



# Beyond “Is It Peer-Reviewed?”:

## Exploring Information Creation in the Sciences

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**ACRL Information Literacy Frame:** Information Creation as a Process

**Discipline:** Science & Engineering

**Subject:** Agricultural Sciences; Interdisciplinary

**Learning Theory:** Constructivism

**Special Populations:** Undergraduate Students

Agriculture faculty teaching upper-division classes require their students to cite peer-reviewed, original research articles for some assignments. Knowing that most of their students have so far had limited exposure to the scientific research literature, some faculty devote class time to bringing in a librarian to provide some instruction and guidance. Originally, our lesson plans were built upon answering the questions, “What is a peer-reviewed article, and how do I find one?” The lesson focused solely on explaining the peer-review process, distinguishing between original research and review articles, and how to find them in a database. An in-class assessment asked students to identify whether an article was peer-reviewed or not and

to provide an explanation of why they thought so. Student's explanations would often simply indicate that the database said the article was peer-reviewed or that it was in a journal they found through the library website. In addition, at the end of each semester, the course instructor provided the librarian with a list indicating whether each student chose an appropriate article (peer-reviewed, original research) for their assignment or not. The lists showed that some students chose articles that were not peer-reviewed and some students were also choosing review articles instead of original research articles. The recurrence of this across sections, semesters, and years indicated the need for a new approach.

## ACRL Information Literacy Frame: Information Creation as a Process

Taking a fresh approach began by asking a new question on which to base the lesson. Instead of asking, "What is a peer-reviewed article?" we asked, "How does a peer-reviewed, original research article get published?" This required us to go beyond addressing just the peer-review process itself to the broader process of publishing research. We thought of the process of publishing research loosely in terms of a timeline. That meant we wanted to address what precedes publication, such as research, collection and analysis of raw data, and the existing body of research that the new research is built upon. We also needed to address the relationships among original research articles by other authors, review articles, books, and other scholarly outputs. For inspiration, we turned to the Information Creation as a Process frame of the ACRL *Framework for Information Literacy for Higher Education*.<sup>1</sup> Two of the knowledge practices associated with the frame seemed particularly apt to our goals:

- Assess the fit between an information product's creation process and a particular information need.
- Articulate the traditional and emerging processes of information creation and dissemination in a particular discipline.<sup>2</sup>

The lesson we developed was designed to address both students' inability to identify an appropriate source for a particular assignment and to deepen their understanding of the position of original research articles within the scientific literature.

## Learning Theory: Constructivism

Poor outcomes from previous instruction assessments pointed toward the need for a more engaging and active lesson. We decided to employ a constructivist pedagogical approach. Constructivism is a student-centered learning theory which posits that students can only learn when they are actively engaged in exploring authentic problems and building on their own prior understanding.<sup>3</sup> Such an approach dovetails well with the experiential nature of agricultural education at the university level<sup>4</sup> and increasingly in undergraduate STEM education as a whole.<sup>5</sup>

Hartle, Baviskar, and Smith assert that there are four key criteria which are the hallmarks of constructivist activities or lesson plans: “1) eliciting prior knowledge, 2) creating cognitive dissonance, 3) applying new knowledge with feedback, and 4) reflecting on learning (metacognition).”<sup>6</sup> Students’ prior knowledge needs to be called to mind and reviewed so as to prepare the students to revise and add to it. It then needs to be challenged so that students become aware that their existing knowledge may not be correct or adequate for the task at hand. This is the discomfort of cognitive dissonance—when a student’s existing mental model does not allow them to meet the new demands made on them—and is considered by theorists to be a motivating factor in the desire to learn. Students then need to apply their new knowledge to “authentic tasks anchored in meaningful contexts.”<sup>7</sup> Activities should be designed to mimic, as much as possible, the real task the students are being asked to master. Finally, timely, detailed feedback needs to be provided by the instructor to help guide students toward developing their new mental models.

### *Lesson Description*

For a pre-lesson warm-up, we show a short video about the peer-review process to provide students with an opportunity to recall what they know about peer-review. We have found during the brief discussion about the warm-up video that many undergraduate students tend toward a simple mental model of peer-review where “an expert said it was good to publish.” Some students exhibit resistance, saying that they already know what peer-review is. To challenge their existing mental models and resistance to changing them, we go beyond merely describing and explaining the peer-review process to actually showing them the process. We do this by

providing them with an original research article along with the reviewer's comments. We then go through the reviewer comments with the students, pointing out the different types of concerns raised (everything from word choice to questions about research methodology) and how they are addressed by the original researcher. This gives us the opportunity to discuss both the benefits and drawbacks of peer-review, and in that process, challenge students' prior understandings of it.

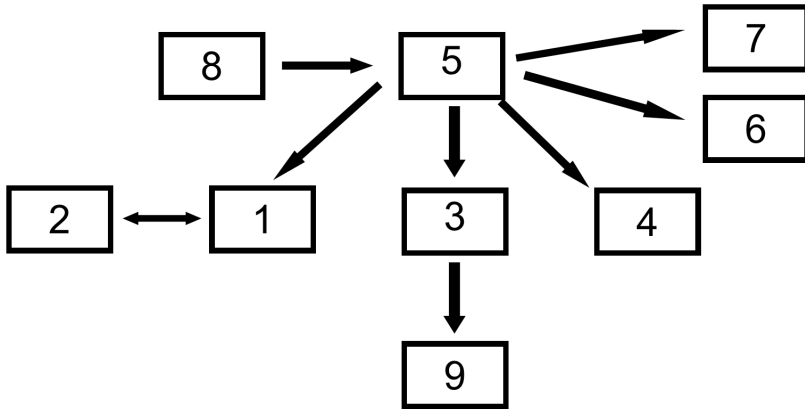


Figure 33.1: Example of one way a group of students represented connections between documents

Documents used in this activity were: (1) original research article that cites original research article #1, (2) book chapter that cites original research article #1, (3) review history of original research article #1, (4) author rebuttal and comments to reviewers of original research article #1, (5) original research article #2, (6) raw data from original research article #1, (7) review article citing original research article #1, (8) credentials/profile of one author of original research article #1, and (9) credentials/profile of the editor of original research article #1.

Students are then given a chance to apply their new understanding of peer-review to test their developing mental models of the process. We accomplish this by presenting small groups of students with a set of documents that are all related, in some way or another, to a single original research article. By working in groups, students have the opportunity to collectively assess and make decisions about sources, which can remove performance pressure. In addition to the research article, document sets may include a review article which cites the research article, peer-review comments, and book

chapters. To make the lesson even more challenging, non-academic sources like news releases and blog posts can be included. The document sets should include both peer-reviewed and non-peer-reviewed sources. Student groups analyze each document in the set and determine how it is related to the others, then make decisions about which sources they think are peer-reviewed. Each group visually represents the connections between documents by placing numbered sticky notes, each representing a document, on a whiteboard and using a dry-erase marker to draw lines and/or arrows between them to indicate relationships (see figure 33.1). We then ask each group to explain why they think the documents are connected in the way they have placed them on the board. As each group presents their reasoning to the class, we provide detailed feedback and corrections, when necessary, to aid students in building their mental models about scholarly discourse.<sup>8</sup>

The focus of this lesson is on students encountering, analyzing, and identifying a variety of documents representing various aspects of the creation and dissemination of scientific information. At least one of the documents is a peer-reviewed original research article. The majority of our science faculty consider original research articles to be peer-reviewed by default, and they use the terms interchangeably with their students. We address this during the part of the discussion about identifying original research articles. As for finding peer-reviewed, original research articles, the librarian can demonstrate how to find peer-reviewed articles in databases, if time permits.

In a best-case scenario, the course instructor will have required the students to complete the pre-session preparation (described below) and given them credit/points for participation. This lesson works best with smaller classes or groups. With larger class sizes or groups, discussions tend to get unwieldy and it becomes difficult for students to provide meaningful feedback. A lack of pre-class preparation by the students and limited class time to cover the activity yielded the worst-case scenario. When this occurs, the lesson can be adjusted by, for example, showing the warm-up video in class, reducing the document set, or reducing the time devoted to discussion.

## Lesson Plan

### *Learner Analysis*

- Upper-level undergraduate students in the agricultural sciences have typically had some introductory classes with assignments re-

quiring the use of scholarly sources, sometimes with the added requirement of peer-reviewed articles.

### *Orienting Context and Prerequisites*

- Prior to class, students should view a brief explanation of the peer-review process (we use a short video, of which there are many available online) posted to their class learning management system (LMS) or emailed by the instructor.

### *Instructional Context*

- The optimal setting for this lesson requires a computer with internet access and projector for the instructor, a classroom set-up that is conducive to group work, a white board for posting sticky notes (which represent the documents the students analyze), and markers for drawing connections between them. If providing electronic access to the documents as well via the course LMS or an online guide, the optimal setting will also require computers for the students. If the room does not have a whiteboard or blackboard, come prepared with large sheets of paper and tape to hang them on the wall. Students can attach the sticky notes to the paper and draw the connections with markers.

Librarian preparation includes:

- ▷ determining document types needed;
- ▷ collecting the documents; and
- ▷ preparing the documents for group work.
- The documents needed can vary depending on the discipline. In this case, we were focused on the process leading up to the publication of a peer-reviewed, original research article in the sciences, and the related information products produced after said article.

We used the following documents:

1. original, peer-reviewed research article
2. author credentials
3. raw data
4. review history<sup>9</sup> of an original research article
5. author rebuttal/comments to reviewers
6. editor credentials

7. article cited by the original research article
  8. review article citing the original research article
  9. book chapter citing the original research article
- Identifying and locating all of these documents can be a time-consuming process. Once all the documents are collected, they need to be organized into sets. Randomly assign a number to each document type and mark each copy with the assigned number. Each document set should include one copy of each document type. Rather than have the students attach the actual documents to the board, use sticky notes to represent each document. To help distinguish among groups, assign each document set a different color. Then number and place each sticky note, in a corresponding color, on each document with its corresponding number.

## *Learning Outcomes and Learning Activities*

### Learning Outcomes

Students will be able to

1. identify peer-reviewed, original research articles in the sciences; and
2. explain the relationship between two or more documents in the context of the scholarly publication process.

### Learning Activities

1. Warm-Up Activities (*LO1, 13–26 minutes, essential*)
  - Students view a short video about peer-review. This is preferably completed before class, but can be done in-class.
  - Students participate in group discussion about what they learned from the peer-review video.
  - Students work in groups to examine a peer-reviewed, original research article that has reviewer comments included.
  - Students participate in group discussion about the purpose, process, benefits, and disadvantages of peer-review.
2. Article Identification (*LO1–2, 30–90 minutes, essential*)
  - In groups of three to five, students examine a set of documents and identify each document type, including whether it is a peer-reviewed, original research article, a review article, or something else. How long the activity takes is dependent on the class size and number of documents used.

- Students listen to the prompt and instructions for the activity. For example:

“At this point, you’ve all likely seen a research article and perhaps read and used it for an assignment. But what you don’t often get to see are the many factors that go into the creation of that research article or the different ways it contributes to the scholarly conversation after it’s been published. In this activity, you will review a set of documents, each of which represents a different and essential aspect of the process of publishing a research article, before, during, and after publication.

“As a group, review each document. Briefly discuss what kind of information each document provides and identify what type of resource it is (such as a peer-reviewed, original research article, a review article, or a book chapter). Also, discuss how the documents relate to each other and their role in the research and scholarly publication process.

“Each document has a sticky note with a number corresponding to the number on the document. When your group is ready, place the sticky notes on the whiteboard in a way that represents how your group thinks the documents relate to each other. Use markers to draw lines connecting the sticky notes to show the connections between the documents.”

- Students analyze the documents to determine how they relate to each other.
- Each group uses sticky notes to build their maps on the whiteboard.
- Each group provides a rationale for why they mapped the documents and connections the way they did.

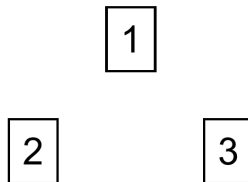


- The instructor guides a discussion, the content of which will be flexible and dependent on student responses but should include:
  - ▷ the peer-review process;
  - ▷ comparing and identifying peer-reviewed original research articles and review articles; and
  - ▷ other aspects of the scholarly communication process that are represented by/in the documents

### *Assessment*

The major focus of this lesson is to expand students' view of scholarly outputs and to get them thinking about the ways in which different documents relate to each other. To assess the effectiveness of the lesson, we chose a summative assessment. We asked each student to complete, on their own, a smaller version of the group activity. For this part of the activity, students are given a set of three numbered documents. The documents utilized may vary but should include an original research article and a review citing or cited by the original research article, both peer-reviewed. The third document should not be peer-reviewed. Options for a non-peer-reviewed source could include a news article, letter to the editor, blog post, commentary, etc. Students complete a diagram representing the three documents, indicating the relationships among them with arrows. Students indicate which document is a peer-reviewed, original research article and support their conclusions based on the class discussion. (See figure 33.2.)

1. Draw arrows to indicate the relationships between the three documents and, based on class discussion, provide a rationale for each relationship.



2. Which document is an original research, peer-reviewed article? \_\_\_\_\_

Figure 33.2: Example Assessment Sheet

We consider students to be successful in meeting the learning objectives if they correctly identify the relationships between the three documents and provide at least three reasons grounded in the class discussion for their decisions. Classroom discussions vary, of course, but obvious elements that students point out to justify their position may include citation chains, publication dates, authors, and indicators of original research.

## Notes

1. Association of College and Research Libraries, *Framework for Information Literacy for Higher Education* (Chicago: Association of College and Research Libraries, 2015), [http://www.ala.org/acrl/sites/ala.org/acrl/files/content/issues/infolit/Framework\\_ILHE.pdf](http://www.ala.org/acrl/sites/ala.org/acrl/files/content/issues/infolit/Framework_ILHE.pdf).
2. *Ibid.*, 5.
3. R. T. Hartle, Sandhya Baviskar, and Rosemary Smith. "A Field Guide to Constructivism in the College Science Classroom: Four Essential Criteria and a Guide to Their Usage," *Bioscene* 38 no. 2 (2012): 43–71.
4. Rebecca K. Splan, C. A. Shea Porr, and Thomas W. Broyles, "Undergraduate Research in Agriculture: Constructivism and the Scholarship of Discovery," *Journal of Agricultural Education* 52, no. 4 (2011): 31–35.
5. Cynthia Bauerle et al., *Vision and Change in Undergraduate Biology Education: A Call to Action*, ed. Carol A. Brewer and Diane Smith (Washington, DC: American Association for the Advancement of Science, 2011), <http://visionandchange.org/files/2011/03/Revised-Vision-and-Change-Final-Report.pdf>.
6. Hartle, Baviskar, and Smith, "Field Guide," 32.
7. Peggy A. Ertmer and Timothy J. Newby, "Behaviorism, Cognitivism, Constructionism: Comparing Critical Features from an Instructional Design Perspective," *Performance Improvement Quarterly* 26, no. 2 (2013): 43–71.
8. Hartle, Baviskar, and Smith, "Field Guide."
9. Some journals use open peer-review and provide the review history to the public. Some examples include PeerJ, Royal Society Open Science, and multiple journals by BioMed Central.

## Bibliography

- Association of College and Research Libraries. *Framework for Information Literacy for Higher Education*. Chicago: Association of College and Research Libraries, 2015. [http://www.ala.org/acrl/sites/ala.org/acrl/files/content/issues/infolit/Framework\\_ILHE.pdf](http://www.ala.org/acrl/sites/ala.org/acrl/files/content/issues/infolit/Framework_ILHE.pdf).
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