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Virtual Laboratories in Digital Libraries

Anita Coleman
University of Arizona, acoleman@lpts.edu

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Anita Coleman, SIRLS, University of Arizona

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

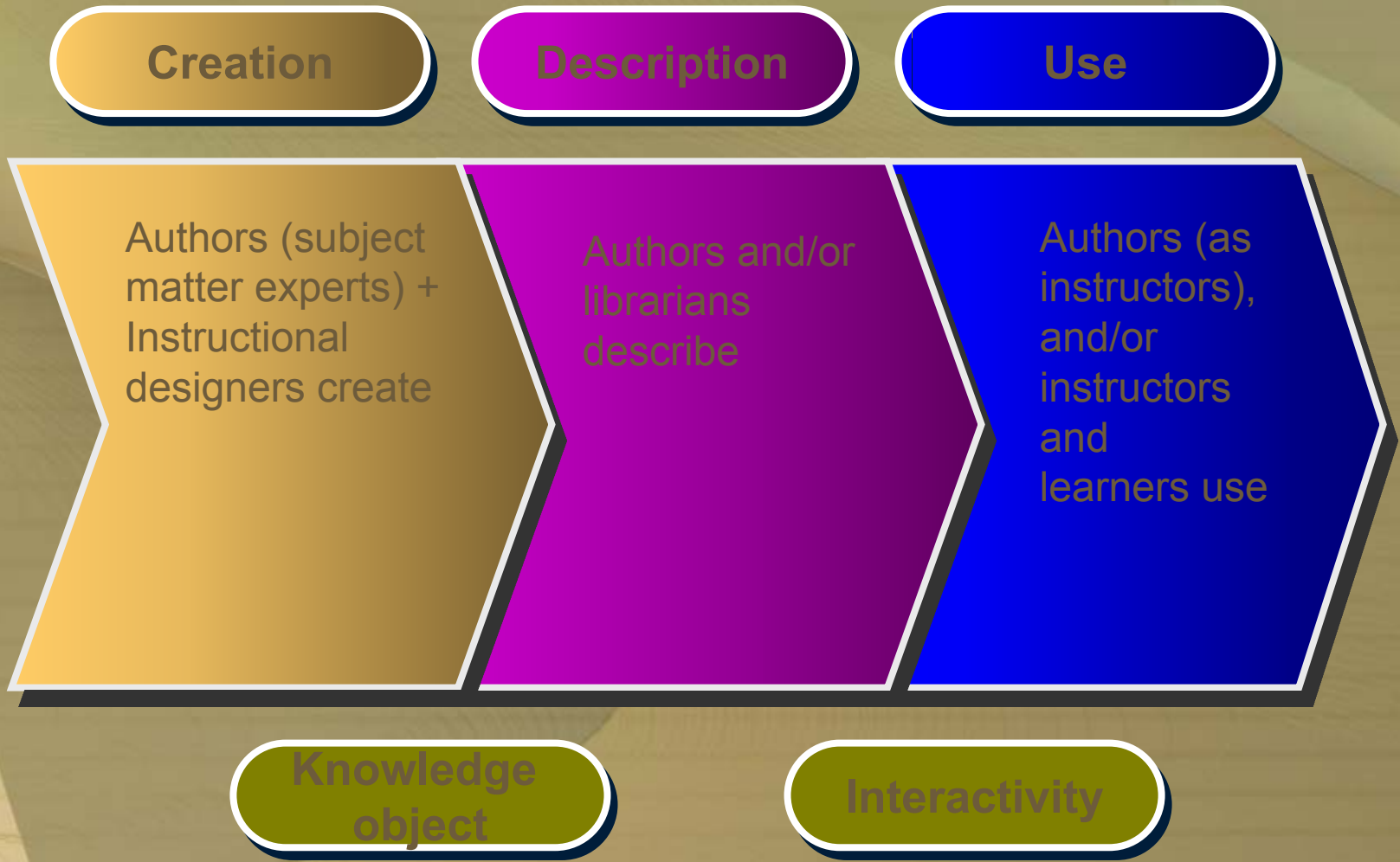
Characteristics of Interactivity

- 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

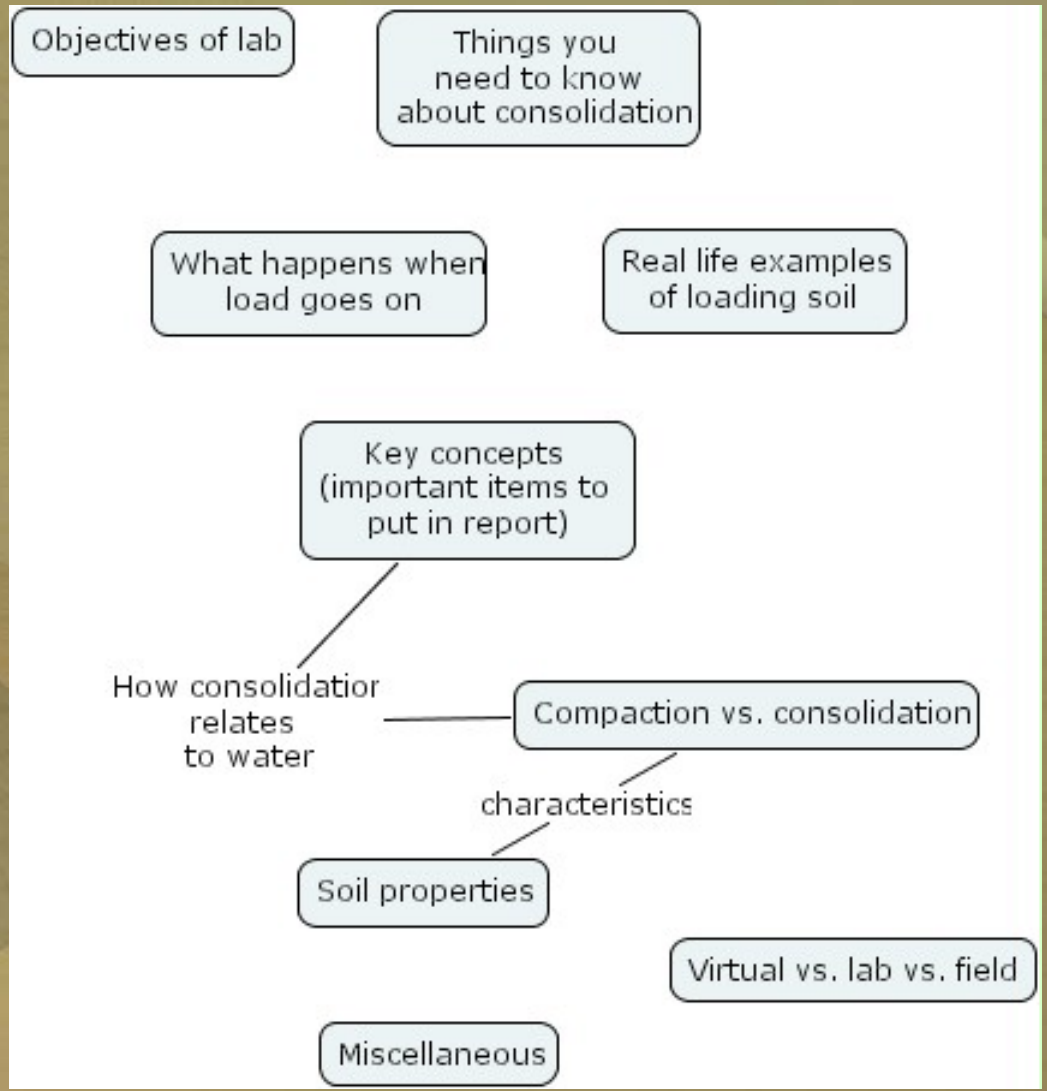
- Choice
  - There are alternatives
- Immersion
  - Provides an immersive experience
- Play
  - Sense of play
- Flow
  - Cognitive flow and locus of attention
- Multidimensionality
  - More than one dimension

Information resource maps



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