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# Mining for the Best Information Value with Geoscience Students

Susan Beth Wainscott and Joshua Bonde

Before a student can understand the social power of information, they must know that information has monetary value and is not always freely findable or available. Students may first experience this after graduation, when they lose immediate online access to their academic library resources. When recent graduates discover that personal access to some information required to succeed in their first professional role has been lost, it can be a rude awakening. Graduates without personal or employer funds to access these resources may feel cut off from trusted resources. In a knowledge-driven society, those with access to more and/or better information can gain more power and social capital. If faculty and librarians inform students before graduation that information often has a cost, and thus social power, and that ethical routes to access do exist post-graduation, each student has an opportunity to develop a personalized plan to access and use information in a more ethical manner.

The Internet allows easy access to a seemingly limitless universe of materials of varying information quality. While affiliated with an academic institution, students are more likely than ever to have web-based access to a wide variety of academic resources, particularly at larger and advanced degree granting institutions.<sup>1</sup> Scholarly databases and discovery service providers have increasingly adapted their products to meet users where they are—pre-

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sumably on Internet search engines. Academic libraries strive to make access to their digital collections nearly effortless for students in the library, on campus computers, on mobile devices, and from remote locations.<sup>2</sup> Undergraduate students may become accustomed to easy, fairly seamless, anywhere, anytime access to academic information resources, and students may not realize that much of this scholarly information is provided to them via institutional purchase or subscription.

It is unlikely that students approaching graduation, and perhaps also their first professional job, consider that they are about to lose access to their academic library's resources. Discipline-specific databases and specialty publications are the most likely to be inaccessible without a subscription or per-use fee. These information-literate, well-informed library users are abruptly thrust into a state of library anxiety—specifically, resource anxiety<sup>3</sup>—just as they are launching their professional careers. Recent graduates in a variety of fields will desire access to information to fulfill their new professional workplace roles. The Project Information Literacy (PIL) Passage Studies found that of twenty-three interviewed employers of new college graduates, most rated as important the new hires' ability to search for information resources on the Internet.<sup>4</sup> Fewer of the interviewed employer representatives also rated as important the new hires' ability to search within academic search tools or corporate databases.<sup>5</sup> Recent college graduates interviewed during the PIL Passage Studies indicated that part of the difference in information seeking in the workplace compared to academic assignments in college was the lack of or decreased access to academic library resources and services.<sup>6</sup>

A more recent PIL Passage Studies report has also confirmed that loss of access to search tools and full-text for professional purposes can be frustrating for some recent graduates.<sup>7</sup> Half of the 1,651 respondents indicated that lack of access to college library databases made continued learning difficult.<sup>8</sup> This more recent report included interviews with alumni of our university (University of Nevada, Las Vegas) and nine other institutions. Indeed, anecdotal observations of the librarian had detected that recent STEM graduates at our institution had been contacting the library for continued remote access to search tools and full text materials that they had come to value. They often expressed shock upon finding that due to our current use policies and license agreements, they could now only get access to some of this university's digital library resources, and only through a physical visit to the campus and one of the guest use computer stations in any of the four library branch buildings. It seems likely that most of our undergraduate alumni may be surprised to learn that they have lost some of the easier routes of access to their former library's resources and that many other academic libraries do not offer access to unaffiliated persons.

How can librarians and instructors address this looming encounter with an apparently closed door? As mentioned earlier, the graduate's discovery of

their current lack of easy access may cause them discomfort and frustration.<sup>9</sup> They now face uncertainty related to obtaining the information they need, and their view of the world is challenged. These are diagnostic characteristics of a potential threshold concept as described by Land, Meyer, and Flanagan: “Learning thresholds are often the points at which students experience difficulty and are often troublesome as they require a letting go of customary ways of seeing things, or prior familiar views.”<sup>10</sup> Some students will have become aware that somebody pays for their access to some information, but others may be surprised and confused. They may feel powerless, and realize that information is a valuable tool that they require to achieve their desired outcomes.

Townsend, Hofer, Hanick, and Brunetti<sup>11</sup> describe how the realization that information often has a monetary value/cost can transform the learner’s understanding that barriers to information may exist and that the choice to use each information source includes an economic decision. This adds an additional consideration and potential stressor to the information-seeking process. In response to this discomfort and stressful threat to their success and/or view of the world, learners may choose between a “flight or fight response.”<sup>12</sup> In this information-seeking scenario, students may flee and return to easy-to-access sources, hoping for the best. Some may turn to materials that are of uncertain provenance or even those that are clearly pirated copies. Those who have grasped the value of these resources may be willing to fight and struggle and be willing to seek an ethical access route to the trusted resources they encountered in their academic studies.

The PIL Passage studies found 23 percent of the 1,651 recent graduates interviewed had used academic libraries for workplace information needs,<sup>13</sup> and 20 percent had sought out virtual or physical visits to academic libraries for personal information needs.<sup>14</sup> Had the other respondents simply gone without the information sources they suspected or knew existed, did they pay for access, or did they perhaps locate copies of the resources through questionable routes? Rather than allow our graduates to fall into an ocean of paywall links and be frustrated or tempted to seek out pirated versions of information sources, librarians and course instructors should provide ample warning and help each student create a personalized strategy as a life raft.

## The importance of information access to geoscientists

In science, technology, engineering, and mathematics (STEM) disciplines such as geoscience, specialized subscription-based resources may contain highly relevant information that would be expensive to recreate with labora-

tory or field research data collection. Compared to other STEM disciplines, very old publications may remain relevant for current geoscience research.<sup>15</sup> Upper-level geoscience information literacy instruction often includes use of the advanced search features of specialized indices and emphasizes the importance of services such as interlibrary loan to provide timely access for students. Academic faculty and library instructors may emphasize these specialized resources because students are engaged in academic assignments that mimic research processes, and the students may also be involved in research activities. It is natural for academic faculty and academic librarians to wish to prepare students for academia if they may pursue advanced degree programs. However, many undergraduate geoscience students may instead go directly into professional practice after receiving their undergraduate degree. Academic faculty and librarians have an equal obligation to prepare students for this career path as well.

Many undergraduate and/or graduate students do not realize that if they attain employment in geoscience outside of an academic institution, they will still be required to research and compose literature reviews and reports. It becomes a culture shock for many when they realize that information is not as easily accessible to them upon graduation. Most entry-level positions for geology majors post-graduation involve a great deal of primary literature research. An informal survey of geoscience professionals by the geoscience professor author of this chapter verified that in their careers graduates will still need access to government reports, technical (peer-reviewed) literature, and maps. Many of these jobs are in the environmental consulting field, so recent graduates are tasked with researching new project areas, finding old maps, and other resources to better assess a project, including potential hazards. Therefore, literature search skills are a must-have for a geoscientist. However, in most job postings and subsequent interviews, the topic of research skills is rarely mentioned. Most of the time it is implicit in a student's research experience on their resume/CV in the form of authored products (conference abstracts, peer-reviewed papers, etc.). The ability to navigate the published literature is essential to the long-term success of a geologist. Additionally, access to information sources is unlikely to be part of the employer or graduate school selection process for new graduates. However, it could become a question posed during an interview or one of the criteria used to select among several graduate schools or positions, where they are expected to perform literature reviews to generate reports or research outputs.

This situation becomes an early career hurdle for geoscience graduates. They are still expected to conduct research but are no longer under the direct umbrella of their university's library. It seems that graduates from every field of the geosciences have to deal with this, with one glaring exception, which is the petroleum industry. The petroleum industry provides its geo-

science workforce with access to technical literature, maps, and government reports as needed. All other fields are forced to make do. A recurring anecdote which arises in conversations between the geoscience professor and early career geologists is that they seek out local institutions of higher education to gain access to technical literature and map libraries. Those who are not near a college or university are forced to see what they can find online via popular search engines or via peer-to-peer exchange of full text files. In the professional world, completing a report with an incomplete literature review is not a satisfactory option, yet there is a concern that without easy access, some early career geologists may simply do without some sources. Without all pertinent literature, many of these projects could be at risk of bias toward only those sources which are more easily available to groups without subscription access. Authoring biased reports could damage a geologist's career prospects. As of 2015, the largest sector of employment for geology majors graduating with a bachelor of science (B.S.) is the environmental consulting industry.<sup>16</sup> The lack of access to information would seem to become less of a problem with advanced degrees, as the petroleum industry is the largest employer of those geologists graduating with a M.S. and academia being the largest employer of Ph.D.s.<sup>17</sup> The authors discussed these factors and modified an existing geoscience library session to focus on this looming loss of online access for students approaching graduation.

## Information literacy instruction for Advanced Field Geology

The Advanced Field Geology course provided an opportunity to speak with upperclass Geoscience undergraduate students and help them to consider options for ethical access to discipline-specific information sources post-graduation. Geology 372: Advanced Field Geology is the capstone course/experience in order to obtain a B.S. degree in Geology from the University of Nevada, Las Vegas Geoscience Department. This is a course that requires students to do intensive field exercises and then synthesize that experience in the form of a professional-style geologic map and report. This is a traditional capstone for most geology departments across the United States, with 2,973 students reported enrolled in such courses for the year 2013, a 5 percent increase over 2012.<sup>18</sup> The ultimate reasoning behind this intensive course is to provide students who are near graduation with a real-world style project so that they can more easily transition into industry. It became apparent to course instructors that some of these upperclass students were very much lacking in two areas: 1) research skills, i.e., many of them did not know where to go to find technical literature,

maps, or government reports, other than popular search engines; and 2) comprehension of the resources they would need upon completion of their degrees. As such, over the past three years, the Geoscience Department faculty have worked to incorporate a library experience into this capstone course.

In past semesters, the library session was a shortened version of a literature review workshop designed for new graduate students. That session was task-oriented and focused on best practices for use of discipline-specific databases provided by the University Libraries. Students were guided in exploration of advanced search tools and techniques and were shown how to quickly obtain full-text copies of articles. Subscriptions or per-copy fees for full-text were only mentioned when discussing interlibrary loan as something for students to avoid paying out of pocket. Seldom did students pose questions or discussion around access to materials or sharing of full-text file copies. Open-access publishing options and copyright status of federal or local government reports were not discussed.

In light of these aforementioned data and observations about the needs and struggles of recent graduates, in spring of 2016, the one-hour-long library session for Advanced Field Geology was revised to deliberately incorporate the information literacy threshold concept, Information has Value. We decided to make the students aware of the looming loss of access and start a conversation with an essential question about the value of information and a big idea related to continuing access to information once they graduate.<sup>19</sup> The session began with the librarian informing the class that after graduation, some library search tools and full-text article copies would become more difficult to access. Indeed, the tools and resources that they found most useful were the most likely to be subscription-based and would be least likely to be accessible from off campus once they graduated. The question framing the session was: What information sources will you need after you graduate, and how will you access them? As part of this session, we also sought to develop skills of immediate use to the students in their course assignment, such as evaluating and selecting appropriate databases, navigating tools to obtain full-text access, and using advanced search techniques.

To explore the utility and desirability of continued access to several search tools, the librarian then led the group in collaborative creation of a rubric to evaluate search tools, including free scholarly Internet search tools and academic indices that were free or subscription-based. The students collaboratively created a rubric that included five criteria: relevance of content searched/indexed, ease of initial search interface (keyword search), options to refine search results, accessibility of the search tool without a university account, and ease of access to full-text copies of content. The rubric included a three-point Likert scale with equal weight for each criterion.

Each team of three to five students each selected a unique search tool to evaluate. The five evaluated search tools were

- a free Internet search engine that returns scholarly material across many academic disciplines with links to open-access or freely available copies of full-text materials;
- a subscription-based, generalized index of scholarly materials across many academic disciplines with links to subscribed and open-access, full-text materials;
- a subscription-based, discipline-specialized index of historical and current geoscience scholarly materials without links to any full-text materials;
- a free discipline-specialized index to more current geoscience scholarly materials with links to subscribed and open-access, full-text materials; and
- a library discovery tool which aggregates results from several subscription-based indices, including scholarly and some popular materials, across many academic disciplines and with links to subscribed and open-access, full-text materials.

Each team then selected a unique topic to use as a sample search to evaluate their selected search tool.

Next, teams shared their evaluation results via a digital whiteboard, and the librarian led a brief class discussion about each search tool. The course instructor and librarian also shared recommendations for good searching and refinement of results within each search tool. Students then discussed ethical access to full-text articles, including a comparison of peer-to-peer sharing of subscription-based materials to music piracy. Access options were discussed, including an employer having a subscription for the organization, use of local public and academic libraries, interlibrary loan through a public library membership, and paying per article as needed. The closing statements from the librarian addressed the university's current practices for alumni access to university library resources, common interlibrary loan policies at public libraries, and how students might consider each of these to ethically address their future information needs.

Assessment of this library session was formative and based upon the authors' observations of each student's involvement in discussions to develop the rubric, how each team tested and evaluated their tool, and how engaged students were in the class discussion. The majority appeared to grasp that information has monetary value, and that each was at risk of losing easy access to useful tools and materials upon graduation. The session had no associated course assignment, yet the just-in-case topic framed with the student-focused, big idea had captured and held the students' attention. As we debriefed after the session, we decided upon several immediate changes for the next session.

## Planned changes

We would keep some portions of the session, but there are a number of improvements that could be made in future semesters. The immediate changes include adding a discussion on useful resource types or formats for geoscientists, changing how copyright restrictions and licenses are discussed, removing a source of variation in search tool evaluations, and adding more discussion of how students can research their personal options for information access. Periodically, the lesson will need to be reviewed to ensure that descriptions of copyright guidelines, licensing practices, and alumni access policies are current. Larger changes might be prompted as the open-access publishing adoption rate within the geoscience discipline changes, or if we decide to add learning activities to explore the social or political ramifications of unequal access to subscription-based information. Each of these changes is discussed in more depth below.

Before the discussion about information access, we will add a short, facilitated class discussion about the wide variety of resource types (print and digital) that students are likely to need for this class project and in their careers. It is likely that in a group of twenty-five to thirty-five advanced undergraduate students, at least a few will have experience using maps, geographic datasets, materials property data, reference books, journal articles, conference proceedings, or technical reports. As our library doesn't have an extensive print or digital map collection, the librarian could briefly describe how to locate sources of print or digital maps and get access to them. This discussion could include an example of map use from the geoscience professor to serve as a demonstration that useful resources are worth the effort to obtain them.

We will keep the student-led rubric development and discussion about evaluating search tools. The student discussion that led to the rubric development was logical and robust. The class rubric closely mirrored the backup rubric the librarian prepared in advance. We will provide all teams with an identical keyword string to enter in their search tools to remove one source of variability in the rubric scores. The topic for this keyword string will be drawn from recent course discussions. If the search tools are selected in advance, the librarian will provide some baseline information to the class about each tool, describing what it indexes, what full-text materials it contains, and whether any of the product is currently available without subscription.

To ensure students have the background knowledge necessary to create their personal information access strategy, we will change how we approach the discussion of copyright restrictions and electronic resource licensing agreements. Instead of trying to help students interpret what the appropriate uses of the information resources might be, we will explain what types of information they need to request or locate in order to make informed decisions.

We will describe the difference between copyright restrictions and license agreements, and discuss the importance of license agreements for digital materials. We will remind students that these license agreements can be more restrictive than copyright, and each one that they accept when downloading a full-text resource may be different. The librarian will provide sample library statements about patron use of electronic resources that have licensing restrictions and a sample interlibrary loan disclaimer. This may be used during the library session or as a resource for a post-session assignment.

Finally, each year we will need to review the session lesson plan as copyright law and guidelines, electronic resource licensing practices, and library policies for alumni access at our institution change. The rate of adoption of open-access publishing and archiving models across the geosciences will also impact the discussion. If more geoscience information resources are published using open access, the importance of their findability will overtake the importance of full-text access. Free information resources are only useful if they can be discovered. Emphasis on search tool access and evaluation of search tool features will be increased in the session design as the rate of open-access publishing increases in the discipline.

## Other possible changes

This session could also be expanded to discuss tools and strategies students can use to investigate their options for access based upon their planned geographic location and employer-provided resources. The class could discuss how each library resource will have a unique license negotiated between the provider and the entity paying the subscription fees. Students would be informed that these may not be the same for one resource at different types of libraries within each state or similar libraries in different states. Each library or information center that the students consider and ultimately use will likely have a statement about acceptable uses, cautioning users to be mindful of the copyright and licensing protections provided to the authors and provider of the resources.

Students should also be encouraged to read the licenses that they click through when accessing materials online, or that are appended to the materials they receive through interlibrary loan. An additional or alternative in the class learning activity could be for each student to locate the license for a particular resource and reflect upon what types of use/distribution they feel would be appropriate for that item. In a wrap-up discussion of that activity, students would be reminded that because these terms and guidelines may change over time, they should read the terms each time they have questions about acceptable uses or sharing of received items.

We could also expand the scope of the library activity to look beyond each individual's information access needs. As students realize and contemplate the impending loss of familiar route of access to library resources, at this point of stress and uncertainty they may experience the liminal state that is diagnostic of the troublesome nature of threshold concepts.<sup>20</sup> If they are crossing through this space of change and transformation, they may begin to question the systems and practices that result in cost and limited access to information and the impact this may have on themselves and on others.<sup>21</sup> We and others could also use this lesson and the students' discovery of a looming and potentially acute personal pain point as an opportunity to start a deeper reflection with our undergraduates about the power of information and how those without access to information are disadvantaged. The information access levels of employers in various geoscience subdisciplines may also change based upon economic forces and the affordability of corporate subscriptions. Thus, the power and resiliency of various employers may shift as their employees lose easy access to information, unless the employees have alternative strategies for access.

Potential library session assignments could include reflective writing, development of a personal access strategy, and evaluation of the power differentials among different organizations or groups.

**Reflective writing assignment.** A reflective writing assignment about the monetary value of information could be completed at the end of the library session. A variety of scenarios could be used to frame a reflection about how the value of information resources is reflected in their monetary cost, and how each student might rank the relative cost to benefit ratio of information sources for different purposes. Instructors and librarians could assess these reflections for evidence of learning of this threshold concept by looking for clues to the knowledge dispositions described in the Association of College and Research Libraries' Framework for Information Literacy for Higher Education (Framework): student agreement that information does have a monetary cost, statements indicating that students are evaluating the fairness of that cost, evidence that students are aware of the potential inaccessibility of some information resources, or student statements indicating the lack of access to individuals with less capital to spend on these resources.<sup>22</sup>

**Personal information access plan assignment.** If a points-bearing, summative assignment is desired, assessment could include creation of a personal information access strategy. These strategies could include a description of the local public and academic libraries near where the student hopes to reside in post-graduation, and an employer or graduate program they hope to be affiliated with. Students could research and describe what the local public library system(s) offer, what their posted use policies are, and describe the interlibrary loan program. The students could also describe what resources

they expect to have through the employer or graduate program they hope to join. The resources of the nearest academic libraries and their community member use policies should also be described. This assignment addresses, in particular, the Framework knowledge practice related to recognizing issues related to lack of access to resources.<sup>23</sup> Assessment of these plans should focus on consideration of cost, risk of unethical access routes, and alternative access routes, but should not include making an overall judgement on the validity or legality of the student's plan to avoid implied approval by the institution on any questionable access options.

Beyond inclusion in this capstone course, the library session and the personal plan assignment could also be adapted for a wider audience and provided to seniors in a variety of disciplines as a lifelong learning workshop. Collaboration with other subject specialist librarians would be necessary to fully develop such a workshop to address specialty information formats, search tools, and the prevalence of open access publication or archiving. An assignment to create a personal information access plan would translate nicely to this audience, as would the reflective writing assignment about the impact of unequal information access. If this activity is completed within a course management system, students could download a copy of their response and potentially update it after graduation.

**Diagnosing power differential assignments.** To encourage students to further explore the notion that information has power, and develop the knowledge practices related to how groups of individuals may be underrepresented or systematically marginalized by differential information access,<sup>24</sup> students could be presented a scenario where a policy decision by a government agency is being evaluated for environmental and social impacts. The scenario could describe a differential in access to information among the policy stakeholders, including the types of impacted local community groups, as well as the agencies, resource extraction and mining corporations, and consulting firms that frequently employ geoscientists. A reflective writing piece could be used to explore the impact of the information access differential among the stakeholders, including the following questions: Who has access to information in a timely manner to address the science surrounding this policy issue? An open-ended question prompt could be, Is that fair? Why or why not? Who has the most power? Can this power differential be balanced in some ethical manner and by whom?

## Reference consultations

In addition to the formal instruction described above, the personal information access plan could also be adapted to script format for reference con-

sultations. These consultations could be with current students approaching graduation, alumni, or community members who are seeking access to academic information without a university affiliation. In academic settings, reference interactions often include informal instruction in order to improve the critical thinking and information literacy of our students and other patrons. While it may be difficult to overcome the affective struggles of a patron suddenly learning that the route to the information they seek may not be as immediate as they would prefer, a longer reference interaction or a follow-up appointment for a longer reference interaction can allow the space and time for the patron to develop a suitable information access plan.

## Conclusion

Aware that students will encounter a point of frustration after graduating and losing familiar access routes to information, librarians and instructors should take advantage of this point of uncertainty to explore the threshold concept Information has Value. Rather than focus on their next assignment, library sessions for capstone courses such as this Advanced Field Geology course should also prepare students for their transition out of academia and into professional practice. While reinforcing more basic information literacy skills and knowledge, students can be provided a chance to become more expert information seekers and producers by exploring the notion that information value imbues it with power. Graduates who grasp the monetary value and social power of information access will be better able to navigate the information landscape. They will be equipped to be more savvy consumers and subscribers, will investigate their local academic and public libraries for access to professional and academic resources, and will seek out any employer information sources and services available to them.

If our students can access the information they need to hit the ground running at their new jobs, we believe it will increase their chances of success in their early careers. For those who continue with advanced degree programs, this session will provide a greater understanding of why university libraries cannot offer all the information resources directly, and how prospective graduate students can evaluate what library resources will be available to them at different institutions. For those graduates who have the opportunity to become authors, they will also be more aware of the potential cost to their desired readers when evaluating various publication options. Whether or not our new graduates become authors and publishers, it is our hope that we have opened their eyes to the systems that produce and make available the information that so fundamentally impacts their world.

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