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Deceived, Confused, or Peer Reviewed? Critical Information Literacy in a First-Year Neuroscience Course

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Information literacy skills are necessary to parse today's complex information landscape full of general audience, scholarly, and deceptive sources. For a student new to college and unfamiliar with publishing norms in the discipline, it can be difficult to identify and select from among the range of sources that electronic searches return — especially on Google or Google Scholar, which most students use regularly at the pre-college level. Centering information literacy as a course objective invites students into the scholarly conversation at a deeper level than typical one-off database searching sessions. Further, framing this objective through the lens of *critical information literacy* engages students in considering how structures of power and privilege direct the production, dissemination, and consumption of scientific research products, including deceptive sources. We, an information literacy librarian and a neuroscience faculty member at a small liberal arts college, have collaborated in developing critical information literacy curricula embedded within an introductory neuroscience course. Here we will briefly describe our motivation, process, and outcomes, and lessons learned from this effort.

   Key words: critical information literacy; first-year seminar; research instruction, curriculum development; faculty collaboration

WHAT IS CRITICAL INFORMATION LITERACY?

Critical Information Literacy theory and praxis provide students with a broader, richer context as they become active participants in the creation, consumption, and dissemination of scholarship and research. Critical Information Literacy (CIL) "...takes into consideration the social, political, economic, and corporate systems that have power and influence over information production, dissemination, access, and consumption" (Gregory and Higgins, 2013). CIL challenges us to recognize how we are complicit in systems of knowledge that are exclusionary or oppressive, and work towards counteracting exclusion/oppression.

   Subject-expert faculty and/or librarians can incorporate CIL into traditional learning outcomes for research-focused lessons and assignments by framing procedural research tasks within a broader theoretical framework. For instance, instead of showing students how to navigate the library website and search subscription databases, students are welcomed into the scholarly conversation as a journey of exploration and deeper understanding of the complex information landscape. A traditional learning outcome such as "Students will locate peer-reviewed journals in library subscription databases" becomes "Students will locate high-quality, peer-reviewed scholarly sources by navigating the complexities of research/academic publishing". Library research instruction often consists of demonstrating how to navigate the library website, how to complete procedural tasks (such as InterLibrary Loan requests or remote printing services), and evaluating websites using a "good/bad" criteria or lengthy attributes checklist. CIL-based instruction instead frames scholarly research as the ability to navigate a larger system of profit and exclusivity in which students are now active participants. As active members of this larger system, we can guide students to ask more critical questions to better articulate their information needs and better assess which sources/materials meet their needs. Shifting our perspective away from students as passive consumers of information to information creators and sharers empowers students to take an active role in their own learning and discovery.

   Sites such as ResearchGate and LibraryGenesis provide open-web access to restricted, pricey journals (often in violation of publisher licensing) and Google Scholar indexes a range of scholarly sources, both peer-reviewed and deceptive, without any transparency of indexing/journal quality. To our students (and to us), all journals look the same. CIL-based instruction frames research as a landscape that needs to be understood before it can be explored: who's in the scholarly conversation and who's out; who's profiting and who's providing transparency and access, and what role do we all play in this landscape? Most importantly, CIL centers students as active participants in this exploration and creates transferable awareness around issues of inequality, influence, and profit as well as how scientific research is reported/distorted for profit in popular/social media.

WHY TEACH CRITICAL INFORMATION LITERACY IN A NEUROSCIENCE COURSE?

Many professors are used to filtering spam solicitations from questionable journals enticing us to publish our work there. What are these journals and why do they exist? High subscription costs and paywalls common in academic publishing inspired a movement towards open-access publishing in which charges to the author, rather than subscriptions, support the journal's operation. The growing

popularity of open-access journals coupled with increased pressures to "publish or perish" has in turn enabled the growth of predatory journals (reviewed in Richtig et al., 2018). Such journals appear legitimate but charge authors sums of money to publish their work as open-access while lacking the robust peer review processes that help ensure quality of work (Bohannon, 2013; Grudniewicz et al., 2019). Such journals are also referred to as "deceptive", given the sometimes two-way benefit that authors and publishers may get from this arrangement (Eriksson and Helgesson, 2018; Frandsen, 2019). While many years of experience as a researcher can help one determine trustworthiness of a journal within their subfield, it can be very difficult for a beginning researcher or non-expert to tell a deceptive source from a legitimate one, especially because deceptive journals often "spoof" the names of trustworthy and well-known journals (Bohannon, 2013). Deliberate action and education must be taken to make the scientific community aware of the pitfalls of predatory publishing (Clark and Smith, 2015). Without knowing anything about this intersection of economics and science, students are not well positioned to question whether or not a journal is predatory/deceptive or trustworthy. In other words, their prior information literacy instruction does not prepare them to discern the credibility of a source that looks like a typical journal article.

I (Leininger) realized the importance of Critical Information Literacy when, several years ago, a student had suggested a paper for a journal club that was published in a deceptive journal. When I saw the article and failed to recognize the journal, I researched the journal and realized that it was deceptive. The student had found the article from a Google Scholar search, which returned results from ResearchGate, a social networking site for scientists to which anyone can upload PDFs. Without knowing the full context of Google Scholar indexing and the rise of predatory sources, the student accepted the result from the literature search like any other result. When I discussed my assessment of the source with the student, they were surprised and remarked that they did not know that predatory/deceptive sources even existed. In another course, the concept of predatory journals came up, which elicited strong reactions and interest from students. These classroom experiences caused me to appreciate how much the information landscape had changed since I learned how to search the literature as an undergraduate student, and that understanding the broader context of academic publishing helps students understand why and how their method of searching matters.

How Did We Approach Our Instruction?
Over the past few years, we (Gold and Leininger) have collaborated on developing a CIL curriculum for an introductory neuroscience course (taught by Leininger with Gold as an embedded librarian) as well as a neuroscience-themed first-year seminar that we co-taught. In both courses, information literacy was a key course objective, including locating high-quality primary and secondary sources in neuroscience and assessing the credibility of scientific sources. We designed our instruction in a way that

empowered students as active seekers of neuroscience information.

Our instruction took the following arc over several class sessions. We began by welcoming students to the scholarly conversation without any assumptions about past experiences. We led discussions about how to critically engage with general audience sources, including how the motivations of the publisher underlie common features like click-bait titles and self-linking. Through additional discussions, we discussed contrasts between general audience and scholarly sources, and described the cycle of scientific research, peer review, publishing, and interpretation of published results for general audiences. We then discussed the economics of scientific publishing, how open-access publishing models are an answer to publishing monopolies, and then how predatory or deceptive publishers have taken advantage of this model. Throughout, we included hands-on activities where students worked with articles of various types. For example, in one activity we gave students PDFs of several sources and prompted them to determine whether the article was published in a trustworthy or predatory journal and to explain their reasoning.

In these courses, our instruction in critical information literacy prepared students to be active searchers and consumers of information, with an awareness of different kinds of articles and motivation to find high-quality sources. Within this context, students were motivated to participate in lessons including how to perform database searches to locate high-quality sources, differentiating types of sources, and critical reading of sources. Students were overwhelmingly able to locate information that they needed for a capstone project, which related neuroscience topics to issues of personal or societal relevance.

What Did Students Learn From The Experience?
Based on early/late semester survey results and the evaluation of sources cited in the final projects, it was clear that the group of students had developed strong foundational college-level research skills as a result of our curriculum and lessons. We administered a survey in the first and last weeks of class to gauge students' perceptions of their research skills and asked them to rate their confidence in differentiating peer-reviewed and deceptive/predatory journals. The survey consisted of four multiple choice questions and one reflection question (Figure 1).

In the first survey, most students reported having had limited prior experience conducting research beyond using Google or Google Scholar and almost all ranked themselves as Unconfident/Very Unconfident in differentiating credible from deceptive journals as well as understanding the peer-review process. In the end-of-semester survey, students reported significantly higher confidence in each of the research skill areas but several students still had questions about how to access and navigate our college's shared library resources.

In addition to the surveys, we evaluated students' research skills from the sources they cited and referenced in their final projects. Students worked in small groups of

How confident are you in the following research skill (5-option Likert Scale):

- I can locate scholarly journal articles using a subscription database.
- I can differentiate peer-reviewed scholarly journal articles from deceptive/predatory journal articles.
- I understand why and how the peer-review journal publication process works.
- I can identify peer-reviewed scholarly journals from a Google Scholar results list.

First Week Reflective Prompt: If you completed a research essay or project before coming to New College (e.g., in high school or at a prior college), explain how you located sources, approximately how many you located, whether/how you could tell if they were trustworthy, and how you used them for your research essay or project.

Last Week Reflective Prompt: Now that you know how to evaluate open web sources for authority and purpose as well as search the library subscription databases, what additional questions or clarifications do you have about conducting college-level research?

Figure 1. Question items administered by anonymous electronic survey by which students rated and reflected upon their confidence in their own research skills.

three or four to create a "Users' Guide to the Brain" — a resource collectively created and peer-edited that would be appropriate for anyone who wants to know more about how their brains help them experience their life." We designed this assignment to position students as active agents in creating the structure and content of the Guide. They wove together written explanations, visual representations, and podcasts to explain the neuroscience behind memory, sleep, and stress, synthesizing information they had learned in prior weeks with independent database research that they did to extend their knowledge. The guide not only allowed students to demonstrate their understanding of the subject/course material, but also provided us with a way to measure students' research skills.

We included two Information Literacy learning outcomes in the syllabus:
- Assess the credibility of scientific information and sources
- Locate primary and secondary sources related to neuroscience

We used a rubric to evaluate the final projects and included two elements for research assessment (Table 1):
- How well students incorporated information from trustworthy, scholarly sources
- How well the students cited their sources

Our assessment of this curriculum is still in early stages; quantitative analysis of student survey results awaits an increased sample size. We are eager to assess future classes with the same survey to more confidently measure the efficacy of our curriculum, but this initial effort was so promising that I (Gold) have adapted it for other Natural Science first-year courses.

WHAT DID WE LEARN FROM THE EXPERIENCE?

We close with some reflections on what we have learned through our collaboration, and advice for those considering incorporating CIL on their courses.

First, *acknowledge that the information landscape that you grew up with is not the same as the information landscape your students encounter.* Students engage with and consume information in ways and environments that we may find unfamiliar (students rarely, if ever, read newspapers or watch television news, for example). Meeting students where they are not only welcomes them to the scholarly community, but it is also important to validate and build on their existing skills. Their experience in fast-moving, rapid clicking and scrolling digital environments provides a foundation to expand on, not one that must be discarded.

Second, *students already consume and create information and it is important for students to be able to build on these habits as they enter the formal scholarly conversation.* Introducing students to college-level library research through demonstrations of procedural literature searching skills (navigating the library website, searching the library subscription databases, formatting citations, dismissing websites as sources) is no longer sufficient for them to understand the complex landscape of scientific information. Students want to know why they need to shift their research habits from one-click Google results to multi-click databases. We as educators need to encourage students to be active agents in scholarship; one way to do this is to teach students to engage in conversation with the sources they are reading and by designing assignments focused on content creation. Providing a broader CIL context serves to invite students into a conversation where they are participants, not just passive receivers or observers. The sooner students see themselves as valued community members, the sooner they may take ownership of their own learning and begin to feel excited to engage with science disciplines and scholarship.

Finally, *information literacy instruction works best as a collaboration.* By collaboration, we mean that librarians and faculty both play an active role in the development of instruction and course assignments. Faculty-librarian partnerships vary in level of collaboration; Douglas and Rabinowitz (2016) reported significant variation in collaboration among first-year seminar faculty that interacted with embedded librarians. In that study, the highest level of collaboration—collaborative design of assignments and instruction—was achieved in 12% of instructor-librarian relationships. Students enrolled in sections with high levels of collaboration between instructor and librarian showed higher rates of library use behaviors and were more likely to schedule research consultations

Three areas of assessment: Neuroscience content (Information Literacy Learning Objective):			
Incorporation of original research	**Exceeds Expectations** Each author incorporates information from **3-6** trustworthy scholarly sources, some of which they located themselves, in addition to the course readings, in a way that enhances the content of the guide.	**Meets Expectations** Each author incorporates information from **1-2** trustworthy scholarly sources they located themselves in addition to the course readings, in a way that enhances the content of the guide.	**Does Not Yet Meet Expectations** The author does not incorporate information from trustworthy scholarly sources; sources may be present but are not the correct type.

Neuroscience communication and style (Information Literacy Learning Objective):			
Attribution of information	**Exceeds Expectations** The author attributes the source of all information in the guide (including any course materials or additional sources) through appropriate citation; multiple citations are used as necessary to substantiate subtleties.	**Meets Expectations** The author attributes the source of all information in the guide (including any course materials or additional sources) through appropriate citation.	**Does Not Yet Meet Expectations** Citations are missing or incorrect sources are cited for the information provided

Table 1. Excerpts of the assessment rubric related to information literacy for the course's final project.

than students enrolled in sections with lower levels of collaboration (Douglas and Rabinowitz, 2016). In this way, collaboration can help customize and deepen the quality of instruction and more effectively develop students' information literacy skills. Furthermore, modeling collaborative dialogue in class provides important intellectual and problem-solving strategies for your students as well as demonstrating how librarians can support students in the research process.

Based on our own experience, here are some recommendations to jump start the collaboration process. If you are a faculty member, get to know the librarians at your institution, and build relationships with your institution's science librarians or information literacy librarians. If you are a librarian, attend Science department events, meetings, and special programs, and host Science department events in the library. Relationship building can take many forms and instructional collaboration may organically develop from adjacent professional social activities. Approach instruction as a collaborative exercise, meaning that you work together to develop and deliver the information literacy lessons and assignment instructions that are targeted to your course's learning objectives.

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