Designing for Geospatial Information Technologies

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Geographic Information Systems

- Map, visualize, and analyze geo-referenced data
  - Industry, businesses, education
- Contribute to science learning
  - Rich contextual learning
  - Critical thinking skills
  - Problem-solving skills
  - Authentic inquiry-based learning

Real-world Design

- Design task
  - Design science instruction supported by a GIS.
  - 8-week instruction
- First-time GIS users
  - Takes time for teacher to learn and teach students.
  - Students get easily frustrated.
- Accepted process model
  - Use Understanding by Design to design instruction
Real-world Design (still more)

- Learners
  - Diverse ethnic backgrounds
  - 10% ESL students
- Content
  - Generated by subject matter experts (SMEs)
  - Developed materials approved by design team

Real-world Design: Implications

- Science Ed experts knew the content really well.
- Environmentally conscious folks.
- Drafts versions of the materials had a few faults...
  - Not very easy to read, particularly given learner group
  - Layout could be stronger...
    - Too much text on one page (so can print on both sides)
    - Small illustration with no arrows or labels
    - Too much highlighting and too many kinds of highlighting
  - Only design model was UbD.

Selected Instructional Design Theories

- Behaviorism
  - Direct instruction
  - Emphasize extensive practice and correct responses
- Constructivism
  - Modify and refine what they know
  - Collaborate on tasks
- Inquiry teaching
  - Hands-on activities
  - Use evidence like scientists
  - Tenet of science education reform
Design Process Models: ADDIEs
Analyze-Design-Develop-Implement-Evaluate
- Dick, Carey & Carey (2005)
- Understanding by Design (Wiggins & McTighe, 2005)
- ARCS Motivational Model (Keller, 1983)
- Guiding principle of ID:
  - Steal only from the best!

Design Models I Used (see last pages of handout)
1. Behaviorism
   - Gagné's (1974) Nine Significant Events Model
2. Constructivism
   - Jonassen's (1999) Constructivist Learning Environments Model
   - Black & McClintock's (1996) Interpretation Construction (ICON) Model
3. Inquiry teaching

Derived Instructional Model
1. Confirm learners have necessary background.
2. Present instruction using appropriate model.
   - Content presentation sub-model
   - Computer-supported activities sub-model
   - Laboratory activities sub-model
3. Confirm instruction is meeting goals and objectives.
4. Confirm learners have acquired desired knowledge, skills, and attitudes.
   - Meta-principles also!
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META-PRINCIPLE 1
Use multiple ways of learning to address learner differences.

META-PRINCIPLE 2
Use procedural facilitators to guide learners’ responses.
META-PRINCIPLE 3
Use icons consistently to enhance and reinforce student learning and use illustrations to reduce learner dependence on text.

META-PRINCIPLE 4
Facilitate the process of modifying instructional materials to meet the needs of different learners.

META-PRINCIPLE 5
Use contrast, repetition, alignment, and proximity (CRAP) design.
INSTRUCTIONAL MODEL: STEP 2.1
Sub-model for content presentation

INSTRUCTIONAL MODEL: STEP 2.2
Sub-model for computer-supported activities

INSTRUCTIONAL MODEL: STEP 2.3
Sub-model for laboratory activities