Virtual Laboratories in Digital Libraries

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Overview

• Knowledge structures
• The types of labs
  • Physical and virtual labs
• Virtual labs in the GROW DL
  • Interactive information resources
• Information resource maps
• Concept maps
Knowledge Structures

- There are many definitions depending on the disciplinary background.
  - “Knowledge structures are organized (mutually reinforcing) systems of claims that one accepts as valid.”
- Concepts and relationships
- Organization in every discipline
  - Classification, taxonomies, nomenclature (controlled vocabularies), genres (form/type)
Knowledge structures for learning

- Learning objects + knowledge objects
  - Learning objects have other things attached to knowledge:
    - Outcomes; Assessment; Activities; Pre-reqs
- Learning objects are grounded in disciplinary discourse & training models
  - Science & eng. : Laboratories, models
  - Traditionally, these are not the objects for collection in libraries
- Knowledge objects: concepts & relationships
CE Curriculum study findings (Lamar U)

• Four subject areas presently receive or should receive a high level of coverage in the civil engineering (CE) curriculum
  • Mathematics through calculus and differential equations
  • Structural engineering
  • Geo-technical engineering
  • Major design experience or course
• Practitioners also recommended that slightly more coverage be given to labs
  • Ability to conduct lab experiments and critically interpret data in more than one of the following subjects: structural/materials, geo-technical, environmental, hydraulics, and surveying.
Library Development

- Current, general trends are still
  - Building critical mass in terms of digital collections, resources and users
  - Debating quality
  - Debating the merits of information filtering and information organization
- Traditional libraries did not really ‘collect’ labs
- Problem: what are the selection criteria for labs in digital libraries?
Types of Labs

- Physical laboratories
  - Space, equipment needs (maintenance, safety), scheduling logistics,

- Virtual laboratories
  - 2-d simulation (line drawings)
  - 3-d simulation (3-d graphics)
  - Remote labs (Sensor-actuated)

- Benefits of virtual labs (3-d simulation)
  - Access (24/7)
  - Costs
  - Ease of use
Components of Laboratories

• Physical laboratories
  • Course Outline with Learning Objectives (below)
    • Reinforce concepts presented in lectures
    • Experience with ‘technical’ procedures
    • Uses, importance, and limitations of lab tests
    • Historical perspective of the people contributions to the field

• Lab Manual
  • Engineering Properties of Soils and Their Measurements. McGraw-Hill

• Lab Reports
  • Structured: Memo; Objective; Description of sample, Calculations, Test procedure, Remarks, Test results, Conclusions, References (syntax), Appendices (raw data)

• Equipment (instruments, samples)
Virtual Laboratories in GROW

- Focus on the labs in the Geo-technical laboratory (accompanying Soils course)
  - Virtual consolidation
  - Virtual constant head permeability
  - Virtual triaxial
  - Virtual shear
- Interactive resources
  - Internet connection, WWW browser that is Macromedia-Authorware enabled
Interactive Resources

• IEEE LOM 6.0 defines interactivity for metadata description purposes
  • Interactivity type
    • Active, expositive, mixed, undefined
  • Interactivity level
    • Very low, low, medium, high, very high

• GROW – concept of interactivities or interactives
  • Interactivities are simply defined as interactivity that enhances learning.
  • Interactivities are consciously designed and developed based on the pedagogical, technical, discipline, and social dimensions of interaction between users and systems
Interactions - 3-d simulations

- Numerous file types
  - Windows application files (Calculator)
  - Movie files
  - Authorware (Flash and Shockwave) files (*.aam and *.aas)
  - Text (*.txt; *.html; *.xml; shtml)
- Numerous ‘activities’ (interactivities?)
  - Watch a video
  - Take a quiz
  - Move objects
  - Input data
Guidelines for authors of learning objects

• New Media Consortium
  • http://www.nmc.org/guidelines/NMC%20LO%20Guidelines.pdf
  • Content; Pedagogy; Graphic Design; Accessibility; Metadata; Interoperability; Reusability; Openness

• Attributes (properties that can be observed or measured) vs. guidelines
Attributes of virtual labs

• The attributes of virtual labs are:
  • Knowledge object + learning object = interactive (information) resource
  • As a Knowledge object
    • Concepts and relationships (tests and experiments)
  • As a Learning object
    • Learning outcomes, Assessment, Glossary, Explanations, Definitions, Examples, Illustrations, Arguments, Data, Evidence, Conclusions
  • Interactive (information) resource
    • Synonymous terms - Multimedia objects
Characteristics of Interactivity

• Reciprocity
  • the reciprocal action when the user does something

• Feedback
  • the amount and type of feedback provided to the user.

• Immediacy
  • the immediacy of reciprocity and feedback

• Control
  • voluntary and instrumental action that users have over the outcome, or rate, sequence, and type of feedback

• Relevancy
  • relevance is calculated based on task and context

• Synchronicity
  • the degree to which users consider their input into system and system response is felt to be simultaneous
Characteristics of Interactivity

- **Choice**
  - There are alternatives

- **Immersion**
  - Provides an immersive experience

- **Play**
  - Sense of play

- **Flow**
  - Cognitive flow and locus of attention

- **Multidimensionality**
  - More than one dimension
Information resource maps

**Creation**
Authors (subject matter experts) + Instructional designers create

**Description**
Authors and/or librarians describe

**Use**
Authors (as instructors), and/or instructors and learners use

**Knowledge object**

**Interactivity**
Concept maps

Concepts & Relationships

Objectives of lab

Things you need to know about consolidation

What happens when load goes on

Real life examples of loading soil

Key concepts (important items to put in report)

How consolidation relates to water

Compaction vs. consolidation characteristics

Soil properties

Virtual vs. lab vs. field

Miscellaneous

MERLOT Conference, Costa Mesa, CA, Aug. 3-6, 2004
Conclusion

- Nature of virtual labs
  - General guidelines vs. attributes
    - Pedagogically sound
    - Scientifically accurate
    - Stimulating, motivating, engaging
    - Primary attributes for selection: type & format

- Nature of learning
  - Primary attributes: Use records; knowledge structures such as glossaries and thesauri or concept maps which show relationships
Acknowledgments

- EIF
- GROW Project
References

GROW, http://www.grow.arizona.edu/
The End

- Questions?
- Thank you!
- Asc at arizona dot edu
- http://www.u.arizona.edu/~asc