)

- Ways to support online learners
- Ways to build digital content effectively
  - Pedagogically
  - Technologically
  - Securely
  - Legally (copyright, accessibility, privacy rights)

# Online Learners

(Wang & Newlin, 2002)

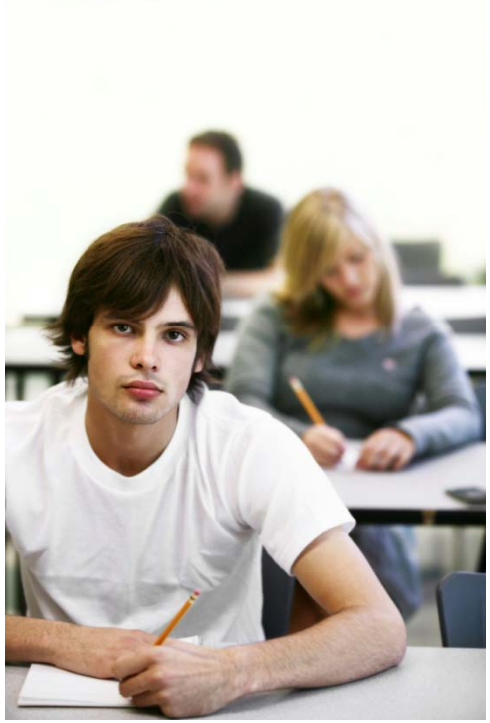
- Self-efficacy related to student persistence and performance across a variety of subject areas, experimental designs, and grade-levels (Multon, et al., 1991, as cited in
- Quasi-experimental design based on six sections of a psychology research methods course
- Student self-efficacy measures correlate with each other (to build a coherent construct)
- Student motivations in taking online courses affected their final grades; highly motivated students performed better grade-wise
- Students who preferred Web-based learning environments and who were curious about web classes were more interactive online and studied more hours a week than those who enrolled only because of course availability
- Online behaviors in terms of accessing the course site in Week 1 was correlated with their final grades in class
  - Faculty would do well to closely monitor online learner behaviors

# Main Barriers to Online Students

(Muilenburg & Berge, 2005)

- Factor analysis of a large survey of online learners to identify the main barriers for online students

1. Administrative / instructor issues
2. Social interactions
3. Academic skills
4. Technical skills
5. Learner motivation
6. Time and support for studies
7. Cost and access to the Internet
8. Technical problems (in descending order)



# State of Distance Learning Today

- Considered a necessity in the current age by offering flexible learning in time, place, pace, and accessibility
- Efficacy
  - No need for the co-location of the instructors and learners
  - 24/7/365 access
  - Closer learner tracking
  - Archival of course materials and content
  - Data analytics to improve teaching and learning (stand-alone systems and back-end systems in learning / course management systems)

# Effective Design of Online Learning

# Central Pedagogical Ideas in Online Learning

- **Student-centered learning:** building learning around learner needs (cognitive, social, cultural, and other)
- **Learning by doing**: hands-on learning; opportunities to practice their work and get customized expert feedback
- **Collaborative learning**: the social construction of knowledge; teamwork
- **Distributed learning**: using various tools to enable distance learning with learners and instructors not co-located
- **Constructivism**: a learning theory which suggests that individuals create meaning (through sense-making) through experiences (experiential learning); instructors "facilitate" the learning
- **Learning styles**: individual learners have a unique set of learning preferences in terms of how they best learn

# Authorizing Documents

- Begin with the course catalog and the official master course description for building the learning
- Use official learning objectives to build the course, the course content, and the assessments
- Assumptions
  - Any online course has to cover the same materials as the face-to-face course
  - Any online course has to ensure that the students come out with the same proper level of learning and skill sets as any face-to-face student
    - If an online course can ensure that learners learn even more and are more rigorous and innovative, then do so

# Pre-Builds

- An online course should generally be built prior to its launch
  - If there have to be real-time captures of lectures (with the F2F and the online course taught simultaneously), then it's better to have all other content and the general course structure pre-created
- This course build includes the syllabus, the content, the assignments, assessments, the interactivity, and even the look-and-feel (logos, design features)
- Alpha and beta testing
  - It should go through alpha testing (to test all functionalities, technologies, and content)
  - It should go through beta testing (critique by other faculty and potential learners, if possible)
- Online courses should not be last-minute affairs or build-as-you-go

# Learning Objectives

- Phrased as verb phrases
- Should have practical applications for the learners
- Observable
- Objectively measurable
- Should link from prior sequenced courses and should link to the next sequenced courses
- Should align the courses in a full certificate or degree
  - The curriculum should not overlap excessively (for repetitive learning), and there should not be gaps (missing parts) in what learners should know, both between and within courses.

# Curriculum Design

**Learning Outcomes**

- What do you want learners to know?
  - Knowledge: declarative and procedural facts
  - Hard skills: technical
  - Soft skills: teaming, communications
  - Cognitive capability: synthesis of ideas; analysis; trouble-shooting and problem-solving; critical thinking
  - Innovation and design
- At what level of expertise and understanding?
- In what objectively measurable way?

# Curriculum Design (cont.)

**Learner Analysis**

- What do typical learners already know? In a "gaps analysis" of their knowledge (their "mental models"), what do they need to know to do well in the course and in the domain field (based on the expert "conceptual model")?
- What do typical learners feel and think? Will their assumptions have to be addressed to enable the teaching and learning?
- What motivates learners in the field to learn more? What de-motivates learners?

# Learning Content

- Videos
  - Lectures
  - Experiments
  - Virtual fieldtrips
  - Guest presentations
  - Panel discussions
  - Interviews
- Slideshows
  - Lectures / notes
- Readings
  - Articles / papers / chapters
- Digital games
  - Simulations
  - Live human-embodied avatar role plays
  - Mock events / trials
  - Dramaturgy
- Animations
  - Sequences
  - Events

# Student Sample Work as Examples

- Portfolios
  - Designs
  - Documentation
  - Narrations about their project
- Separate research papers
- Experiment laboratory notes
- Team assignments
- Videotaped presentations and slideshows

(This assumes legal copyright release and media release from the students.)

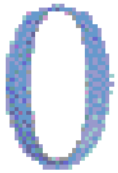
# Organizational Structure of the Learning

- Developmental sequential structure from simple to complex
  - Opt-in supporting materials offered to learners
  - Tutoring support
  - Classmate support
- Incremental build-up of knowledge and skills, with more complex applications as the course progresses

# Modules

- A stand-alone unit of learning that connects with other such units for coherent learning in an online course
- May contain a variety of content and media types
- Usually containing the following
  - Learning objectives
  - Video
  - Slideshows
  - Readings
  - Interactivity with other learners (like discussions)
  - Assignments / assessments (with customized feedback to learners)
  - Opt-in learning resources (digital flashcards or lists of new words; extra readings)
- (Note that outliers on both the high-end and the low-end of a bell curve are addressed with learning resources. This is known as "scaffolding" the learning to be more inclusive of different learners' needs.)

# Pacing and Uses of Time



- Pre-Week or Week Zero
  - K-State Online opens to students a week before the official start of the term
  - Instructors should be present from the beginning
  - Pre-learning content may be offered to students to "prime" them for the rest of the term
  - Get-to-know-you activities should be offered
- Courses should be structured with some clear expectation of when work is due but with some reasonable amount of flexibility
- Some faculty have all content folders and message boards published at the beginning; others reveal fresh folders and hide older folders in certain time sequences

# Asynchronous vs. Synchronous Learning

- Most online learning is asynchronous for practicality and ease-of-learning (given busy schedules)
- Asynchronous learning usually involves deadlines
  - Open-entry and open-exit courses have the lowest completion rates of all the types of online learning
- Synchronous learning usually takes the form of web conferences or web-mediated distributed sessions or tele-conferencing
  - May involve instructor (or guest lecturer) lectures or demonstrations
  - May involve high interactivity with learner participation
  - May involve student presentations of their work to each other
  - May involve group work, and others

# Asynchronous and Synchronous Learning (cont.)

## Asynchronous

- Lectures
- Experiments
- Readings
- Research
- Discussion questions
- Group work
- Design

## Synchronous

- Live presentations (by guests, instructor, and / or students)
- Interactive simulations
- Live meetings
- Live presentations or demonstrations
- Live lab work
- Student presentations
- Group simulations

# Live Web Events: Ensuring Access

- Student preparation
  - Low-value practice event (or even online office hours) to help students run through technologies; have people regularly log on 10 – 15 minutes prior to the event
- Presenter preparation
  - Presenter should pre-upload digital content (polls, slideshows, visuals) into the web conferencing system
  - Practice pacing sufficiently because of the latency in people's connections (most presenters need to slow down)
- Recording the event
  - Always include an early slide about the recording and archival of the event; participation means agreement with the recording
  - Actually record the event, and use the archived materials for further learning

# Live Web Events: Ensuring Access (cont.)

- Supporting the event
  - Support staff should be available to support real-time accessibility (with a back-up access phone number for participants to use)
  - Consider live-captioning if accessibility is an issue for the live event

# Live Web Events: Pedagogical Strategies

- Using pre-, during- and post-event learning opportunities
  - Pre: set up some pre-event assignments; integrate learners' ideas in the planning; integrate learners' questions; send out relevant materials; set up the pre-learning; prime learners for the live online event
  - During: assign roles for students to support the event; integrate some interactivity
  - Post: debrief the event; review the learning; offer assignments and feedback
- Have a colleague host the event to make sure everything is working and to vet people's comments and questions

# Live Web Events: Pedagogical Strategies (cont.)

- Ensure that the live event is high value because synchronous time is expensive for learners across different time zones
- Make sure that you learn from each event and improve each time

# Assessment Methods

**Convergent vs. Divergent Learning**

- Convergent learning: close-ended answers; suited to well-written multiple-choice, true/false, matching, definition, sequencing, and other types of automated questions handled by the learning / course management system
  - Lower-level undergraduate courses; survey courses
- Divergent learning: solving ill-structured (real-world) and complex problems; open-ended answers; suited to essays, projects, designs; requiring hands-on feedback by the instructor, learner peers, and subject matter experts (SMEs) in the field
  - High-level undergraduate and graduate courses

# Assessment Methods (cont.)

**Assignment Design and Assessment**

- Formative assessment: assessments that promote learning and are not necessarily evaluative for the learner; may be used by the instructor to calibrate the teaching to better meet learner needs
- Summative assessment: evaluative assessments that assess the learners' level of knowledge and has impacts on his / her advancement

# Assessment Methods (cont.)

- Problem-based learning
  - Real-world and practical (usually)
  - Uses real-world standards
  - Involves analysis of a range of data (including "distractors")
- Project-based learning
  - Real-world and practical (usually)
  - Collaborative
  - Competency-based
  - Modeled
  - Tested

# Assessment Methods (cont.)

- Should be
  - Fair
  - Relevant to the learning
  - Consistent
  - Inclusive of unique feedback to learners
  - Up-to-date
  - Protected against academic dishonesty (through randomization; through design, and other features)

# High-Value Assessments

- Proctoring of examinations may be set up with the Division of Continuing Education's Student and Faculty Services Office ("Proctors and Test Taking Accommodations")
  - System works anywhere in the world where the students are
  - Students register proctors who are unrelated to them and who can monitor their test-taking
- In the future, may include biometric verification of learner identity

# Interactivity Design

- What benefits are there in having the learners and the instructor interact?
  - How do the instructors and learners interact? What sorts of information is exchanged? How responsive are the instructors to the learners, and vice versa?
- What benefits are there for having the learners interact with each other?
  - What sorts of support can learners provide to each other? How can human connections be made to enhance learner retention?
  - What sorts of information can learners share with each other?
  - What sorts of constructive collaborations can learners engage in?

# Interactivity Requirements of the U.S. Department of Education

- Online interactivity in a course should include "regular and substantive interaction" to fit the requirements and definition of distance education by the U.S. Department of Education
- For a university to continue to receive federal aid for its students,
  - Online courses may not be "correspondence courses" (using online sites just to send out work and to receive it *only)*
  - Online courses may not be self-paced courses without any instructor interaction
- Because online courses are archived and recorded, the interactivity may be reviewed by university administrators (and auditors) if the need arises

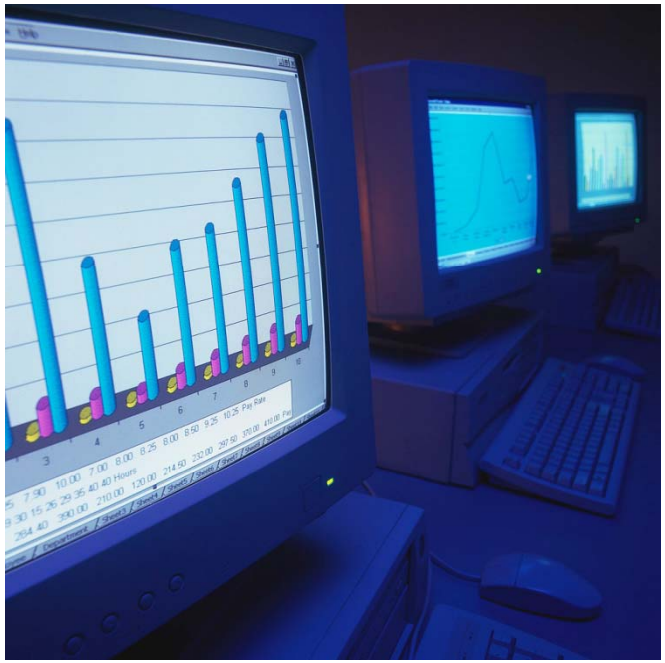
# Student Group Projects

- Random, instructor-chosen, or student-chosen groups
- Role assignments
- Expectations
- Access to collaboration tools
- Group management challenges
- Specific directions
- Incremental work and documentation of contributions
- Peer reviews
- Instructor reviews

# Measuring the Efficacy of Online Learning

**Various Data Points of Student Performance**

- Course performance
- Academic career performance
- Standardized assessments
- Domain field certifications
- Student performance
  - Professional competitions
  - Graduate school
- Professional careers



# Updating Course Curriculums

- Online course curriculums should be updated every few years
  - Legal issues
  - Changes in the domain field
  - Course curricular strategies
  - Relevant updated technologies (Hai-Jew, 2010)
- Consider learner feedback in updating online courses
- Keep all raw files (video, screen captures, and others) as those are the least "lossy" formats and the best to use for future editing (Note: "Lossy" just means tending to lose visual information.)

# Future-Proofing


- Build smartly using the proper technologies (and then maintain your files smartly—within the online course shell)
- Avoid using dated materials (or be willing to re-create new content sooner than every year or every other year)
- Do not build a course based on a set textbook and its structure (many textbooks change every year or few years)
- Follow all laws regarding
  - Intellectual property and copyright;
  - Accessibility;
  - Privacy rights…and document…

# Required Technological and Content Resources

# Technological Tools for Online Teaching and Learning

- Learning / course management system (L/CMS)
- Social media (like video sharing; slideshow sharing; and others)
- Repositories
- Social networking sites
- Wikis
- Web logs (blogs)
- Screen capture tools
- Video / image / audio / multimedia editing tools
- Authoring tools

# Free(ish) Stuff

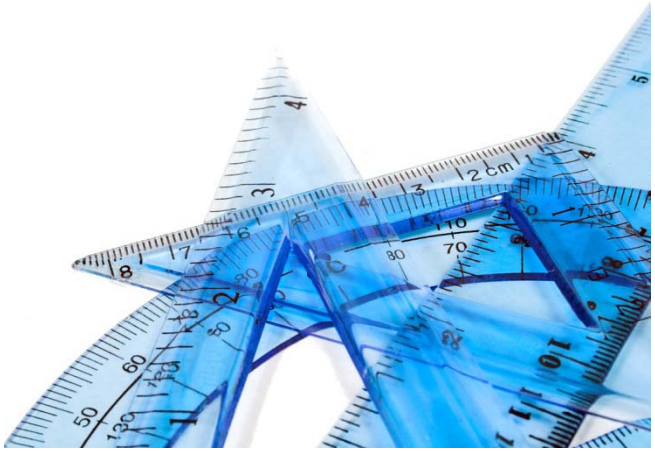
- Hosted solutions
  - Tableau Public (spatialized dataset creation and web visualization)
  - Prezi (presentation software)
  - Second Life (virtual immersive world)
  - Various wiki and blog sites

(Please read the fine print. Do not require students to share their work publicly if they do not want to. Do not sign over content rights to a third-party provider.)

- Open-source software
  - Audacity (audio recording and editing)
  - Libre Office

# Content Resources

- Information
- Imagery
- Video
- Audio
- Multimedia
- Access to subject matter experts (SMEs)



# Common Legalities

Based on policies, liabilities follow the professor…

# Intellectual Property

- Respecting the copyright protections of others' works
  - Not downloading and using others' informational materials without permission
  - Not uploading published articles into an online course without permission
- Attaining the proper copyright releases for the use of works
  - Maintaining documentation of those releases
- Checking with the electronic content librarian for copyright clauses that may allow the uses of
- Using an appropriate copyright policy in the online classroom to prevent works from being mis-used
- Not forcing students to give over copyright of their work to an instructor as a pre-requisite of the course

# Accessibility

- Multiple perceptual channels for information
  - Offering verbatim transcripts for all video and audio; timed text (captioning) preferable
  - Alt-texting (alternate text) images for equivalent informational value
  - Labeling tables properly; using lead-up and lead-away text to describe the informational value of the tables
  - Building a hierarchy of text for clearer understanding
  - Not using color as the sole conveyor of information
  - Avoiding strobe "light" effects (which may cause seizures in others)
  - Using plain English

# On-Campus Accessibility Support

Refer students…

- Disability Support Services
- dss@k-state.edu
- 785-532-6441
- Adaptive Technology Specialist

Use the following resource to ensure the accessibility of your courses…

- K-Access
- K-Access Quick and Simple Accessibility Checklist

# Privacy Rights

- Media releases used whenever video, imagery, or audio of students are collected and recorded
  - Not making signing over of rights required for a grade
- Not sharing any FERPA-protected information in an online class (such as grades)
- Not requiring the sharing of private information by students
- Not forcing students to go public with their work if they do not wish to (offering an alternative assignment if going live and public is required)
- Using a slide to let students know that they may be recorded if they are taking part in a web conference (if that conference will be recorded and possibly used)

# Publishing

- Sharing domain specific insights about teaching and learning online
- Some reputable online journals in online education
  - Educause Review Online
  - Journal of Online Learning and Teaching (JOLT) of Multimedia Educational Resource for Learning and Online Teaching (MERLOT)
  - The International Review of Research in Open and Distance Learning (IRRODL)

# Online Campus Tools for Distance Learners

# Online Tools

**Learner Resources**

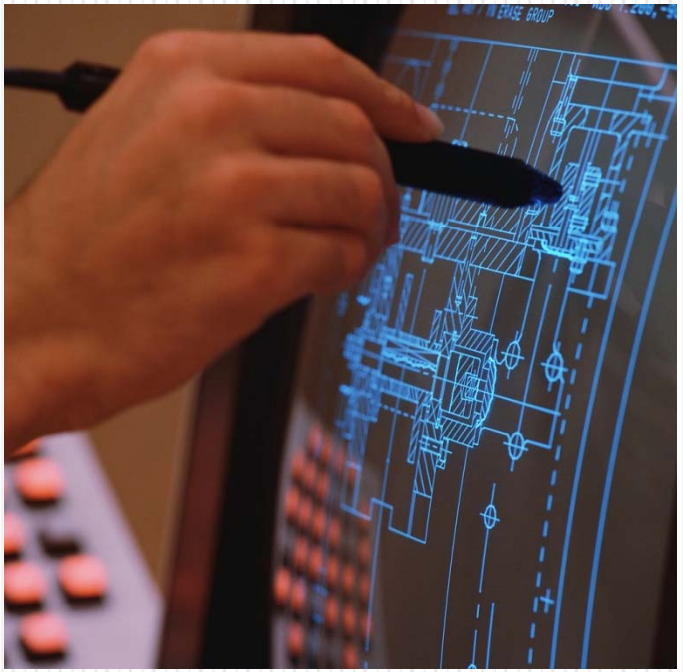
- Essential Course Tools (DCE): getting started, eID, textbooks, exams, university policies and procedures, grades and transcripts, financial aid and scholarships, and others

**Library Resources**

- K-State Libraries: digital repositories, electronic books, e-journals; services, copyright consultation, research consultation
- Information for Distance Learners (K-State Libraries): interlibrary loans (with free one-way shipping), live Ask a Librarian services, and other library resources
- LibGuides (for particular courses): online resources; access to databases; embedded librarians to support learner research and to enhance interactivity in discussion boards (with instructor approval)

# Civil Engineering and Online Learning

The State of the Art



# Enhanced Visualizations in Civil Engineering

- Uses of virtual reality (VR) to enhance 3D models in the construction sciences (for vocational training, education, and professional practice) (Sampaio, Ferreira, Rosário, and Martins, 2010)
- Designed simulation and remote labs for engineering education (Balamuralithara & Woods, 2009)
- Simple simulations available for civil engineering education (Budhu, 2002)
- Online student understandings of structural concrete improved with the uses of explanatory animations and simulations to enhance visualization
  - Includes photos, diagrams, animations, and simulations (Ebner & Holzinger, 2002)

# Technological Changes to Enhance Civil Engineering E-Learning

(Ebner, Scerbakov, & Maurer, 2006)

- Web Based Training Master (server) or WBT-Master enhanced to accommodate the needs of civil engineering instructors and learners
  - Learners need an intuitive understanding of structural behavior
  - Learners need to be able to collaboratively problem-solve
  - Involved iVISiCE (interactive visualizations in civil engineering)
- Features of the program include the following: e-books, discussion forum, discussion room, meeting room, thematic discussions, project management room, personal lockers (for private student assignments), examination room, tutoring sessions and mentoring sessions

# Engineering Design Competency Challenges

(Brault, et al., 2007)

- Open-ended 17-module hybrid (both online and F2F) course developed to enhance engineers' abilities to attain engineering design competency
- Includes
  - "Overview of environmental challenges facing industry"
  - "Concepts in sustainable development and industry practice"
  - "Pollution prevention techniques in industry"
  - "Industrial effluent treatment and residuals management"
  - "Industrial air pollution control"
  - "Life cycle analysis (LCA)"
  - "Process integration and process control"

# Geotechnical, Rock and Water (GROW) Digital Library

- GROW repository currently inactive
- Ambition to build a high-quality civil engineering learning object repository and portal (Han, 2006)

# Games for Civil Engineering Education

- A game on the theory of structures
  - Involved a pre-test / post-test experimental control group
  - Minimum learning result of playing the game was "equal to that achieved with traditional methods"
  - Increased learner "joy" (Ebner & Holzinger, 2005)
- Simulation game (MERIT or "Management, Enterprise, Risk, Innovation and Teamwork") in construction industry for lifelong learners
  - Includes assessment, decision-making, role-playing, and planning
  - Blended (F2F and online) learning game used for continuing professional development (Wall & Ahmed, 2008)

# Online Civil Engineering in the Military

("Update on CE Education" in *Air Force Civil Engineer*: 15(2), 2007)

- In 2005 and 2006, more than 100 students in the U.S. Airforce took distance courses
  - Some self-paced DVDs, some Web-based courses
- Course topics include
  - Logistics Management
  - Electrical Power Systems Design
  - Comprehensive Planning Development
- Includes an in-residence capstone project

# Some Current Constraints for E-Learning and Civil Engineering

- Few online laboratories for civil engineering
- Complex technologies and data-heavy systems used in civil engineering
- The need for high reliability work (for safety) (Love, et al., 2011)
- Prevalence of math anxiety among engineering students (Vitasari, et al., 2010)
- Limited simulations with the risks of potential negative learning
  - Need more opportunities for instructors to elicit responses from learners to understand their real level of understanding and skills

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