



Addressing the Dunning-Kruger Effect through Research Logs

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abstract: This article describes how and why the Dunning-Kruger effect, in which novice students fail to recognize their own lack of research skills, often occurs with the one-shot library instruction mode. In contrast, we offer a holistic model of instruction that emphasizes closer information literacy connections to higher education curricula. Through collaboration, embedded librarianship, and using class time to address ACRL Framework concepts, such instruction promotes deeper, student-centered, authentic inquiry. A case study using research logs and a learning community approach indicated that students acquired a deeper understanding of the research process. The collaborative use of research logs highlights one approach to avoiding the Dunning-Kruger effect, even with limited class time.

Introduction

The Dunning-Kruger effect, first described by psychologists David Dunning and Justin Kruger, is illustrated in studies that show how novice learners can perform poorly while they mistakenly believe they are doing well.¹ This paper discusses how the Dunning-Kruger effect can occur with the library one-shot instruction model and how it is especially likely when content is handled in a cursory manner or when faculty lack awareness about the information literacy learning process. The Dunning-Kruger effect also occurs when there is a lack of a holistic approach to information literacy, as reflected in frame concepts in the Association of College and Research Libraries (ACRL) Framework for Information Literacy for Higher Education. The paper further explores the conditions under which one-shot classes can

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transcend the basics and when new models of information literacy instruction may be necessary to promote deeper learning experiences and authentic, student-centered inquiry. In this paper, we illustrate the ways the Dunning-Kruger effect occurs and how new models of teaching information literacy can combat that effect. Finally, we provide a case study in which we describe how the authors, a research librarian and a mathematics education professor, collaborated on a project to support undergraduate education majors. These future teachers learned to find resources to address challenges in elementary mathematics classrooms. Our innovative model of librarian-faculty collaboration centers around research logs and a collaborative approach that provides students an opportunity for reflective, deeper learning. It thus avoids the Dunning-Kruger effect, even with limited class time.

Origins of the One-Shot

Defining the one-shot mode of library instruction, Heidi Buchanan and Beth McDonough explained, "Instead of serving as the instructor of record for an entire course, librarians typically work with different classes for a single session, generally only fifty to seventy-five minutes in length. These single sessions are commonly referred to among teaching librarians as *one-shots*."² The one-shot, in-person model of library instruction has been used since as early as the 1830s, though few libraries offered library instruction of any kind in the nineteenth century.³

In the 1920s and 1930s, more structured programs on "bibliographic instruction" came to the fore in academic libraries, mainly because their collections had grown in size and became harder for users to navigate.⁴ Aside from occasional credit-bearing bibliography courses, academic librarians offered one-shot "bibliographic instruction" classes in their libraries to show students how to navigate the collections of books, print journals, and reference resources.⁵

Starting in the early 1970s and through the 1980s, the concept of bibliographic instruction transformed to include information literacy, which embraced a much broader range of goals and learning outcomes.⁶ Such instruction still, however, centered on the library collection of print literature. The goals included mastering finding aids such as library catalogs and print indexes, evaluating sources, and citing sources appropriately. It also offered instruction that was more integrated into the curriculum, focused more on class assignments, and developed stronger collaborative relationships between librarians and academic faculty.⁷ In the mid-1990s, added goals for instruction grew with the emergence of electronic resources such as indexes on CD-ROMs and early Internet resources. As the Internet evolved, libraries became less linked to print materials.

In 2000, ACRL created the Information Literacy Competency Standards for Higher Education, which outlined learning goals and outcomes.⁸ With the emergence of the ACRL Framework for Information Literacy for Higher Education in 2016, information literacy teaching and learning goals expanded to include discussions about the research process itself and how the information ecosystem fits into that process.⁹ Despite the huge expansion of information literacy content over the decades, the one-shot has been, until recently, the default model for library instruction. Librarians struggled to squeeze in more and more content with the same amount of time that was given to them in the

1920s and 1930s. The one-shot, while being questioned as the best instructional practice today, is still characterized as “ubiquitous.”¹⁰

Student Attitudes and the Dunning-Kruger Effect

Some research related to undergraduate information literacy skills supports the idea that students believe that there is little to learn about doing research, and thus overestimate their abilities.¹¹ In one study by Christopher Freeman, 40 students who attended a one-hour library orientation revealed on a follow-up survey that they were not interested in attending any future library instruction classes. From that same group, 82 percent of respondents indicated they thought of themselves as effective library users after the one-shot. Only 57 percent of the group felt that a class on conducting research with sources from the library would benefit them.¹² Given that the questionnaire focused mostly on how to use the library catalog or a database to find books and articles, it is not surprising that 82 percent of the students may have exhibited the Dunning-Kruger effect regarding conducting research generally. Melissa Gross and Don Latham also concluded in their findings that “traditional information literacy instruction may not be effective with non-proficient students, who are unlikely to see themselves as needing or benefiting from such instruction.”¹³

To say that these students may have exhibited the Dunning-Kruger effect is not meant to “blame” them or promote a deficit view. We acknowledge the presence of the Dunning-Kruger effect with an understanding that students rely on librarians and faculty to provide the opportunities they need to develop their information literacy skills. We highlight Dunning-Kruger to bring awareness that current practices may fail to support students adequately and leave them overconfident in skills they have not yet developed. Our use of Dunning-Kruger theories is not meant to diminish student capabilities, but rather to shed light on the importance of adequately equipping students to conduct research.

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Faculty Attitudes and the Dunning-Kruger Effect

Librarians may suspect that faculty attitudes toward information literacy instruction can contribute to the Dunning-Kruger effect in students. William Badke points out how one-shots might give false impressions: “Faculty are perceived as giving lip service to the need for a student body properly schooled in research skills, offering only limited opportunity for students in their courses to develop those skills, and standing by the long-held false assumption that students develop their abilities simply by being sent to the library to use its resources.”¹⁴ If the research process is given such a cursory treatment, no wonder students get a false impression of its importance. In his 2012 book *Teaching Research Processes*, Badke goes further to speculate that faculty may also suffer something similar to the Dunning-Kruger effect with regard to teaching students about the research process because they think that (1) it can be taught in a one-shot orientation

session, (2) it cannot be taught very well to students other than through their own trial and error (possibly the way the instructor learned it), or (3) they may have forgotten how complex the process is, given how much time has elapsed since they were novice researchers.¹⁵ Because of these attitudes and practices, students sometimes conclude that the research process is merely an exercise in quickly amassing just enough material to complete an assignment. The oversimplification of information literacy instruction by instructors is one reason one-shots often involve instruction done piecemeal. Some of it is covered by the instructor, and other, smaller parts—mostly related to the library tools, services, and resources—is presented by librarians. Without strong collaboration with the instructor, much of information literacy instruction, particularly the major concepts, can get lost in translation.¹⁶

Librarians and the Dunning-Kruger Effect

Along with students and academic faculty, librarians also may suffer from overconfidence. Nicole Pagowsky makes the point that the one-shot has limited information literacy instruction impact when librarians equate the quantity of one-shot sessions with the quality of learning. She points out that “one-shot models essentially create a check-

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box that gives us the appearance of success based on numerical accomplishments.”¹⁷ She goes on to say that the “focus on quantity through endless cycles of one-shots” glorifies outputs and reduces information literacy instruction to “simplistic pieces to gather and check off a list.”¹⁸ This perception might even be reinforced by how the Association of Research Libraries (ARL) asks that instruction be reported to them statistically. The ARL 2018–2019 reporting form tells organizations to “Report the total number of sessions during the year of presentations made as part of formal bibliographic instruction programs and through other planned class presentations, orientation sessions, and tours”

and to “Report the total number of attendees in all group presentations,” as if numbers are the key to success.¹⁹ Thus, it is possible that even librarians themselves could exhibit the Dunning-Kruger effect, especially if they evaluate success by quantity of one-shots rather than assessing the transfer of learning for the students.

Surface Learning versus Deep Learning and the One-Shot

The default, isolated one-shot is questioned in the literature as a method for deep learning and transfer of knowledge, particularly related to students’ ability to synthesize and integrate their sources.²⁰ Nora Belzowski and Mark Robison opine that one-shots fail to build deeper competencies.²¹ Cognitive scientists have long pointed out that deep learning goes beyond simple procedures or memorization. It is effortful, it is durable, and it allows students to put new knowledge into a larger context. Deep learning re-

quires time to acquire and process new information. It also needs deliberate, repeated practice that is interleaved and varied over time, with plentiful feedback along the way. Scientists have discovered that “massed practice,” or what we commonly refer to as “cramming,” is mostly a waste of time.²² All too often, library one-shots are cram sessions due to lack of time for instruction, practice, and feedback. Thus, when surface or shallow learning takes place, participants may get a false sense of confidence about what they know. Also, because of time constraints, one-shots commonly focus on using specific resources, accessing needed content, and delivering point-of-need assistance to accomplish specific tasks with an assignment. Unfortunately, this often means that time cannot be devoted to the larger information literacy picture, which includes more complex research processes. The ACRL Framework concept “Information Creation as a Process” outlines this complexity, saying, “Information in any format is produced to convey a message and is shared via a selected delivery method. The iterative processes of researching, creating, revising, and disseminating information vary, and the resulting product reflects these differences.”²³

Teaching broader concepts about the research process itself allows students to better comprehend the complexity of the enterprise and fosters a greater transfer of learning. Several anchoring concepts or frames in the ACRL Framework that librarians and academic faculty potentially could address in greater depth are disciplinary knowledge (Scholarship as Conversation), working with students developing research questions (Research as Inquiry), helping students select search tools and map out a search plan (Searching as Strategic Exploration), discussing the distinction between discovery and information seeking and going deeper with evaluating sources (Authority Is Constructed and Contextual), citing sources appropriately and ethically (Information Has Value), and the research process as a whole (Information Creation as a Process).²⁴ Teaching ACRL frames and threshold concepts allows students to get a more holistic picture about what research entails and provides a space for deeper, more contextual learning. The National Research Council book *How People Learn* sums up the same point when it says, “Transfer is enhanced by helping students see potential transfer implications of what they are learning.”²⁵ As another author puts it, “The Framework addresses the notion of ‘context’ head on, and challenges anyone thinking about information to situate themselves, and the information with which they interact, within that larger context.”²⁶

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Moving from Traditional One-Shot Models to New Models

Like the writing process, authentic research is complex, it is iterative, and it includes concepts and skills that cannot be taught in only one session. Heidi Jacobs and Dale Jacobs describe typical information literacy instruction programs for freshman composition classes as those in which one-shots were taught by librarians who randomly volunteered

to do them, revealing the “assumption that a single ‘dose’ of library instruction would teach students all they needed to know about research.”²⁷ That model of instruction not only perpetuates a superficial view of information literacy instruction but also assumes that librarians, what they teach, and how they teach are not unique but made up of interchangeable widgets. As Jacobs and Jacobs put it, the instructional goal is not really teaching research, but “asking the library to inoculate students against bad research habits.”²⁸ In contrast to this practice, Jacobs and Jacobs describe a transformation of the program from isolated one-shots by various librarians, none of whom worked together, to a course-integrated learning community model of teaching information literacy.²⁹ The transformation from coordination into an authentic, collaborative model meant that librarians could be involved with students for the duration of the course, and thus could focus more holistically and meaningfully on the information environment. Such a model allowed for more in-depth work with students because of strong collaboration between librarians and instructors in creating assignments, contextualizing information literacy instruction into the course, monitoring student progress, and following up with students. It also enabled students to gain a more realistic perspective about research and about librarians.

The Learning Community, Embedded Librarianship, and Flipping the Basics

Librarians can create a learning community model that goes well beyond the one-shot.³⁰ Having students complete assigned modules before they meet with librarians in a synchronous class environment allows librarians and instructors to concentrate in-person sessions on a deeper level of information literacy concepts. The use of asynchronous learning modules offers educators more time to develop nuanced discussions about in-

With some point-of-need, skills-based information covered in asynchronous instruction, instructors have more time to discuss holistic concepts

formation literacy, beyond locating and discussing what constitutes an authoritative source. Becoming embedded in learning management systems allows the librarian to learn more about the instructor’s learning goals, review the syllabus and research assignments, and plan more relevant instruction. Embeddedness also enables librarians to create or link to asynchronous learning module content about library basics (a practice often referred to as “flipping” of instruction).³¹ With the emergence of the COVID-19 pandemic in 2020, online alterna-

tives to live, synchronous classes have paved the way for the further development of asynchronous learning modules in many library instruction programs.³² With some point-of-need, skills-based information covered in asynchronous instruction, instructors have more time to discuss holistic concepts central to the frames and dispositions explained in the Framework and related to the research process.

Teaching the Research Process

Addressing broader information literacy concepts (frames or dispositions) goes beyond superficial or surface learning to deeper understanding and can help mitigate the Dun-



ning-Kruger effect. Authentic inquiry can be facilitated for students when instruction concentrates on formulating student-centered research questions, selecting specialized databases (beyond default discovery tools), planning advanced searching for customized information-seeking activities, and allowing time for student reflection on the research process itself (as opposed to a rush toward getting the required number of sources). In Peter Elbow's classic, *Writing with Power*, Elbow points out that compulsory writing in classroom settings means that students are "swimming against the stream of natural communication" because they must write for teachers who generally know more than they do about a topic.³³ In contrast, when students are motivated to find answers to questions that are important to them, the process entails authentic, student-centered inquiry. Inquiry-based learning is defined in the literature as "instructional practices designed to promote the development of high order intellectual and academic skills through student-driven and instructor-guided investigations of student-generated questions."³⁴ What makes this process authentic is that it is student-driven rather than assignment-driven.

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Combating Dunning-Kruger through Research Logs

The use of the research log is one way information literacy instruction can support student progress beyond online learning modules or short activities within the classroom. Louise Fluk points out that research logs emphasize that research is a process, not just something one does to produce a product. Fluk says that using a research log as a "tool for acquiring metacognitive skills . . . is necessary in order to really learn."³⁵ Yet, by identifying more than 50 terms used to describe student narratives about the research process, Fluk's 2009 literature review documented that there is little consistency and wide variability about what authors call a *research log*.³⁶ Research logs can range from simple descriptions of the inquiry process involving which databases were used, what keywords were identified, and what search strategies were used to comprehensive logs composed over a semester that reveal student feelings, frustrations, and confidence levels.³⁷ Across this wide variety of formats, research logs may slow the research process enough for students to reflect on what they are doing. Such activity and reflection can potentially help combat the Dunning-Kruger effect.

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Using a method like Jacobs and Jacobs's model, the authors (a librarian and a math education professor) collaborated in courses for preservice teachers. They asked undergraduate education majors to inform their internship teaching practice with what they learned from their research projects. Detailed findings from our Institutional Review Board (IRB)-approved studies and research collaborations have been described in detail



in our previous publications.³⁸ In this paper, we focus specifically on our development and use of the research log, in combination with information literacy workshops and online modules. Our work together has been iterative, and we have collaborated over a decade, revising and refining our use of research logs over multiple cycles within an undergraduate mathematics methods course.

We began our collaboration when the mathematics education faculty member consulted with the education liaison research librarian about how to support a mathematics methods course in which she asked students to link research to their emerging teaching practice. The faculty member previously valued supporting information literacy development in students, but when she started consulting with the librarian, she was able to articulate her goals as they related to information literacy. She wanted her students to develop both confidence and competence in finding educational research that could guide them toward solutions to problems that emerged in their internship teaching. For example, her students sometimes struggled to meet the math learning needs of students with exceptionalities, such as attention-deficit/hyperactivity disorder (ADHD), or to lead effective mathematics discussions with full-class participation. These undergraduates needed research-informed solutions to try in their classroom teaching.

We began our collaboration with this clear goal: that undergraduate students in their last year in a teacher preparation program could develop the information literacy skills they needed to use research to inform their teaching practice. Therefore, this assignment and the matching research log that we designed provided us with an opportunity for an authentic assessment of student development of these skills. We could evaluate the extent to which students' practices changed based on what they learned from their literature searches.

Like all faculty and librarians, we had time and resource constraints. The librarian had broad teaching responsibilities across multiple colleges in an urban, public, research-intensive university. The faculty member had a plethora of mathematics methods learning objectives in the course. Our collaboration required us to find creative ways to get maximum impact from the little class time we could share with the students. As we began our collaboration, we explicitly developed a shared commitment to honoring the complexity of teaching information literacy as a process and to addressing that process through authentic inquiry. In recognition of this complexity, we shifted basic information literacy skill building blocks, such as accessing article databases and developing search terms, to online modules. The librarian developed each module to provide a series of self-paced video and text-based interactive activities. The 27 students in the course spent approximately four to five total hours to complete the modules along with the accompanying quizzes to check for understanding. This background, modular preparation liberated our in-class workshop time for teaching the more complex information literacy processes, such as refining research questions, interacting with the literature, and applying research to issues related to classroom teaching and learning. Most importantly, we developed an online research log for each student that provided shared, real-time access to the student's learning across the project. In the next section, we outline detailed information about the design of the research log and its functionality in our collaboration.

Table 1 provides an overview of the elements of the research log that we used in our collaboration as well as the significance those elements had in combating the



Dunning-Kruger effect. We used a real-time document-sharing platform (in our case Google docs) to allow the faculty member, librarian, and student to have access to the student's thinking and progress related to finding research articles and addressing the problem of teaching or learning. The research log template gave progressive due dates throughout the eight-week project, and students checked in at least once per week (some weeks more frequently). This shared document became central to the embodiment of the learning community that Jacobs and Jacobs recommended.³⁹ As is visible in Table 1, the research log provided question prompts that asked students to address: (1) information literacy content (such as articulation of the research question, keywords, search terms, database use, and criteria for article selection), (2) discipline-specific content (such as summaries of what was learned through reading the research literature), (3) the affective domain (such as questions about student confidence in the research process), and (4) reflections integrating the previous three domains. We suggest that the integrated nature of our research log more closely approximates the full definition of information literacy as described in the ACRL Framework: "Information literacy is the set of integrated abilities encompassing the reflective discovery of information, the understanding of how information is produced and valued, and the use of information in creating new knowledge."⁴⁰ The research log with its structured guidance offered integration, reflection, and authentic student-centered application of research findings. Because the student, librarian, and faculty member all had real-time access to the log, each community member could independently participate, monitor, and provide feedback on the research process. Both the faculty member and librarian could use the student data to inform their instructional decisions, whether in the moment or for future iterations. In addition, both could address problems or questions that students documented on their research logs. We saw clear evidence, as described in the next section, that this feedback encouraged students and enabled them to persist through the challenges of their searches. We also saw indications of deeper learning about information literacy concepts and little evidence of the Dunning-Kruger effect in student responses.

Indicators of Authentic Inquiry and Deep Learning

The research logs allowed us to assess whether authentic, student-centered inquiry and deeper learning about the research process occurred. Three types of student comments indicated deep learning: (1) comments about their own inquiry process, (2) comments about the complexity of the research process, and (3) comments about having further questions at the end of their research.

The research log with its structured guidance offered integration, reflection, and authentic student-centered application of research findings.



Table 1.
Research log elements

Phase	Significance
Statement of the problem	Student ownership of identifying the problem and intrinsic motivation to solve.
Why do you think it is important to address this problem?	Prompts that raise and require reflection about process and metacognition.
How much do you already know about this topic?	
What do you want to remember from the IL workshop (number 1 and number 2)?	
List your research-guiding question.	
List your main ideas and keywords.	
Which keywords were most helpful?	
In the process of managing topic/mapping concept/selecting articles, did the question change?	
Discipline-specific phase	Significance
Read the articles and consider implications for teaching. What did you learn?	By scaffolding the process of applying what was learned to practice, student motivation to process and integrate new knowledge is high.
Please describe your plan for implementing what you've learned from reading the research (include steps to collect data to evaluate the success of your plan).	Prompts that raise and require reflection about process and metacognition.
Please provide details about the evidence that you collected after implementation.	
What did you learn from this evidence?	
What conclusions did you make?	
How will you revise this implementation for future teaching?	

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Table 1, continued.

Repeated affective checks	Significance
How confident do you feel about your ability to engage in the process of linking research to mathematics teaching? (Asked weekly)	Documented experiences of student affect (confidence) going up and down.
How confident do you feel about your ability to create a research-guiding question? (Asked weekly)	Raised student awareness of emotions and complexity of the process.
Integrated reflection	Significance
What did you learn about turning a problem of practice (or natural language question) into a research-guiding question?	The acknowledgment that authentic inquiry can lead to new questions.
Do you think you were able to answer your original question?	Consistent with comprehensive view of IL as presented in the ACRL Framework.
Did you generate additional questions through this process?	
What did you learn about the process of applying research to practice?	
Was the process worth the effort? Please explain.	
Will you use this process of linking research to practice during future teaching?	

Comments about Their Inquiry Process

Under the frame “Research as Inquiry” in the ACRL Framework, the inquiry part of research is described as one that “ranges from asking simple questions that depend upon basic recapitulation of knowledge to increasingly sophisticated abilities to refine research questions, use more advanced research methods, and explore more diverse disciplinary perspectives. Novice learners acquire strategic perspectives on inquiry and a greater repertoire of investigative methods.”⁴¹

The information literacy instruction, particularly the workshop, focused on turning a natural language question about a classroom problem into a research question, setting up a search plan, and conducting advanced searching for answers to that question. Overall, this workshop guided students through what we intended as a student-centered, authentic inquiry process. Many of their comments on the research logs showed evidence of learning more about inquiry through this workshop. Table 2 documents some participant comments related to this category.



Table 2.
Indicators of learning related to forming a research question

Student	Comment	Indicator of authentic research experience
ID5	I learned how to formulate a question, how to best research a question, how to analyze the research I find, and how to use the research that I find and analyze and implement it in my classroom.	Student described the process, not just isolated library skills.
ID10	I found that I needed to change my classroom problem to one more focused on math. I then needed to narrow the topic because it was too broad. The process overall I would say was somewhat difficult, but I learned a lot from the challenges I had in the process.	Student described the problem of focus and narrowing topic.
ID16	I learned that turning a problem into a practice becomes easier when the focus is specific and contains keywords or phrases that can be easily researched. Broad questions are difficult to answer because it is hard to find research that can be used in the classroom, [though in] my situation, it was difficult to create a specific question . . . but it is really beneficial in the long run.	Student discusses challenge of question formulation.
ID12	I also learned that my question changing may not always have to do with a lack of interest in the original question, rather a shift in interest within the question or an area the question addressed.	This comment acknowledges the recursive nature of the research process.
ID27	I love how the [research log] laid out each step of the process and allowed my question to change multiple times because throughout this process my question changed several times.	The student addresses the process of refining research questions.

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The student comments reveal that they could engage in the authentic and evolving process of articulating a research question. The students wrestled with the formulation of the question, the need to narrow or broaden their questions as they engaged in the literature search process, and the refining of the questions as they interacted with the literature itself. Overall, their comments show that they came to see the act of forming a research question as an evolving process rather than a static step.

Comments about the Complexity of the Research Process

In articulating the complexity of the research process, the ACRL Framework says that the process “demands behavioral, affective, cognitive and metacognitive engagement with the information ecosystem.” It adds that “critical self-reflection is crucial to becoming more self-directed in that rapidly changing ecosystem.”⁴² By asking students to reflect on their own process both affectively and academically, the research logs revealed how students began to understand why research is so complex. Table 3 documents the comments students made about the overall research process and its complexity.

The first comment in this table is an example of how a student articulates overcoming the Dunning-Kruger effect. The student reflects on how the research process is “not as simple as it seemed” and on how she learned some specific skills (effective use of keywords) that enhanced her ability to engage in the research process. The comments in this table also demonstrate an understanding of the research process as iterative and evolving over time.

Comments about Having Further Questions

As the Framework points out under the frame on Research as Inquiry, “Research is iterative and depends upon asking increasingly complex or new questions whose answers in turn develop additional questions or lines of inquiry in any field.” We learned from the research logs that many students engaged in authentic inquiry and did, indeed, have additional questions that arose from their initial research. The selected comments in Table 4 illustrate how the initial research generated further inquiry for some students.

The students’ comments provide evidence of the authenticity of the research process for them. Their initial questions often spurred new queries as the students interacted over time with the literature. Student reflections on the research logs offer a useful look into their understanding about the process and the overall value of academic research. They also reveal the extent to which instruction was successful in guiding and creating an authentic inquiry process.

The students wrestled with the formulation of the question, the need to narrow or broaden their questions as they engaged in the literature search process, and the refining of the questions as they interacted with the literature itself.

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Table 3.

Indicators of learning related to the complexity of research process

Student	Comments	Indicator of authentic research experience
ID10	I learned that the process is not as simple as it seems. The actual research part took me the longest, but in the end, I found helpful articles. I learned that it is very important to use the right type of keywords as you search and how to form your research.	These comments indicate the complexity of the research process and finding relevant research.
ID22	I learned that this process takes time, and it requires a dedicated hand and mind to handle these problems and research. I learned that any problem can be turned into a research question because most problems that you run into as a teacher aren't brand new problems, you aren't alone, most likely someone else has struggled with that same issue.	This student acknowledges an understanding of the labor-intensive nature of the process and research as a valuable resource.
ID23	Research is not linear, it is recursive, which means that it is cyclical, or that the process can be repeated or lead to new ideas in which you would then repeat the process. I also learned that this type of inquiry is attainable, and that inquiry doesn't have to be an extensive project such as one you would submit to a conference.	This comment indicates a more holistic understanding of the process and that research is not just for those in the academy.
ID 24	Even though it took a lot of time to go through the process of asking a question, researching an answer, and implementing my findings, it was so exciting to find answers to a problem I was facing. It was even more exciting to see my students benefit from my efforts!	This is an acknowledgment of the complexity and value of research as it is applied to real-life situations.



Table 4.
Indicators of learning seen in additional questions

Student	Comments	Indicator of authentic research experience
ID12	Yes, I generated additional or sub-questions through this process. I began to wonder about the effectiveness of small group instruction in general, though my focus never shifted from differentiated instruction for my lower-level students who lack number sense. Toward the end of this documented process, I began to wonder about how to promote self-evaluation and help the students generalize the skills they learn so they can apply [them] independently.	Reflection shows the nature of engagement the student had with the research and the desire to learn more.
ID3	I do not believe that I was able to answer my original question. The one strategy I picked to implement in my classroom was not effective with my student. I saw little progress while implementing the research strategy that I read about. From this, I conclude that I need to do more research on ways to keep the attention and focus for this student. I want to know different strategies that I can implement to keep my student's attention.	Here the student indicates that not all efforts are effective in finding answers but acknowledges the value of the research literature and the desire to try again.
ID17	Throughout the process, I did generate additional questions, such as, what type of data/evidence should I collect that will go well with my plan of implementation and will differentiation also improve student behaviors throughout math lessons.	Student is interested in learning more about research methodology for action research.

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Table 4, continued.

Student	Comments	Indicator of authentic research experience
ID25	I learned that questions can lead to more questions, which is OK. I preferred to stick to my original question, so I could answer it, but recorded along the way other questions that might build off of this original, that I can research at a later time.	This illustrates how research literature can impact the process itself and lead to more questions.

Discussion

One-shots are not inherently good or bad—but they are, by themselves, insufficient for providing students with the opportunity to attain genuine information literacy competency as described in the ACRL Framework. Moreover, when delivered in isolation,

... foundational skills can be learned asynchronously through online learning modules, while research logs can help focus in-person time on holistic and challenging work that deepens the learning of information literacy concepts.

one-shots can contribute to a Dunning-Kruger effect for students, faculty members, and even librarians themselves, resulting in overconfidence about the information literacy competency that was acquired. In contrast, we argue for innovative ways to wrap learning communities around one-shots to make the time spent in the classroom more effective. We have suggested that foundational skills can be learned asynchronously through online learning modules, while research logs can help focus in-person

time on holistic and challenging work that deepens the learning of information literacy concepts. Based on our many cycles of using research logs, we present the following recommendations for librarians and faculty members ready to explore this method of supporting deep student learning:

- **Authenticity:** Start with an authentic project that students will be internally motivated to research. If students are future professionals (such as engineers, teachers, social workers, psychologists, and the like), a good place to start is to ask them to identify a problem that they are currently experiencing or that they anticipate in their future professional lives. If that is not possible, allow students to choose an issue that they feel is relevant to their interests or experiences.
- **Course content:** Given our recommendation of authenticity, we have found it helpful for the faculty member to first articulate the extent of the course requirements that they would like included in the research project. This includes details such as the topics and types of references that are allowed or not allowed, the number of references needed, and what is expected as the final product, such as a research paper, presentation, or other creative product.

- Consultation: Next, the faculty member and librarian can consult about students' current information literacy abilities and how those skills can be further developed through the project. We have found it useful to give students a preliminary assessment in which we ask about prior information literacy instruction as well as a variety of information literacy questions.
- Prioritize: Identify which foundational skills (such as selecting databases, using controlled vocabulary, and evaluating sources) could be addressed through online or asynchronous modules or readings and what information literacy processes are better taught in person or live online.
- Research log template: Create a template that can guide students through the research process (see Table 1 for examples of template prompts). We find it helpful to include due dates on the template so that students move through the steps at the same time that they receive instruction.
- Metacognition and affective awareness: To support students' metacognition, or awareness of their own thinking processes, we recommend regularly prompting them on the template to reflect upon their research questions and to note the ways questions may evolve as they interact with the literature search. We also assess students' affective awareness, asking them about their confidence related to the research process. Asking about confidence can help students recognize the affective components of research and persist through the often frustrating, uncertain process of finding research literature.
- Continuous monitoring and feedback: Both the faculty member and librarian can regularly check the research log to provide ongoing feedback to students. Typically, we identify certain times to provide formal feedback to students, but we also respond to their questions and comments as they arise.
- Collaborative assessment: After students have completed their projects, we recommend scheduling a debriefing session where the librarian and faculty member can discuss student outcomes. We have used these sessions to adjust or revise the template and associated learning activities for the next use of the research log.

Identify which foundational skills (such as selecting databases, using controlled vocabulary, and evaluating sources) could be addressed through online or asynchronous modules or readings and what information literacy processes are better taught in person or live online.

Conclusion

We have cautioned that the status-quo use of one-shot library instruction sessions can result in the Dunning-Kruger effect, an overestimation of learning, for students, faculty members, and librarians. To counteract this effect, and to promote authentic inquiry and deep learning, we recommend that librarians and faculty members collaboratively develop research logs to support sustained, integrated information literacy instruction.

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