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From the Selected Works of Anita S. Coleman

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Virtual Laboratories in Digital Libraries

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Virtual Laboratories for 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

Description

Use

Authors (subject matter experts) + Instructional designers create

Authors and/or librarians describe

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

Knowledge object

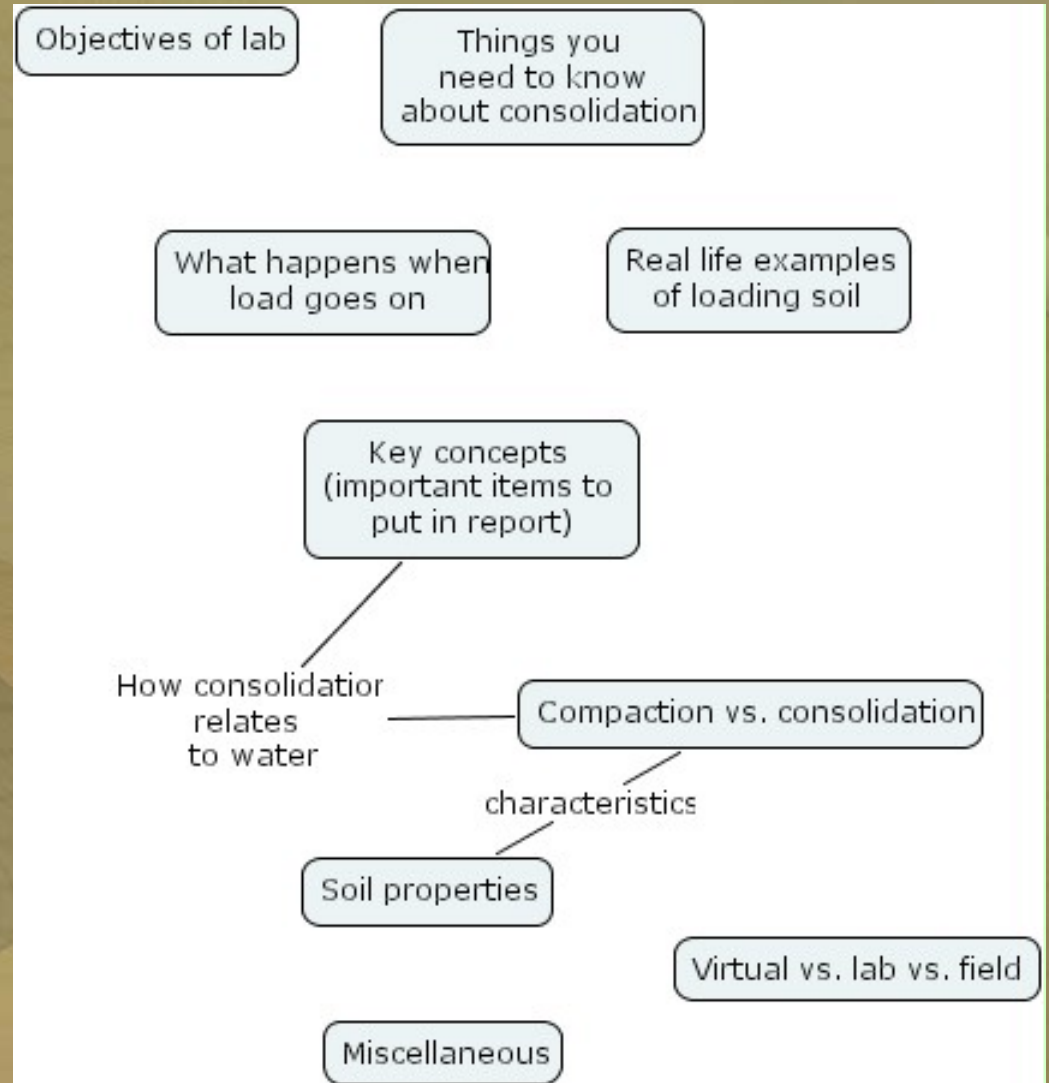
Interactivity

Concept maps

Concepts

&

Relationships



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>