Teaching Data Computing Literacy to Future e-Scientists: From a Critical Literacy Perspective

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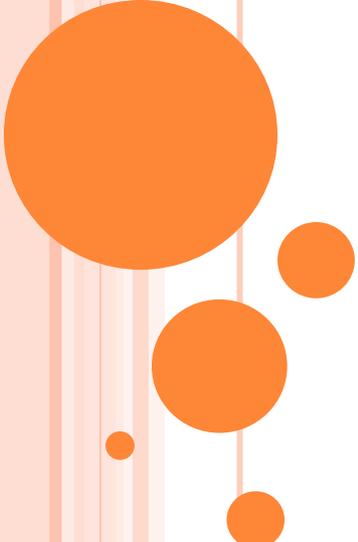
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AGENDA

- E-Science Literacy
  - Contents perspective: data/statistical/quantitative literacy
  - Standard perspective: information literacy standards
  - Theoretical perspective: inspired by new literacy theory and critical education and learning theories
- Practice e-Science Literacy in Teaching Data Computing

WHAT IS E-SCIENCE?

- "e-Science is about global collaboration in key areas of science, and the next generation of infrastructure that will enable it." "e-Science will change the dynamic of the way science is undertaken."

  - John Taylor, Director General of UK Research Council's Office of Science and Technology

- 'e-Science' is networked, data-driven science.

  - Tony Hey and Jessie Hey, "e-Science and its implications for the library community," Library Hi Tech 24, no. 4 (January 10, 2006): 515-528.

- e-Science is where "IT meets scientists.

  - "Jim Gray on eScience: A Transformed Scientific Method," *Fourth Paradigm* (Redmond, Wash.: Microsoft Research, 2009).

LIBRARY AND E-SCIENCE

We provide services

- Data curation services
- Data management services
- New scholar communication (network platform and publishing)

And, we are educators/instructors too

- **Data computing software/packages**
- **Data management best practices**

As educators, how can we teach more than techniques?

Is there an e-Science Literacy?

Aren't these enough?

- Data literacy
- Statistical literacy
- Quantitative literacy

And, there is even an literacy standard for higher education!

INFORMATION LITERACY COMPETENCY STANDARDS FOR HIGHER EDUCATION (ACRL, 2000)

An individual is information literate if he/she is able to:

- Determine the extent of information needed;
- Access the needed information effectively and efficiently;
- Evaluate information and its sources critically;
- Incorporate selected information into one's knowledge base;
- Use information effectively to accomplish a specific purpose;
- Understand the economic, legal, and social issues surrounding the use of information, and access and use information ethically and legally.

Disciplinary Applications

- *Information Literacy Standards for Science and Technology* (June 2006)

- *Information Literacy Standards for Anthropology and Sociology Students* (January 2008)

- *Research Competency Guidelines for Literatures in English* (June 2007)

- *Political Science Research Competency Guidelines* (July 2008)

LIMITATION OF STANDARDS AND WE NEED INSPIRATION FROM THEORIES

"In fact, these standards and models have been profoundly important in guiding librarianship toward a student-centered educational philosophy, but without complementary theoretical perspectives, none of these approaches can generate important critical questions about its own conclusions, assumptions, or methods."

- Elmborg James, "Critical Information Literacy: Implications for Instructional Practice," *The Journal of Academic Librarianship* 32, no. 2 (March 2006): 192-199.

ACQUIRING SKILL
->
LEARNING AND BE CREATIVE IN THE REAL WORLD

LITERACY, EDUCATION, AND LEARNING THEORY

- Information Seeking Theory
- New Literacy Theories
- Critical Education and Learning Theories

- **Individual learner -> learner as social actor**
- **Cognitive process -> emotions, social process and life world**
- **Be functional and conformist -> be reflective and critical**

THEORY REVIEW:
KUHTHAU'S INFORMATION SEEKING THEORY

- Learners take several steps before they can reach the point of collected right information they need. During the process, learners are experiencing uncertainness, confusion, and frustration.

- Kuhthau argues that between learners and information, formal mediators are not only needed for assisting to locate the right information, but also needed for helping students focus their research topic and understand the unexpected complexity they face during the information seeking process.

THEORY REVIEW: NEW LITERACY THEORIES

- Multiple literacy (Hobbs)
- Literacy as a social practice in life world (Gee)
- Literacy as an ideology based on social and especially power structure (Street)

THEORY REVIEW: CRITICAL EDUCATION AND LEARNING THEORIES

- Vygosky's social constructionist theory
  - Children learn from social interactions and especially with those advanced peers, parents, and teachers, all those who are more capable than them.
- Freire's insights about the illness of the banking pattern of teaching and learning
  - the student is expected to passively absorb whatever the teacher is teaching for the hope that these contents will be used to find them jobs in the society and be functional technically well in their future social positions.

THEORY REVIEW: CRITICAL EDUCATION AND LEARNING THEORIES

- Schön calls for a system that educates the reflective practitioner.
  - Let student be a practitioner who sets his/her own problem, chooses and names the unique things he/she notices, and learns by doing. The teacher's role is to develop the artistry of coaching, have genuine dialogue with students in concrete practical context, exemplify traditions, and provide psychological supports.

THEORY REVIEW: CRITICAL EDUCATION AND LEARNING THEORIES

- Humanistic and librating theory of education does not avoid the challenges of mixing objective and subjective, fact and value in the education process.

  - It encourages students to not only to know themselves and the society, but also to change themselves and the society.

  - A student has to make his/her own choices eventually, but the teacher has the responsibility to and "can help students think through historical context and social surround, can point to the larger universe of possibilities, and can offer alternatives that might be unknown to the student." (Ayers)

CONNECTING THEORIES AND PRACTICE

- Theoretical Inspiration
  - Research as a social process, researchers within social networks
  - Academic culture/habit changing and cultivation
  - Aware of history of science practice and knowledge of methodology issues
  - Conscious of the social, economic and political context of research

- An outline for e-Science Literacy
  - Aware of the research network, use it and contribute to it
  - Best practice of documenting data and research process, cultivate the culture of sharing
  - Make critical and wise use of data and technology
  - Conscious of the current scholar practice, communication, policies, and issues

PRACTICE IN DATA COMPUTING INSTRUCTIONS

- Networks of researchers/experts
  - Software local user groups, MeetsUps
  - Software user forums and email lists
  - Experts in specific fields to contact (local and global)

PRACTICE IN DATA COMPUTING INSTRUCTIONS

- Documenting data and research process
  - Emphasize using and saving code/program/syntax when doing analysis using statistical software packages, even though click-point-click menu functions are available and convenient
  - Emphasize using of comments when write code/program/syntax
  - Provide metadata template for documenting program files
  - Mindset of collaborative approach and research's replicability

SPSS Syntax:
DOCUMENT YOUR ANALYSIS

- At the beginning: Describe your project and document your data source. Feel free to use this template:

  *==.

  *FILENAME StateSAT.xls

  *CREATED BY: Minglu Wang, 09/12/2011.

  *PROJECT: Using SPSS To Do Data Analysis Examples.

  *PURPOSE: Introduction to SPSS Workshop.

  *USES: c:\temp\StateSAT.xls.

  *based on 1997 Digest of Education Statistics.

  *note: http://www.amstat.org/publications/jse/secure/v7n2/datasets.guber.cfm.

  *==.

PRACTICE IN DATA COMPUTING INSTRUCTIONS

- Make wise use of data and technology
  - Emphasize theory-driven research
  - Compare software options
  - Understand the mechanism/structure of your tools

PRACTICE IN DATA COMPUTING INSTRUCTIONS

- Holistic view of doing "e-Science"
  - Contextualizing data analysis within a broader process of research life cycle
- Critical view on "e-Science"
  - methodology debate: the limitation of data-driven
  - Ultimate goals of science, humanities, and social sciences
  - Current situations of the not-open academic culture
  - Who are the advocates for and practitioners of the open culture, and why?
  - What are the obstacles, and let them make their own choices.