Is It Scholarly? A Lesson Plan for Collaborative Chemistry Information Literacy

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Is It Scholarly?

A Lesson Plan for Collaborative Chemistry Information Literacy

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This chapter describes a lesson plan that incorporates information literacy into an introductory chemistry course. The learning outcomes of the activity include becoming familiar with the peer-review process, knowing how to locate original research articles based on “clues” in a general news article, and differentiating between popular and scholarly periodicals. Students work in small groups in a collaborative classroom setting. The activities of the lesson plan are mapped to the Framework for Information Literacy for Higher Education. The lesson plan is supported by a literature review outlining the importance of collaborative, active learning in STEM courses, and highlights the correlation between information literacy instruction and student retention.
Introduction

Current trends in librarianship show a strong evidence-based preference for an active, collaborative learning process for acquiring information literacy skills. The Association of College & Research Libraries’s revised Guidelines for Instruction Programs in Academic Libraries recommend that “instruction should employ active learning strategies and techniques that require learners to develop critical thinking skills in concert with information literacy skills”.¹ These trends are not only mirrored, but perhaps more strongly reflected in the Science, Technology, Engineering, and Mathematics (STEM) education literature and best practices, including the American Chemical Society’s Guidelines for Chemistry in Two-Year College Programs. The American Chemical Society (ACS) pedagogy recommendations include “problem- or inquiry-based learning, peer-led instruction, group learning, learning communities or networks, writing throughout the curriculum, and technology-aided instruction.”²

There is also growing evidence for the need for information literacy instruction in higher education in general. O’Kelly³ demonstrates that at Grand Valley State University, for three consecutive years, 2012-2014, there was a highly statistically significant correlation (p < 0.0001) between students having had library instruction and student retention. Although these results are a correlation, and the specific cause or reason for the link between library instruction and student retention is yet unknown, there is increasingly reason to consider information literacy instruction to be among high-impact educational practices.⁴

Based on these trends and needs, as well as requests for information literacy instruction in an introductory chemistry course, I designed the following lesson plan for an introductory, non-majors chemistry course in a classroom designed specifically for collaboration with or without technology. The lesson plan focuses on finding known items and distinguishing popular from peer-reviewed/scholarly articles. This lesson plan was in part inspired by Kathleen Gregory’s article in Issues in Science & Technology Librarianship “There is No Escape: What Google Can Teach Instruction Librarians.”⁵ In this commentary piece, she describes motivating factors embedded in Google’s Advanced Power Searching online course and how they could be incorporated into STEM (Science, Technology, Engineering, Math) information literacy sessions. I had been intrigued by some of the methods she described, having taken the Power
Searching course myself, and wanted to see if there were any way I could use some of the techniques in developing a lesson plan. That lesson plan is described in this chapter. It’s a basic information literacy lesson plan, but it can serve as a springboard or scaffold to increasingly complex concepts in information literacy.

The lesson plan described here incorporates multiple active learning techniques, including problem-based learning, collaborative learning, and technology-aided instruction, to achieve the stated goals (see Table 1). Additionally, elements of the lesson plan are mapped to current trends and best practices based on a literature review, as well as mapped to threshold concepts according to the Association of College & Research Libraries’ Framework for Information Literacy for Higher Education.6

Table 1. Overview of lesson preparation

<table>
<thead>
<tr>
<th>Suggested Materials:</th>
<th>Learning Goals:</th>
</tr>
</thead>
<tbody>
<tr>
<td>• Computers or other internet-connecting devices</td>
<td>• Locate an original, scholarly research article from a “lead” in a popular periodical, newspaper or trade periodical article</td>
</tr>
<tr>
<td>• Copies of news article based on a peer-reviewed journal article, accessible through your institution.</td>
<td>• Become familiar with the peer-review system and how it differs from other publishing models</td>
</tr>
<tr>
<td>• Student handout.</td>
<td>• Know the characteristics and features that differentiate scholarly and popular periodicals</td>
</tr>
<tr>
<td>• Optional: whiteboards &amp; markers</td>
<td>• Develop strategies for finding scholarly articles through library resources</td>
</tr>
<tr>
<td>• Optional: Steelcase Media:Scape (or similar) collaborative workstation, and corresponding projection capabilities</td>
<td></td>
</tr>
</tbody>
</table>
Lesson Plan: Is It Scholarly?

This lesson plan was developed for an introductory (non-majors) chemistry course, but could be adapted for a general chemistry majors course; ideally, this instruction would be used with freshmen and sophomore-level students because it focuses on lower-level information literacy skills. The lesson can be completed in a 50-minute class, although if students are very engaged and ask many questions, it could expand to 90 minutes or 2 hours. It is intended to take place in a library instruction room that is designed for collaborative learning (see Figure 1).

Figure 1. Students engaged with the lesson plan in the collaborative classroom setting.
Anticipatory Set

The students are given a brief chemistry-related news article to read either prior to class, or at the beginning of the class session. The articles should be based on a study that appears in a peer-reviewed journal, specifically one to which the institution has access. To generate interest among the students, chosen articles could be humorous and/or timely, based on current headlines or topics currently covered in the chemistry course. Table 2 lists the articles used; articles may be selected to match a specific unit of chemistry, or for student engagement.

Table 2. Article titles used during lesson plan execution

<table>
<thead>
<tr>
<th>News Article Title</th>
<th>Corresponding Journal Article Title</th>
</tr>
</thead>
<tbody>
<tr>
<td>First scientific method to authenticate world’s costliest coffee, from the feces of the palm civet.</td>
<td>Selection of discriminant markers for authentication of Asian palm civet coffee (Kopi Luwak): a metabolomics approach.</td>
</tr>
<tr>
<td>Organic molecules found in Sutter’s Mill meteorite, not previously found in any meteorites.</td>
<td>Processing of meteoritic organic materials as a possible analog of early molecular evolution in planetary environments.</td>
</tr>
</tbody>
</table>

In addition to the ScienceDaily news website used to obtain the two articles described here, Science News11 and the “Seriously, Science?”12 blog on the Discover Magazine website are good sources for science-related news items. Students are only shown the news article. On my campus, I use a print copy of the article in class because online access and our link resolver will automatically link to the journal article if students click on the DOI or other hyperlink in the journal citation. Part of this lesson is to gauge the students’ ability to locate a known item, and allowing a simple click would defeat that purpose.
Input/Modeling

To engage students and prompt discussion of the article, students are asked to discuss among their table group whether the article is considered “scholarly,” or peer-reviewed. Then the class is polled using an interactive polling website, such as Socrative.13 The differences between popular and scholarly are not discussed prior to this in the library session (though they may have been in their chemistry class). This step addresses prior knowledge and prompts discussion among students.

The librarian can use the student responses to lead a discussion about publication lifecycle and the peer-review process. Many students in an introductory science class are unaware of the scholarly publishing lifecycle, although some will have familiarity with the process.

Once consensus is reached that the news article is not considered scholarly, the focus then shifts to identifying the peer-reviewed study on which the news item is based.

Students are asked to use any information in the news article to identify the more scholarly study. This is easily accomplished with ScienceDaily articles because the original study’s citation is included at the end of the news article. Most students are able to identify this, and the librarian can ask a student to point this citation out using the Media:Scape workstations (individual laptops are connected to a large monitor at each table; screens from each table monitor can be projected onto large classroom screens for all to see).

Students are then asked to locate a PDF of the journal article. Students are encouraged to share with their table group their strategy for locating the journal article. On our campus, several paths can be used to gain full text access to these articles:

- Summon 2.0 search box on library home page
- DOI
- Article title/author
- Journal title search
- Database search
- Google Scholar search
- Google search

The Google search works because in order for a student (or anybody) to use the internet on our campus, they must first login with their university credentials, whether they are using Wi-Fi or a cable connection. The library link
resolver works somewhat seamlessly to connect an authenticated user to our
full-text content.

The purpose of this activity is three-fold:

1. Gauge prior knowledge about accessing known journal items.
2. Emphasize that not all of these methods would work from an off-campus
   setting unless the user were logged into the university website first.
3. Provide a challenge to solve.

After several students report locating the PDF, they are asked to share their
method of access, and the librarian can explain the difference between on and
off-campus access, and which of the above approaches will work better than
others.

Students can at this point be instructed to use classroom whiteboards (if
available) to summarize the differences between the peer-reviewed journal
article and the popular news article. The librarian can lead a discussion of the
key elements of a peer-reviewed science journal article, as well as the peer-
review process itself. In particular, a discussion of publishing practices in the
sciences, including open access opportunities and constraints could be included
here.

The final part of the lesson plan is a modeling or guided practice
component. The librarian can demonstrate for the students, while they follow
along, how to use library resources, primarily Ulrichsweb, to verify whether a
journal is peer-reviewed. This may also be verified by going to the journal’s
home page and locating submission guidelines and editorial policies.

Guided Practice/Check for Understanding

Students can then be given a poll/quiz that lists several journal titles and
asks them to choose which one is not peer-reviewed, according to Ulrichsweb
(or whichever method of verifying peer review is used).

Additional questions may be posed with the Socrative polling website, or by
simply asking questions without the technology, for assessment purposes as
desired.
Threshold Concepts Addressed

This lesson plan can be mapped to the following threshold concepts presented as the frames of the ACRL’s Framework for Information Literacy for Higher Education. Not every component of the frames will be addressed by the activities in the lesson plan, but this lesson touches on parts of the following concepts:

1. Authority is Constructed and Contextual

As students embark on a study within a discipline, they must soon understand who the experts of that discipline are. Level of expertise varies by discipline and information need. This lesson plan demonstrates this concept during the discussion about the news article “scholarliness,” and the subsequent comparison with the peer-reviewed journal article.

2. Information Creation as a Process

The whiteboard activity and/or following discussion of the hallmarks of a peer-reviewed science article and a discussion about open access policies address the concept of information creation.

3. Information Has Value

A discussion of open access vs. traditional publishing addresses this concept.

Discussion

Active and Collaborative Learning in Librarianship:

This lesson plan supports current recommended pedagogy and best practices in both information literacy and STEM education. There is a nagging concern among librarians and academic faculty in general, that students entering higher education today are satisfied with superficial information literacy skills, courtesy of the ease of search engines such as Google and informational websites like Wikipedia. Indeed, Head and Eisenberg (2010), in their survey of college students’ information-seeking behavior, discovered that “despite their reputation of being avid computer users who are fluent with new technologies, few students in our sample had used a growing number of Web 2.0 applications
within the past six months for collaborating on course research assignments and/or managing research tasks.”

As discussed in the introduction, the ACRL’s Guidelines for Instruction Programs recommends an active learning approach to teaching information literacy. Likewise, although the new ACRL Framework for Information Literacy for Higher Education does not directly address pedagogy practices, the active language of the knowledge practices and dispositions associated with each frame/threshold concept strongly suggests active, collaborative learning. Megan Oakleaf has recommended employing active learning techniques to best assess student learning of information literacy using the new framework, pointing out: “What do all these examples have in common? They all employ active learning strategies.” The trend is becoming ubiquitous; in a recent study of information literacy pedagogy, Detlor, et. al., concluded “these findings suggest that ILI practitioners may wish to turn attention to the delivery of active ILI, and limit or even eliminate the delivery of passive ILI altogether.” This lesson plan supports this recent trend toward active learning of information literacy because there is very little lecture time included; students will be active participants throughout the session.

**Active and Collaborative Learning in STEM**

The need for active/collaborative learning in STEM courses has been well-documented in recent years. In what is now considered a landmark study, Freeman, et. al. conducted a meta-analysis that examined 225 studies of student performance in STEM courses while comparing active versus passive pedagogy, the largest study of STEM education to date. Their findings showed that students in classes where the primary mode of instruction was active gained 6% on exam scores overall, and students in which the primary method of instruction was traditional lecture were 1.5 times more likely to fail. Moreover, Gregory suggests inserting information literacy into the most active part of a STEM course, the laboratory. Gregory examined two case studies in which information literacy was embedded into introductory chemistry and biology lab sections, respectively. Although scores on an Information Literacy (IL) assessment improved in both sections, results were not resoundingly significant. But these case studies provide the groundwork for future studies. Dolan and Collins assert that active learning “is when the instructor stops talking and students make progress toward a learning objective by actively doing something, such as working on a problem in a small group or using “clickers” to answer a conceptual question.”
The lesson plan described here, albeit brief and narrow in goals, does exactly that; students work collaboratively to solve a problem (locating a journal article based on clues in a news article), and answer questions with a clicker-type system (Socrative doesn’t require the use of clickers, just an internet-accessing device).

More specific to the field of chemistry, studies have also shown increased student learning when collaborative and problem-based teaching methods are applied. Process-Oriented, Guided-Inquiry Learning (POGIL)\textsuperscript{21}, a student-centered learning technique, has been increasingly adopted by chemistry departments at universities throughout the United States. Hein conducted a study comparing traditional lecture with POGIL techniques in a second-year organic chemistry course. She found that “the implementation of the POGIL method in the organic chemistry classroom has been shown to positively impact student proficiency on nationally standardized ACS organic chemistry exams”.\textsuperscript{22} Therefore, implementing an active, collaborative information literacy session into an active, collaborative chemistry course will maintain the learning style to which students have been acclimated.

Future Applications/Scaffolding

Gregory’s case studies imply another aspect of STEM information literacy that is pervasive in the literature: embedding IL instruction into STEM courses.\textsuperscript{19} The lesson plan described here was designed as a stand-alone, “one shot” session, however, it is poised to be built upon with increasingly complex levels of information literacy concepts and threshold concepts. Embedding – incorporating information literacy instruction throughout a course or curriculum, emphasizing point-of-need knowledge – is not a feature of this lesson plan. But this lesson plan could be part of a more comprehensive instruction plan that continues in future sessions that focus on the threshold concepts “Research as Inquiry,” “Scholarship as Conversation,” and “Searching as Strategic Exploration.”\textsuperscript{26}

The current lesson plan incorporates aspects of three of the threshold concepts of the ACRL Framework for Information Literacy, and is aimed at an introductory level in both the science and the information literacy. Scaffolding can be described as a process that allows a student new to a subject solve problems that they couldn’t otherwise without assistance.\textsuperscript{23} Scaramozzino, in her article “Integrating STEM Information Competencies Into an Undergraduate Curriculum,” includes a table mapping the ACRL Science & Technology Section’s Information Literacy Standards into the information skills and learning
objectives that each class level needs to achieve.” The table can be used to outline a scaffolding path for STEM IL, allowing for modifications to adapt to local needs. This could be applied to the lesson plan presented here if there were faculty agreement to embed the science librarian throughout the course (or over several years of a curriculum). For example, the activity in the current lesson plan that asks students to locate a scholarly journal article and compare it to a news article describing the same study certainly fulfills the “lower division student learning” criteria of the information skill:

“Information Channels: Demonstrate the function and uses of:
• General Web sources
• Mass-media sources
• Professional journal articles
• Academic databases
• Books (1.1, 1.2)”

(Although books and general web resources are not part of this lesson plan.) Also included in current learning outcomes would be: “Describe peer-review process,” under the upper-level student learning. This lesson could be built upon in future sessions, depending on course assignments and learning objectives, to include:

- “Locate conferences papers/posters (1.3)
- Recognize use of and find (1.2, 1.3):
  • subject specific peer-reviewed materials
  • standards
  • technical reports
  • patents
  • data sets and handbooks”

These skills could be attained within the same course by adding a research paper requiring at least one of the sources in the list. A session introducing search strategies could also include an activity that focuses on developing search terms and narrowing a topic (“Searching as Strategic Exploration,” in the ACRL Framework).

This lesson plan could also act as a scaffold for more in-depth understanding of the scholarly communication/publishing lifecycle. Students could create annotated bibliographies to accompany a digital poster session (posters displayed electronically on monitors rather than printed on paper), for example, and the librarian could be embedded to consult on copyright and citation questions.
Conclusion

Studies are beginning to demonstrate the overall effectiveness of information literacy in a college curriculum, particularly with respect to student retention, and it appears likely that information literacy instruction will be included among the “high-impact practices” recommended for student retention and success. Presented here is a lesson plan for an introduction to scholarly communication in a single session of an introductory chemistry course. The lesson plan was designed with regards to current best practices of both information literacy and STEM education, both of which strongly encourage active, collaborative learning processes. Although this lesson plan only addresses a few of the threshold concepts found in the Framework for Information Literacy for Higher Education, it provides a basis for expansion to include all of the frames. Thus, this lesson plan can serve as a platform in an information literacy scaffold that can span a single course or an entire curriculum.

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First scientific method to authenticate world’s costliest coffee, from the feces of the palm civet -- ScienceDaily


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