Change is Hard:
Using Conceptual Change Theory to Promote "Research as Inquiry"

Kimberly Miller
Learning Technologies Librarian
Towson University

ACRL Information Literacy Frame: Research as Inquiry
Discipline: Multidisciplinary
Subject: Research process
Learning Theory: Conceptual Change Theory
Special Population: First-Year Students

Every so often during library instruction sessions, I overhear professors advise their first-year students to "trust the process." Students are asked to "trust" that each step of their scaffolded, semester-long research project will lead them where they want to go. Similarly, the *Framework for Information Literacy for Higher Education* challenges librarians to help students see "Research as Inquiry."[1] We encourage students to use information to iteratively ask and answer interesting questions; however, this approach conflicts with the mental picture of the research process that students bring with them to college. Students may instead struggle to understand the relevance of what can look like a drawn-out and repetitive process, preferring to rely on a more linear approach that has worked well for them in the past. In response, this chapter shares a two-part blended lesson, grounded in conceptual change theory, designed to nudge first-year students toward an iterative research process.

ACRL Information Literacy Frame: Research as Inquiry

"Research as Inquiry" describes research as "iterative and depend[ent] upon asking increasingly complex or new questions whose answers in turn develop additional questions or lines of inquiry in any field."[2] Ideally, this means students learn to view research as an iterative process that requires deep engagement with the information environment, allowing questions and answers to guide their studies. However, based on their previous experiences, expectations, and motivations about college-level research, novice students instead see research as moving in a straight path from idea to final product as quickly as possible. They may skip early stages of the research process,[3] stop looking for information when they feel they have a correct amount rather than when they have sufficiently used the information to refine a question,[4] and collect just enough sources to earn a good grade.[5] This approach conflicts with the goals of Research as Inquiry, and means that library instruction needs to encourage students to critically examine their existing mental models of the research process before considering how new approaches may help them answer increasingly complex questions.

Learning Theory: Conceptual Change

"Conceptual change" is one theory librarians may use to understand how and why students change their mental models of the research process. Conceptual change theory proposes that learners create new knowledge when they actively engage with their prior experiences and alter their underlying conceptual frameworks, or "structured mental representations."[6] While change may be as simple as incorporating new knowledge into existing mental models, it is unlikely that students' "naïve conceptions" reflect an expert's understanding.[7] Instead, learning requires modifying existing concepts, or creating entirely new concepts, to account for new knowledge. Conceptual change theory is also helpful while working with the framework because threshold concepts are overarching conceptual understandings that change the way we understand a discipline.[8] Crossing a threshold may also be understood as undergoing conceptual change.[9] In the frame Research as Inquiry, students should grasp the concept that research is a non-linear process that requires using a variety of information sources to ask and answer complex questions.

In conceptual change, learners must first uncover and become dissatisfied with their initial mental concept.[10] Students explore their existing mental representations and discover why knowledge gaps are cause for concern.[11] For library instruction, this means students need to explore their existing model of the research process before they can consider a new approach. Likewise, library instruction that is overly focused on new skills, like the mechanics of searching unfamiliar databases, may mistakenly confirm students' mental model of research as a linear, information-gathering task. After examining their existing mental models, students should encounter replacement concepts that are understandable, plausible, and lead to new ways of thinking.[12] Instruction that coincides with early phases of the research process and demonstrates how an iterative approach helps alleviate concerns, like topic selection anxiety, can be an opportunity to promote change in how students conceptualize the research process.

Teaching to conceptual-level information literacy objectives is not new, and tools like concept maps and analogies can be used to help overcome students' inaccurate mental models.[13] Concept maps are helpful conceptual change instructional tools because they provide learners and instructors with a tangible opportunity to engage with otherwise invisible mental models.[14] Likewise, analogies help students create a bridge between their initial concept and a new mental model.[15]

This two-part learning environment uses conceptual change theory and tools to (1) assess students' existing conceptions of the research process, (2) present a new concept aligned with Research as Inquiry, and (3) use students' research experiences to present the new concept as a viable alternative. In the first pre-instruction activity and instruction session, students create concept maps to examine their existing mental models of the research process. The second pre-instruction activity and instruction session seek to demonstrate how an iterative research process assumes new questions will shape a topic over time. Framing research as an opportunity dive into answering an interesting and flexible question should continue to ease the change process.[16]

Lesson Plan

Learner Analysis

This two-part lesson is designed for a first-year social science seminar course with twenty to twenty-five students.

- First-year students struggle through college-level research, in part, due to strategies they bring to their coursework from high school.[17]
- Developmentally, first-year students' black-and-white view of knowledge results in seeing research as a one-way, linear path of information gathering.[18]
- These expectations and behaviors conflict with Research as Inquiry's iterative process and are challenges that librarians can address during information literacy instruction.

Orienting Context and Prerequisites

This lesson is a blended learning environment with activities before and during two face-to-face instruction sessions.

- Students complete two pre-instruction online learning modules outside of class time. See "Learning Activities" for module details.
- It is helpful if the course professor allows students to earn credit for completing pre-session modules.

Instructional Context

Learning Management System (LMS)

- This lesson works best if pre-session modules are embedded within the class LMS.
- With no access to the LMS, distribute pre-session content using other common web-based tools like Google Forms or SpringShare's LibGuides.
- Create and distribute pre-session activities at least one week before each face-to-face session.

Concept Mapping Tools

- Students complete individual concept maps as part of the first pre-session module.
- There are many free, web-based concept mapping programs; however, students should be able to label and indicate the directionality of links between concepts.[19]
- Students may find it easiest to work on paper while they learn how to construct a map.

Face-to-Face Sessions

- Facilitate the first face-to-face session in any classroom with a large whiteboard. Large sticky notes are helpful to facilitate collaborative concept mapping.
- Facilitate the second face-to-face session in a computer lab so that students may practice searching for materials.

Learning Outcomes and Learning Activities

Learning Outcomes

1. Students will map their approach to research in order to identify important steps or stages of an academic research process (Session One).
2. Students will illustrate the connections between components of an academic research process in order to model an iterative, rather than linear, process (Session One).
3. Students will describe how information sources encountered at the beginning of their research process help them refine their topics or questions (Session Two).

Learning outcomes one and two are essential to expose and explore students' existing mental models, while learning outcome three is an optional opportunity to reinforce useful elements of an iterative process during the early stages of research.

Learning Activities

1. Pre-Session One: Research Map Activity *(LO1, 30–45 minutes homework, essential)*
    - Before the first face-to-face session, students review an online module to learn how to create a concept map that depicts their view of the research process. Training is an essential first step to any concept map activity,[20] and limited contact time with learners makes concept maps difficult to complete during traditional library instruction.[21] To solve this problem, learners create their concept map as part of the first pre-session online learning module.
    - Within the module, students review resources that demonstrate the steps to create a concept map.[22] Resources should illustrate how to label links between concepts; these labels

distinguish concept maps from "mind maps"[23] and require students to articulate the relationships among various components of the research process.

- Next, students draw a concept map depicting their view of the research process, based on the following assignment prompt:

> Now that you know how to create a concept map, use those skills to draw a map of what you think the process looks like for writing a college-level research paper. Remember to follow the principles laid out in the concept mapping resources. You should brainstorm a list of stages, activities, and information resources, arrange these concepts onto your map, draw linkages between related concepts, and label the links. Draw your final map on a sheet of paper and bring it with you to your first library instruction session.

2. Session One: Research Map In-Class Instruction *(LO1-2, 25–30 minutes, essential)*
   - Conduct the first face-to-face session before students begin their research projects, and work with students to create a collaborative class concept map of the research process. This process should help students analyze their own approach to research and discover new connections among components of an iterative research process. Students begin revising their mental models when they compare individual concept maps to those of their peers or the instructor.[24]
   - First, students compare their individual "Writing a Research Paper" concept maps with a partner.
     - ▷ Ask students to identify overlapping or essential concepts (at least three to five concepts) and linkages.
     - ▷ Distribute slips of paper or large sticky notes; students should write one essential concept on each piece of paper.
   - On a large whiteboard, begin the collaborative class map by placing key beginning (i.e., reading the assignment) and ending (i.e., submitting the assignment) points of the research process at opposite ends of the board.

- ▷ Students place their essential concepts onto the class map. Using the sticky notes makes it easy for students to rearrange concepts as necessary.
- ▷ Finally, help students finish the map by leading a discussion to add key missing stages or resources, organize the map, and establish links among the concepts. Input from the librarian and the professor models an expert's approach to research.
- ▷ Take a picture of the map to post to the course LMS site.
- ▷ Collect individual maps for assessment.

- Ideally, the class concept map includes:
  - ▷ multiple in-going and out-going links between research and writing tasks, indicating an iterative process;
  - ▷ early phases of the research process depicted as an opportunity to ask and answer questions; and
  - ▷ linkages within the map that demonstrate a recursive relationship between information sources and the research topic or question.

3. Pre-Session Two: Background Searching *(10–15 minutes homework, essential)*
   - A successful conceptual change learning environment reinforces how a new mental model is useful,[25] and the second pre-activity uses the uncertainty of topic selection as motivation for students to review their approach. Focusing on how an iterative view of the research process creates space for initial sources to refine or change a topic should help students discover the relationship between the information they find and their ultimate research directions.
     - ▷ Students watch a video that demonstrates how initial searches help to narrow or redefine a research topic.[26]
     - ▷ Students review the collaborative class concept map from Session One and describe the relationship between the research process, information sources, and topic selection, based on the following assignment prompt:

> Based on the video and our class research process map, how do you think choosing a topic fits into your research process? How can background research help you select or improve your topic?

4. Session Two: Background Searching In-Class Instruction *(LO3, 50–75 minutes, essential)*
    - This session starts with an everyday information-seeking task that can be used as an analogy to academic research. The analogy should be used to connect students' everyday information strategies to beginning phases of an iterative research process. For example, if your campus has a culture of study abroad participation, you may consider the following:

> Pretend the University will pay for you to study anywhere in the world for one semester. What steps would you follow to plan your semester abroad? Consider factors like which country and city you would visit, where you would study, how you would decide to travel, and anything else you think is important.

    - Students first discuss this prompt with a partner (five to seven minutes), followed by a full-class discussion (ten minutes).
    - Write down and organize students' overarching themes or steps in the process on a whiteboard and point out connections to the collaborative research process map.
        - ▷ For example, students may describe selecting a specific geographic location for study before narrowing to a specific university based on academic programs. This process is analogous to selecting a general research topic based on personal experience while narrowing one's focus based on preliminary results.
    - Whichever analogy you choose should "bridge" students' naïve conceptions of the research process to a more complex approach.[27]
    - Use direct instruction to introduce background research as an opportunity to narrow or clarify research topics, understand new directions, identify scholarly vocabulary, or find links and citations to other sources.
    - Demonstrate search tips useful for using the library's academic databases to find background information (ten to fifteen minutes).

- Using the rest of the class time and finishing as homework, students search for two background sources and use a worksheet to describe what they learn from each source (see Appendix 3A: "Sample Worksheet Questions for Background Searching").
  - ▷ Tailor the worksheet to the library's resources, guiding students to the best databases to use for background information.
- In the worksheet, students pose new questions about their topic based on the two sources. Students should discover how they could refine their research topics or questions due to early exploration.
- Emphasizing that professors expect this process to occur should ease fears about topic selection and tap into students' drive to fulfill their professor's expectations.
- Collect student worksheets for assessment.

5. End of the Semester
   - Due to the short-term nature of course-embedded library instruction, conceptual change is difficult to detect immediately after class. More likely, this instruction coupled with experience working through the research process influences students' long-term conceptual change.
   - At the end of the semester, students once again complete a concept map of their research process using resources from the first pre-session module.
   - Students complete the map as homework and submit it to the librarian for assessment.

Assessment

Summative assessment for learning outcomes one and two uses individual concept maps completed before instruction sessions, the maps completed at the end of the semester, and the worksheet from session two. Concept maps are particularly useful for pre- and post-instruction assessment because they can detect changes in students' mental models.[28]

Assessing Learning Outcome One

Count the number of concepts in each student's map as well as the number of concepts added (from the first to the second map).[29] Successful students

should list more concepts in the second concept map, which demonstrates a more complex understanding of the research process.

Assessing Learning Outcome Two

Evaluate each student concept map for the number of links and map complexity (the ratio of links to concepts).[30] Successful students will draw a more complex, iterative approach to research, and their second map should include more links and higher complexity scores.

Assessing Learning Outcome Three

The final question from students' second instruction session worksheet is a summative assessment of how initial sources influence topic refinement or research direction. This question asks students to describe how their specific topic changes after initial searching. Successful students should articulate what they learned from background research and how they refined their topic.

To understand whether students shifted their mental models to account for a recursive relationship between research topics and information sources, examine the final concept maps to see if students include both outgoing and incoming links between topics and sources.

Appendix 3A

Sample Worksheet Questions for Background Searching

Think About Your Topic

1. What is one topic you're considering researching for your class project?
2. What would you like to learn about this topic before you finalize your decision?

Find Background Information—Using the skills we learned in class, find two sources you can use to learn more about your research topic. At least one source must come from the library's resources (either electronic or print). Answer the questions below to evaluate your source.

SOURCE 1

- What type of source is this (e.g., encyclopedia entry, book, blog, Wikipedia page, etc.)?
- What is the title of the source?
- Who is/are the author(s)?
- What does this source help you learn about your topic? Try to discuss 2–3 new ideas.
- What is at least one new question you have about your topic?

SOURCE 2

- What type of source is this (e.g., encyclopedia entry, book, blog, Wikipedia page, etc.)?
- What is the title of the source?
- Who is/are the author(s)?
- What does this source help you learn about your topic? Try to discuss 2–3 new ideas.
- What is at least one new question you have about your topic?

Bring it all Together: Your Research Direction—Use what you've learned from these two sources to focus your research direction.

3. Based on what you've read so far, how would you like to revise or change your research topic? Make sure to explain how the sources you found helped you think about your initial research idea.

Notes

1. Association of College and Research Libraries, *Framework for Information Literacy for Higher Education*," February 2, 2015, http://www.ala.org/acrl/sites/ala.org.acrl/files/content/issues/infolit/Framework_ILHE.pdf.
2. Ibid, 7.
3. M. J. Braun and Sarah Prineas, "First-year Composition as an Introduction to Academic Discourse," in *Strategies for Teaching First-Year Composition*, ed. Duane Roen, et al. (Urbana: National Council for Teachers of English, 2002), 574–75, http://files.eric.ed.gov/fulltext/ED459476.pdf; Wendy Holliday and Qin Li, "Understanding the Millennials: Updating Our Knowledge About Students," *Reference Services Review* 32, no. 4 (2004): 363–64, https://www.emeraldinsight.com/doi/full/10.1108/00907320410569707.
4. Sonia Bodi, "How Do We Bridge the Gap Between What We Teach and What They Do? Some Thoughts on the Place of Questions in the Process of Research," *The Journal of Academic Librarianship* 28, no. 3 (2002): 111, doi: 10.1016/S0099-1333(01)00302-0; Firouzeh Logan and Elizabeth Pickard, "First-Generation College Students: A Sketch of Their Research Process," in *College Libraries and Student Culture: What We Know*, ed. Lynda M. Duke and Andrew D. Asher (Chicago: American Library Association, 2012), 116–18, Ebrary Academic Complete; Whitney M. Olsen and Anne R. Diekema, "'I Just Wikipedia It': Information Behavior of First-Year Writing Students," *Proceedings of the Association for Information Science and Technology* 49, no. 1 (2012): 5, doi: 10.1002/meet.14504901176.
5. Melissa Gross and Don Latham, "Undergraduate Perceptions of Information Literacy: Defining, Attaining, and Self-Assessing Skills," *College & Research Libraries* 70, no. 4 (2009): 342, doi: 10.5860/crl.70.4.336; Barbara Valentine, "The Legitimate Effort in Research Papers: Student Commitment Versus Faculty Expectations," *The Journal of Academic Librarianship* 27, no. 2 (2001): 108, doi: 10.1016/S0099-1333(00)00182-8.
6. Susan Carey, "Knowledge Acquisition: Enrichment or Conceptual Change," in *Concepts: Core Readings*, ed. Eric Margolis and Stephan Laurence (Cambridge: MIT Press, 1999), 460.
7. Ibid, 461.
8. Jan Meyer and Ray Land, "Threshold Concepts and Troublesome Knowledge: Linkages to Ways to Thinking and Practising Within the Disciplines," *ETL Project Occasional Report 4, Enhancing Teaching-Learning Environments in Undergraduate Course Project*, http://www.etl.tla.ed.ac.uk/docs/ETLreport4.pdf.
9. Peter Davies and Jean Mangan, "Threshold Concepts and the Integration of Understanding in Economics," *Studies in Higher Education* 32, no. 6 (2007): 715, doi:10.1080/03075070701685148; Max Scheja and Anna Bonnevier, "Conceptualising Students' Experiences of Understanding in Medicine," *Psychology: The Journal of Hellenic Psychological Society* 17, no. 3 (2010): 243–58.
10. George Posner et al., "Accommodation of a Scientific Conception: Toward a Theory of Conceptual Change," *Science Education* 66, no. 2 (1982), 214.
11. Kaarina Merenluoto and Erno Lehtinen, "Number Concept and Conceptual Change: Towards a Systematic Model of the Processes of Change," *Learning and Instruction* 14 (2004), 523–26, doi: 10.1016/j.learninstruc.2004.06.016.
12. George Posner et al., "Accommodation of a Scientific Conception," 214.
13. Esther S. Grassian and Joan R. Kaplowitz, "Library Anxiety, Mental Models, and Conceptual Change," in *Information Literacy Instruction: Theory and Practice*, 2nd ed. (New York: Neal-Shuman Publisher, 2009): 73–83.
14. David Jonassen, Johannes Strobel, and Joshua Gottdenker, "Model Building for Conceptual Change," *Interactive Learning Environments* 13, no 1–2 (2005): 19, doi: 10.1080/10494820500173292.
15. Naomi R. Sutherland and C. M. Winters, "The A, B. Z's of Bibliographic Instruction: Using Real-Life Analogies to Foster Understanding," *Reference Librarian* 35, no. 73 (2001): 294, doi: 10.1300/J120v35n73_06.

16. Marcus Lee Johnson and Gale M. Sinatra, "Use of Task-Value Instructional Inductions," *Contemporary Educational Psychology* 38 (2013): 59. doi: 10.1016/j.cedpsych.2012.09.003.
17. Alison J. Head and Michael B. Eisenberg, "Truth Be Told: How College Students Evaluate and Use Information in the Digital Age," *Project Information Literacy Progress Report* (2010): 21, 33, http://www.projectinfolit.org/uploads/2/7/5/4/27541717/pil_fall2010_survey_fullreport1.pdf; Logan and Pickard, "First-generation College Students," 113; Hannah Gascho Rempel, Stefanie Buck, and Anne-Marie Deitering, "Examining Student Research Choices and Processes in a Disintermediated Search Environment," *portal: Libraries and the Academy* 13, no. 4 (2012), 378, doi: 10.1353/pla.2013.0036.
18. Ethelene Whitmire, "Epistemological Beliefs and the Information-Seeking Behavior of Undergraduates," *Library and Information Science Research* 25, no. 2, (2003): 127–42, doi: 10.1016/S0740-8188(03)00003-3.
19. For example, Cmap Cloud, https://cmapcloud.ihmc.us/.
20. Maria Pinto, Anne-Vinciane Doucet, and Andrés Fernández-Ramos, "Measuring Students' Information Skills Through Concept Mapping," *Journal of Information Science* 36, no 4 (2010): 467, doi:10.1177/0165551510369633.
21. Heidi Gauder and Fred Jenkins, "Engaging Undergraduates in Discipline-based Research," *Reference Services Review* 40, no. 2 (2012); 291, doi: 10.1108/00907321211228327; Carolyn J. Radcliff et al., "Concept Maps," in *A Practical Guide to Information Literacy Assessment for Academic Librarians* (Westport: Libraries Unlimited, 2007): 107.
22. For example, ITS Training Services, "Concept Maps," *iStudy for Success! Online Learning Tutorials for Essential College Skills*, last modified November 4, 2014, http://tutorials.istudy.psu.edu/conceptmaps/index.html; "Concept Mapping," YouTube video, 1:43, posted by "uPittBradford," July 25, 2012, https://youtu.be/8uoZpTYmrmo; or "Concept Maps—A Visual Study Tool," YouTube video, 3:25, posted by "nooluoit," August 30, 2011, https://youtu.be/vuBLI6ijHHg.
23. April Colosimo and Megan Fitzgibbons, "Teaching, Designing, and Organizing: Concept Mapping for Librarians," *Partnership: The Canadian Journal of Library & Information Practice & Research* 7, no. 1 (2012): 2, doi: 10.21083/partnership.v7i1.1800.
24. Jonassen, Strobel, and Gottdenker, "Model Building for Conceptual Change," 23.
25. Johnson and Sinatra, "Use of Task-Value Instructional Inductions," 59–60.
26. For example, Burke et al., "Picking Your Topic is Research," *North Carolina State University,* last modified August 2013, *Libraries*, http://lib.ncsu.edu/tutorials/picking_topic/.
27. Sutherland and Winters, "The A, B, Z's of Bibliographic Instruction," 294.
28. Colosimo and Fitzgibbons, "Teaching, Designing, and Organizing," 11; Radcliff et al., "Concept Mapping," 107.
29. Sally Sue Richmond, Joanna F. Defranco, and Kathryn Jablokow, "A Set of Guidelines for the Consistent Assessment of Concept Maps," *International Journal of Engineering Education* 30, no. 5 (2014): 1077–78.
30. Ibid, 1077–81.

Bibliography

Association of College and Research Libraries. *Framework for Information Literacy for Higher Education*. February 2, 2015. http://www.ala.org/acrl/standards/ilframework.

Bodi, Sonia. "How Do We Bridge the Gap Between What We Teach and What They Do? Some Thoughts on the Place of Questions in the Process of Research." *The Journal of Academic Librarianship* 28, no. 3 (2002): 109–14. doi: 10.1016/S0099-1333(01)00302-0.

Braun, M. J., and Sarah Prineas. "First-Year Composition as an Introduction to Academic Discourse." In *Strategies for Teaching First-Year Composition*, edited by Duane Roen, et al., 570–82. Urbana: National Council of Teachers of English. 2002. http://files.eric.ed.gov/fulltext/ED459476.pdf.

Burke, Anne, Kim Duckett, Daria Dorafshar, Mara Mathews, Jason Evans Groth, Andreas Orphanides, Sarah Craig, and Jennifer Garret. "Picking Your Topic is Research." North Carolina State University Libraries. Last modified August 2013. http://www.lib.ncsu.edu/tutorials/picking_topic/.

Carey, Susan. "Knowledge Acquisition: Enrichment or Conceptual Change." In *Concepts: Core Readings*, edited by Eric Margolis and Stephen Laurence, 459–87. Cambridge: MIT Press, 1999.

Colosimo, April, and Megan Fitzgibbons. "Teaching, Designing, and Organizing: Concept Mapping for Librarians." *Partnership: The Canadian Journal of Library & Information Practice & Research* 7, no. 1 (2012): 1–15. doi: 10.21083/partnership.v7i1.1800.

"Concept Mapping." YouTube video, 1:43. Posted by "uPittBradford," July 25, 2012. https://youtu.be/8uoZpTYmrmo.

"Concept Maps—A Visual Study Tool." YouTube video, 3:25. Posted by "nooluoit," August 30, 2011. https://youtu.be/vuBLI6ijHHg.

Davies, Peter, and Jean Mangan. "Threshold Concepts and the Integration of Understanding in Economics." *Studies in Higher Education* 32, no. 6 (2007): 711–26. doi: 10.1080/03075070701685148.

Gauder, Heidi, and Fred Jenkins. "Engaging Undergraduates in Discipline-based Research." *Reference Services Review* 40, no. 2 (2012): 277–94. doi: 10.1108/00907321211228327.

Grassian, Esther S., and Joan R. Kaplowitz. "Library Anxiety, Mental Models, and Conceptual Change." In *Information Literacy Instruction: Theory and Practice*, 2nd ed., 65–84. New York: Neal-Schuman Publishers, 2009.

Gross, Melissa and Don Latham. "Undergraduate Perceptions of Information Literacy: Defining, Attaining, and Self-Assessing Skills." *College & Research Libraries* 70, no. 4 (2009): 336–50. doi: 10.5860/crl.70.4.336.

Head, Alison J., and Michael B. Eisenberg. "Truth Be Told: How College Students Evaluate and Use Information in the Digital Age." Project Information Literacy, November 1, 2010. http://www.projectinfolit.org/uploads/2/7/5/4/27541717/pil_fall2010_survey_fullreport1.pdf.

Holliday, Wendy, and Qin Li. "Understanding the Millennials: Updating Our Knowledge About Students." *Reference Services Review* 32, no. 4 (2004): 356–66. doi: 10.1108/00907320410569707.

ITS Training Services. "Concept Maps." iStudy for Success! Online Learning Tutorials for Essential College Skills. Last modified November 4, 2014. http://tutorials.istudy.psu.edu/conceptmaps/index.html.

Johnson, Marcus Lee, and Gale M. Sinatra. "Use of Task-Value Instructional Inductions for Facilitating Engagement and Conceptual Change." *Contemporary Educational Psychology* 38 (2013): 51–63. doi: 10.1016/j.cedpsych.2012.09.003.

Jonassen, David, Johannes Strobel, and Joshua Gottdenker. "Model Building for Conceptual Change." *Interactive Learning Environments* 13, no. 1-2 (2005): 15–37. doi: 10.1080/10494820500173292.

Logan, Firouzeh, and Elizabeth Pickard. "First-generation College Students: A Sketch of Their Research Process." In *College Libraries and Student Culture: What We Know Now*, edited by Lynda M. Duke and Andrew D. Asher, 109–25. Chicago: American Library Association, 2012. Ebrary Academic Complete.

Merenluoto, Kaarina, and Erno Lehtinen. "Number Concept and Conceptual Change: Towards a Systemic Model of the Processes of Change." *Learning and Instruction* 14 (2004): 519–34. doi: 10.1016/j.learninstruc.2004.06.016.

Meyer, Jan, and Ray Land. "Threshold Concepts and Troublesome Knowledge: Linkages to Ways of Thinking and Practising Within the Disciplines," *ETL Project Occasional Report 4, Enhancing Teaching-Learning Environments in Undergraduate Courses Project*, May 2003. http://www.etl.tla.ed.ac.uk/docs/ETLreport4.pdf.

Olsen, M. Whitney, and Anne R. Diekema. "'I Just Wikipedia It': Information Behavior of First-Year Writing Students." *Proceedings of the Association for Information Science and Technology* 49, no. 1 (2012): 1–11. doi: 10.1002/meet.14504901176.

Pinto, Maria, Anne-Vinciane Doucet, and Andrés Fernández-Ramos. "Measuring Students' Information Skills Through Concept Mapping." *Journal of Information Science* 36, no. 4 (2010): 464–80. doi: 10.1177/0165551510369633.

Posner, George J., Kenneth A. Strike, Peter W. Hewson, and William A. Gertzog. "Accommodation of a Scientific Conception: Toward a Theory of Conceptual Change." *Science Education* 66, no. 2 (1982): 211–27.

Radcliff, Carolyn J., Mary Lee Jensen, Joseph A. Salem Jr., Kenneth J. Burhanna, and Julie A. Gedeon. "Concept Maps," in *A Practical Guide to Information Literacy Assessment for Academic Librarians*, 106–14. Westport: Libraries Unlimited, 2007.

Rempel, Hannah Gascho, Stefanie Buck, and Anne-Marie Deitering. "Examining Student Research Choices and Processes in a Disintermediated Searching Environment." *portal: Libraries and the Academy* 13, no. 4 (2013): 363–84. doi: 10.1353/pla.2013.0036.

Richmond, Sally Sue, Joanna F. Defranco, and Kathryn Jablokow. "A Set of Guidelines for the Consistent Assessment of Concept Maps." *International Journal of Engineering Education* 30, no. 5 (2014): 1072–82. http://www.ijee.ie/contents/c300514.html.

Scheja, Max, and Anna Bonnevier. "Conceptualising Students' Experiences of Understanding in Medicine." *Psychology: The Journal of the Hellenic Psychological Society* 17, no. 3 (2010): 243–58.

Sutherland, Naomi R., and C.M. Winters. "The A, B, Z's of Bibliographic Instruction: Using Real-Life Analogies to Foster Understanding." *Reference Librarian* 35, no. 73 (2001): 293–308. doi: 10.1300/J120v35n73_06.

Valentine, Barbara. "The Legitimate Effort in Research Papers: Student Commitment Versus Faculty Expectations." *The Journal of Academic Librarianship* 27, no. 2 (2001): 107–15. doi: 10.1016/S0099-1333(00)00182-8.

Whitmire, Ethelene. "Epistemological Beliefs and the Information-Seeking Behavior of Undergraduates." *Library and Information Science Research* 25, no. 2 (2003), 127–42. doi: 10.1016/S0740-8188(03)00003-3.