Towards a National SMETE Digital Library at www.smete.org

Alice Agogino
Principal Investigator

Brandon Muramatsu
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Outline

- Introduction
- Synthesis Coalition
- NEEDS—The National Engineering Education Delivery System
- Towards a National SMETE Digital Library
- Prototype: www.smete.org

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What is a National Science, Mathematics, Engineering and Technology Education (SMETE) Digital Library?

Vision...

"… a network of learning environments and resources for Science, Mathematics, Engineering and Technology education, will ultimately meet the needs of students and teachers at all levels—K-12, undergraduate, graduate, and lifelong learning—in both individual and collaborative settings."

Towards A National SMETE Digital Library...

Should NSF Establish and Fund a National Science, Mathematics, Engineering and Technology Education Digital Library?

- **April 1996 - NSF Committee Meeting (LIBUSE)**
  - "Towards a National Library for Undergraduate Science Education Resources in Science, Mathematics, Engineering and Technology"
- **August 1997 National Research Council**
  - Digital National Library for SME&T Education Workshop
- **July 1998 National Science Foundation**
  - SMETE-Lib Workshop
- **January 1999 National Science Foundation**
  - Digital Libraries and Education Workshop

Funding through Digital Libraries Initiative – Phase 2 And NSDL Programs

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Synthesis Coalition Goals (1990–1998)

- Reform undergraduate engineering curricula
- Improve retention
- Link to K-14
- Develop digital infrastructure ← NEEDS

Synthesis Coalition Strategy

- **Introduce multidisciplinary systems design**
  - Mechatronics
  - Architecture/Engineering/Construction
- **Bring industry and research into the classroom**
- **Enhance laboratory/hands-on learning**
- **Increase social context of technology**
- **Improve student's communication and teaming skills**
- **Introduce new delivery/learning styles**

Multidisciplinary, Multimedia Case Studies

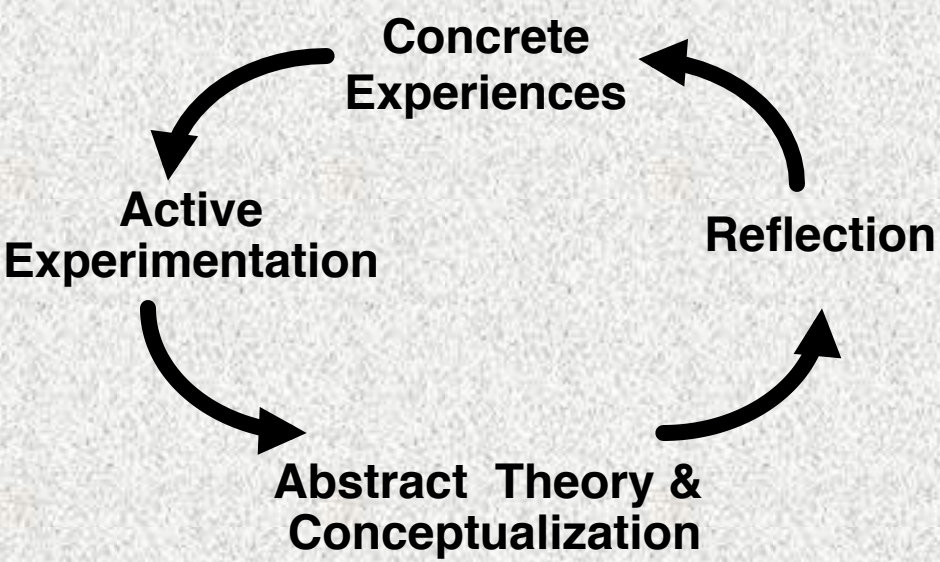
- **Highlight examples of successfully engineered design products.**
- **Brings "best practices" from industry into the classroom:**
  - customer-driven design
  - quality and continuous improvement
  - multifunctional teams
  - design for 'x' (assembly, environment, service, etc.)
- **Complements dissection and design activities.**
- **Promotes integrative thinking.**

Multidisciplinary Mechatronic Cases and Dissection Exercises

Some of the Disciplines Involved:

- Mechanical Engineering
- Electrical Engineering
- Computer Engineering
- User Interface Designers
- Manufacturing Engineering
- Industrial/Process Engineering
- Business and Management of Technology

Multimedia Cases & Mechanical Dissection Promote Integrative Learning



Virtual Disk Drive Design Studio Case Study

Integrates multimedia case, dissection and design activities

Synthesis Courseware Integrates Research, Education and Industry

Technical Research

Disk Drive
High Speed Networks
Multimedia & Video Servers
Design & Mfg. Integration

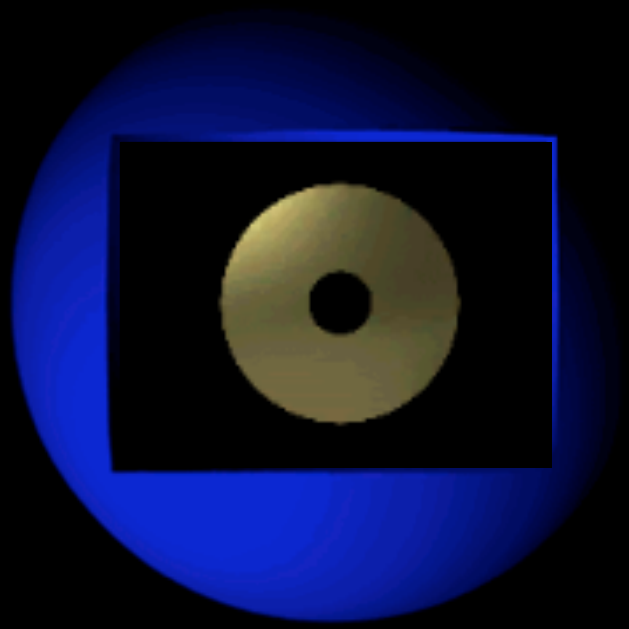
Industry

Western Digital
IBM Almaden Research
Berkeley Computer Mechanics Lab

Education Research

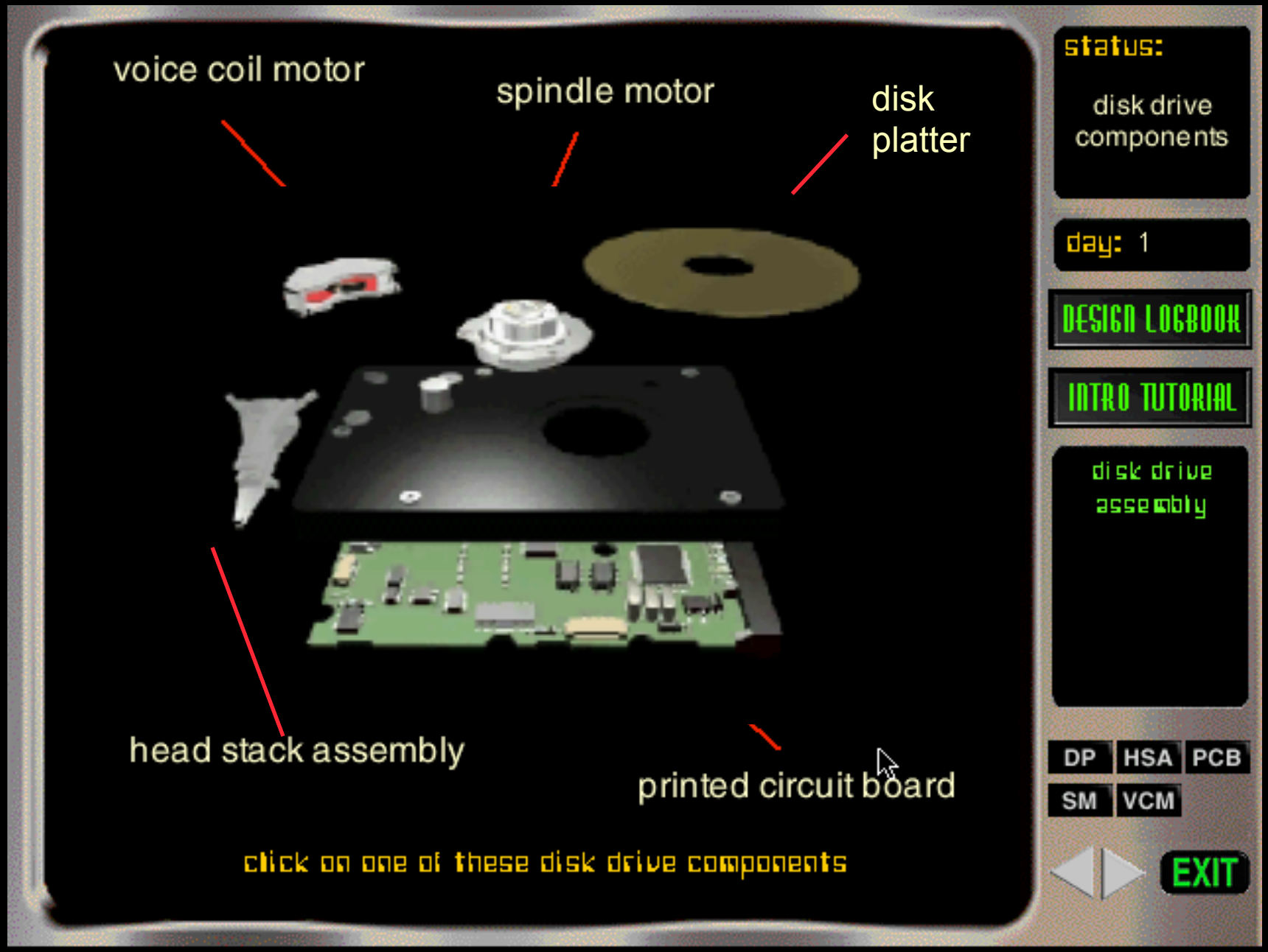
peer, scaffolded & experiential learning

Virtual Disk Drive Case Study - Game, Dissection Example



THE VIRTUAL

DISK DRIVE DESIGN STUDIO


voice coil motor
spindle motor
disk platter
head stack assembly
printed circuit board
click on one of these disk drive components
status:
disk drive components
day: 1
DESIGN LOGBOOK
INTRO TUTORIAL
disk drive assembly
DP
HSA
PCB
SM
VCM
EXIT

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NEEDS—The National Engineering Education Delivery System
www.needs.org

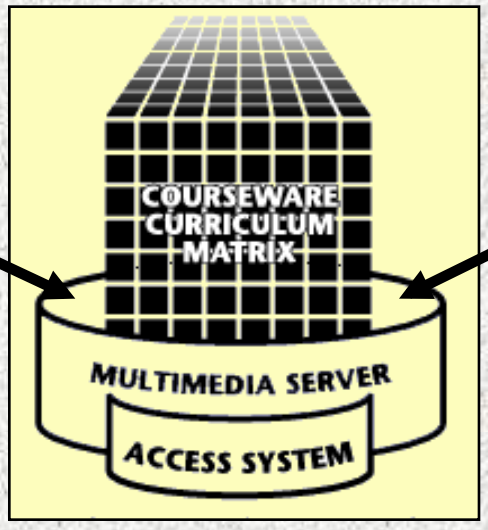
NATIONAL ENGINEERING EDUCATION DELIVERY SYSTEM

www.needs.org

Delivery

- Classrooms
- Instructional Labs
- Small Study Groups
- Residences
- Libraries
- **Anywhere**

Three Components Connected Through the Internet



Development

- Courseware Studios
- Instructional Labs
- Faculty Offices & Residences
- Libraries
- **Anywhere**

We are building upon our experience with NEEDS as the foundation for the National SMETE Digital Library, coupled with on-going research.

What Is NEEDS?

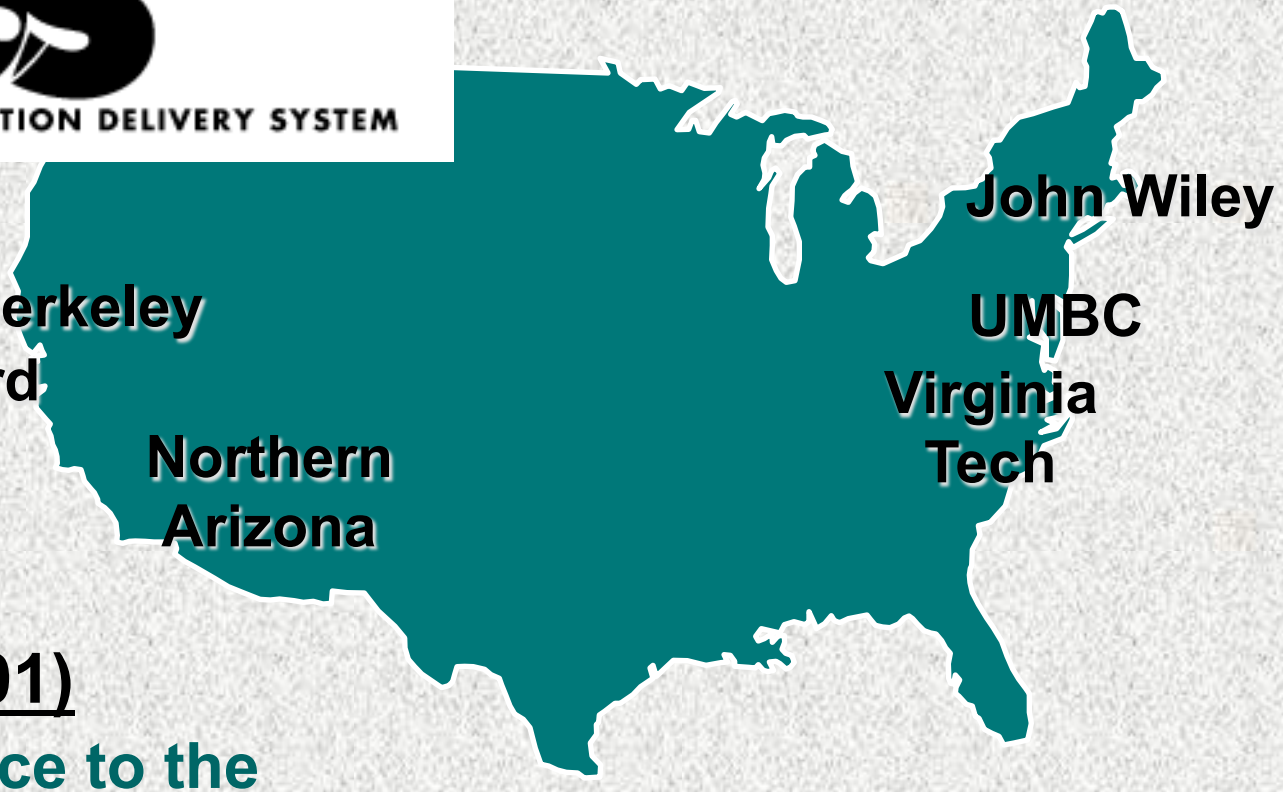
- **Integrated Database of Multimedia Engineering Courseware**
  - Bibliographic records with downloadable courseware
  - Multimedia elements - downloadable movies, images, and text
- **Multilevel Courseware Evaluation System**
  - Peer Review of Courseware
  - *Premier Award for Excellence in Engineering Education Courseware*
- **Expanding Services and Features**

How does NEEDS help users "re-use" learning materials?

- **Provides mechanisms to help user locate materials**
  - Uses standardized descriptions (metadata) to describe resources
- **Provides mechanisms to help users evaluate the "quality of materials"**
- **Developed upon an extendable platform to support multiple uses, as well as integrate new services and features**

NEEDS

NATIONAL ENGINEERING EDUCATION DELIVERY SYSTEM



Goals (1998–2001)

- Provide a service to the engineering education community
- Grow and evolve NEEDS as the foundation for an on-line engineering education community
- Expand courseware review and evaluation efforts
- Serve as a bridge to the development of a National SMETE Digital Library

Quality Review of Courseware on the NEEDS Database

- Establish credibility of NEEDS as a source of <u>Quality</u> educational material
- Enhance recognition of scholarly and creative effort of courseware developers
  - Peer/Expert Review of Courseware
  - *Premier Award for Excellence in Engineering Education Courseware*

The Premier Award for Excellence in Engineering Education Courseware

- **A national competition to identify and reward the authors of high-quality, non-commercial courseware designed to enhance engineering education.**
  - The *Premier Award* is about the entire experience of using the courseware by learners, not just the courseware itself
- **A dissemination system to distribute the Premier Courseware (via CD's and presentation at engineering education conferences).**

WILEY Premier Award

Premier Courseware of 1997-1999

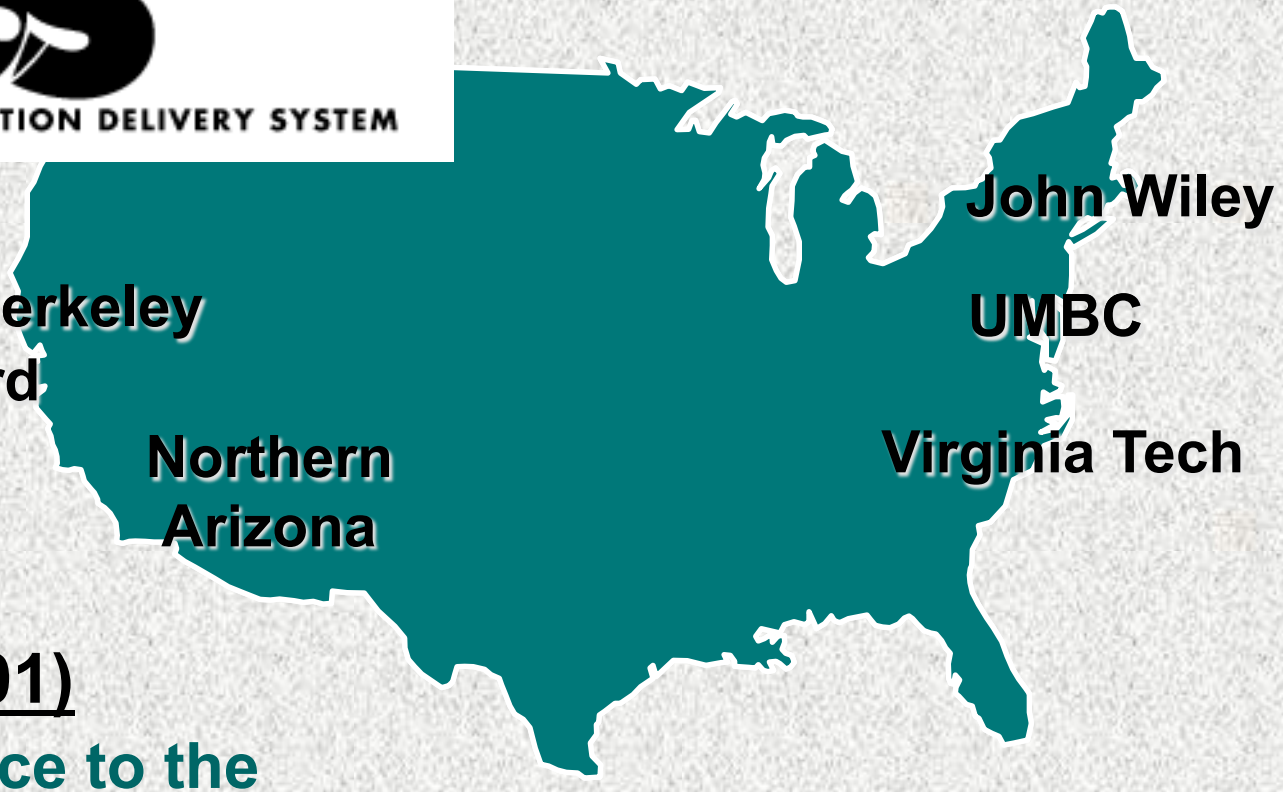
- Virtual Disk Drive Design Studio
- Drill Dissection and Bicycle Dissection
- Mars Navigator
- Della Steam Plant
- MDSolids
- Structural Engineering Visual Encyclopedia - UNH
- Engineering Graphics
- Cracking Dams

6500 CD-ROMs Distributed

For more info or to receive copies go to http://www.needs.org/premier/

NEEDS

NATIONAL ENGINEERING EDUCATION DELIVERY SYSTEM



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Towards
A National Science, Mathematics, Engineering and Technology Education (SMETE) Digital Library

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"… a network of learning environments and resources for Science, Mathematics, Engineering and Technology education, will ultimately meet the needs of students and teachers at all levels—K-12, undergraduate, graduate, and lifelong learning—in both individual and collaborative settings."

Needs Assessment with Members of the Math and Science Community

Purpose:

To understand the math and science communities of educators and examine their needs in order to design services and structures to support users from multiple communities.

Research Questions:

- What services, features & programs are integral to success?
- What do users expect with regards to quality of the holdings?
- Who makes up the SMETE digital library community?

American Association of Physics Teachers, American Mathematical Society, American Association for the Advancement of Science, members of the NSF Chemistry Consortia and the NSF Engineering Education Coalitions

Findings, Trends, & Design Implications

Quality

- Library as a marketplace/shopping mall of ideas and products
- Contents range from “works in progress” to highly rated products
- “Peer review” includes cognitive science, pedagogy, curriculum and user reviews

Findings, Trends, & Design Implications

Community

- Communication potential is most highly valued
- A place for networking, learning from peers and communication — not just a repository
- Users look to their peers first to learn about teaching — strong discipline identify

Contents

- Library holdings should be diverse:

  problem sets to entire courses, books to data sets, visualizations and simulations, instructors' guides and assessment tools

Translating Findings into Services & Features

Quality

- System to rapidly identify the quality of holding
- Place to comment about a learning object or regarding something of interest to the community
- Reviewers should include experts in pedagogy and content

Translating Findings into Services & Features

Community

- Embedded structures for developing and maintaining communication links
- Developing community should be on par with building content
- Build on discipline based communities to establish connection to a broader community

Content

- Useful content and community interaction will ensure user participation as authors, reviewers, adapters/ adopters, and consumers

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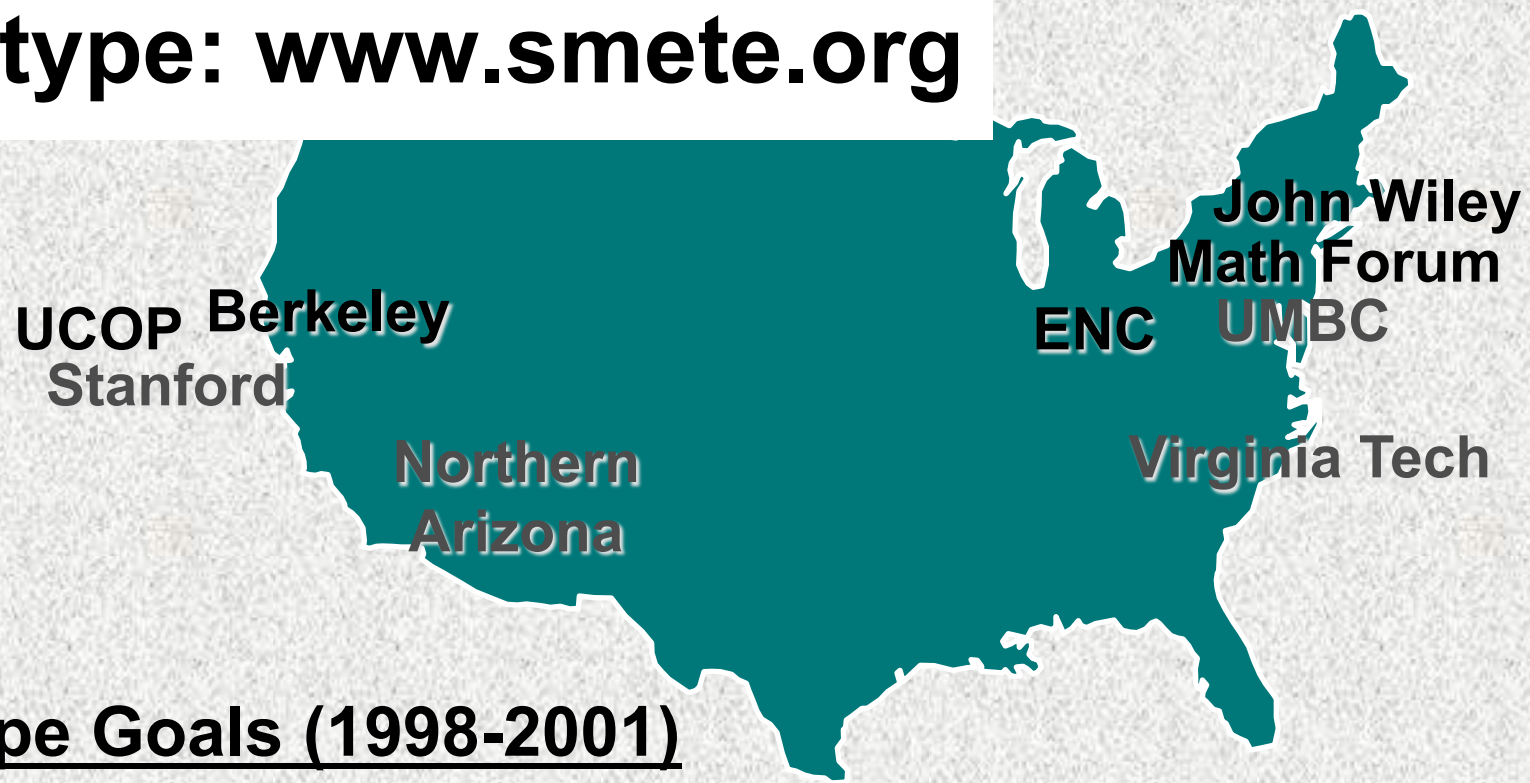


Prototype Goals (1998-2001)

Develop a Prototype National SMETE Digital Library

- test interoperability of federated searches/shared services with partners
- expand requirements analysis to include K–12
- develop criteria and standards to assess the impact of learning objects across disciplines
- implement community feedback systems, evaluate services

Building a National SMETE Digital Library at www.smete.org

- **Searching for learning resources**
- **Cataloging (adding) learning resources**
  - Standards, IEEE and IMS
- **Evaluating the quality of learning resources**
  - “User” reviews
  - “Expert” reviews
- **Forming a community of users in SMETE**

Systems Development

- **Expanding www.smete.org/NEEDS platform**
  - Continuing to participate in the development of IEEE/IMS Learning Object Metadata Standards
  - Adopting emerging IEEE standards
  - Expanding User Comments
  - Developing Discussion Systems
- **Expanding Collections**
  - Expanding into Chemistry, Physics, and Mathematics

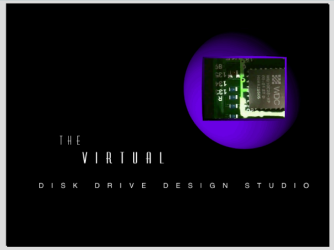
Total Collection	
Engineering	58%
Chemistry	21%
Physics	14%
Math	5%
Other	2%

Sample Record: www.smete.org

Info | Download | Pedagogy | Comments & Reviews | Add Comment | Details

The Virtual Disk Drive

Premier Courseware of 1997



Download | Reviews | Comments

Title: The Virtual Disk Drive Design Studio

Authors: David Y. Yu
Alice M. Agogino

Publisher: University of California at Berkeley (03/1997)

Courseware Series: Multimedia Case Studies of Design in Industry

Version: 1.0b5

Summary: The Multimedia Virtual Disk Drive Design Studio is an engineering design case study using interactive multimedia courseware for undergraduate engineering and science students. The purpose of this multimedia case is to introduce students to the world of mechatronics in the form of a disk drive. Students play the role of a project engineer for the ACME disk drive company and will have to mine out the necessary information from a multimedia archive in order to build a new disk drive model. Students will have to keep track of the development and production costs. They will also be asked to launch their new disk drives in a certain time frame, simulating the idea of time-to-market. This interactive disk drive case study is ideally complemented by hands-on mechanical dissection of an actual disk drive.

This entire project is put together using Macromedia Director. This cross-platform software will allow us to distribute CD-ROMs to a wide spectrum of students around the country with 2x CD-ROM drives. The author is currently collaborating with Western Digital Corporation and IBM Almaden Research Center in San Jose. Western Digital Corp. provided the mathematical model for performance calculations while IBM has contributed in the form of

Collaborating with Partners

- **Working with Eisenhower National Clearinghouse and Math Forum**
  - Identify common metadata
  - Exchange records for common searching
  - Working together as part of the American Mathematics Metadata Task Force

www.mathforum.com **www.enc.org**

AMMTF American Math Metadata Task Force

www.mathmetadata.org

- **Development of Best Practices of using metadata for the Mathematics community**
- **Development of subject thesaurus for range of mathematics resources**

NEEDS needs

THE MATH FORUM

Where there is matter, there is geometry. Johannes Kepler

enc Eisenhower National Clearinghouse

www.needs.org

www.enc.org

www.mathforum.com

Also American Mathematical Society, Mathematics Association of America

AMMTF American Math Metadata Task Force

www.mathmetadata.org

- **Development of Best Practices of using metadata for the Mathematics community**
- **Development of subject thesaurus for range of mathematics resources**
  - Level I: Pre-variable Mathematics
  - Level II: Post-variable, pre-proof oriented mathematics
  - Level III: Pre-professional and professional mathematics

Collaborating with Partners

- **Working with University of California Office of the President**
  - Identifying courseware under development systemwide
  - Developing TLT@UC Website to showcase teaching and learning with technology at the University of California

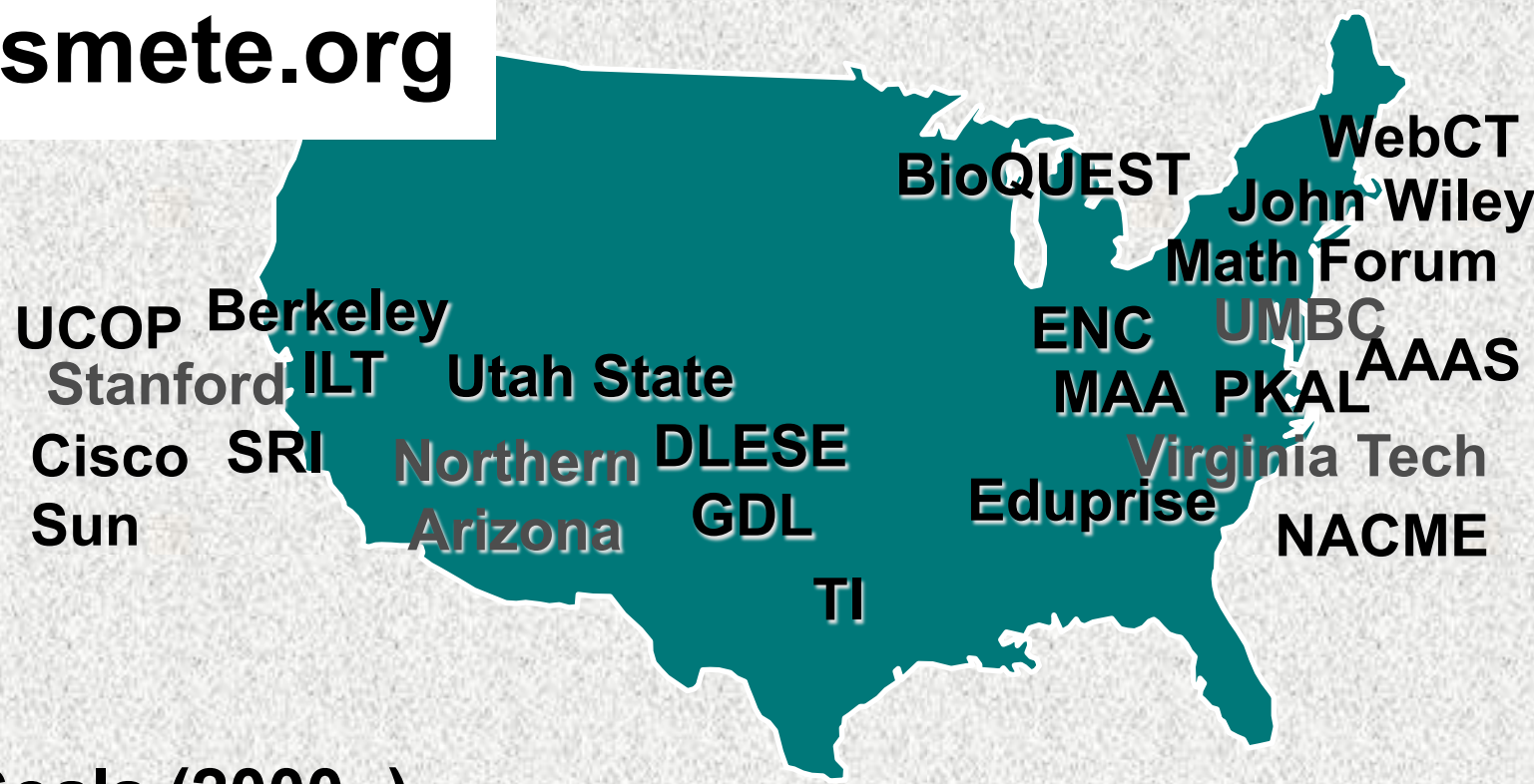
TLT@UC
Teaching, Learning and Technology at the University of California

Challenges Toward the Future...

- **Continuing to understand and support users' needs**
- **Improving ability to encapsulate the instructional intent and use of materials**
  - Metadata standards and cataloging practice
- **Supporting communities of use and practice**
  - pedagogy
  - content

- **Which allows for a user to find what they're really looking for as well as personalization of content.**

www.smete.org



NSDL Goals (2000-)

- **Develop the National SMETE Digital Library**
  - Provide seamless access to services and resources
  - Create a dynamic learning community that promotes and supports SMET education in the 21st century
- **Expand Partnerships**
- **Expand Services and Community**

www.smete.org NSDL Project Goals

- **Build and Demonstrate a Core Integration System for the NSDL:**
  - Demonstrate an operational Core Integration System (CIS) with a gateway at www.smete.org.
  - Demonstrate a portal with interoperability and federated search with multiple disciplinary collections.
  - Extend and improve accessibility to collections at www.smete.org.
  - Coordinate the development of shared metadata across multiple disciplines in SMETE.
  - Develop subject thesauri and descriptors for describing pedagogy in SMETE.
  - Develop and test community-building services.

www.smete.org NSDL Project Goals (cont).

- **Lead the Development of Governance and Sustainable Models for the Future NSDL:**
  - Provide leadership in developing the NSDL program governing structure.
  - Organize and host a national government/industry/ academeme roundtable on intellectual property and business models for the NSDL.
  - Identify models for economic sustainability.
  - Develop classifications for ranking materials; identify issues associated with curation of aging materials.
  - Develop criteria for evaluating the NSDL CIS and specify 'best practices.'

Contact Information

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