Apprenticing Researchers: Exploring Upper-Division Students' Information Literacy Competencies

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abstract: This study explores upper-division students' research competencies, dispositions, challenges, and developments through focus group interviews implemented by surveys, including local responses to the Experiences with Information Literacy topical module from the National Survey of Student Engagement (NSSE). These undergraduates, apprenticing as researchers, use research practices that are more novice than expert, as described in the Framework for Information Literacy for Higher Education. They employ a range of abilities in the research process and demonstrate an emerging knowledge of the information environment and of academic disciplines. Because curriculum strongly influences information literacy development, librarians should pursue close collaborations with faculty.

Introduction

As students embark on their undergraduate education, they undertake a form of academic apprenticeship into the research practices of their chosen field. They often must navigate a new and complex information environment to meet the demands of their academic work and activities. They struggle to develop the knowledge, abilities, and values they need to locate, evaluate, and use information both appropriately and effectively—initially for general education purposes and then for more field-specific courses and activities. This study explores how upper-division students engage with research practices during this apprenticeship to articulate their information literacy (IL) competencies and dispositions, particularly their challenges and development. The findings are intended to inform how librarians and campus partners can better support and advance students' information literacy.

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The coauthors, with backgrounds in writing studies and library science, chose to investigate upper-division students' IL experiences at the University of California, Merced using both qualitative and quantitative methods.[1] The literature review describes the research process as an apprenticeship model, based on interdisciplinary scholarship focused on upper-division undergraduates and on the Association of College and Research Libraries (ACRL) Framework for Information Literacy for Higher Education—hereafter referred to as the Framework—which describes both novice and expert research practices.[2] Fieldwork for this study involved qualitative analysis of students' focus group interviews through the lens of the Framework. When appropriate, the authors complemented the interview summaries with quantitative data from the Experiences with Information Literacy topical module of the National Survey of Student Engagement (NSSE), an assessment instrument to measure students' participation in learning at colleges and universities in the United States and Canada. The findings depict students' research practices, challenges, dispositions, and development.

Upper-division undergraduates' IL competencies are most often typical of what the Framework refers to as "novice learners," rather than the abilities of what the Framework calls "experts," indicating that these students are in early stages of an apprenticeship where they have begun to practice information literacy but have not yet become proficient. They have an emerging knowledge of the information landscape in their disciplines, engage in a range of activities as part of finding and using information, and are highly influenced by curricular expectations in their IL development. Due to the impact of curricular requirements, librarians should seek opportunities to reach students through academic programming and curriculum development.

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Literature Review

The Research Process: Major Studies

A significant area of interest in library and information studies has been users' research practices, particularly their approach to information finding. Carol Kuhlthau introduced her seminal Information Search Process model in 1983 and, through a series of subsequent studies, found it a common user experience.[3] Her description of a six-stage Information Search Process included common thoughts, actions, and feelings at each stage.[4] Between 2004 and 2010, librarians and anthropologists initiated two major ethnographic studies, the Undergraduate Research Project at the University of Rochester in New York and the Ethnographic Research in Illinois Academic Libraries (ERIAL) study. Both explored how students conducted academic research.[5] In 2007, Alison Head published Project Infor-

mation Literacy's first exploratory study, "Beyond Google: How Do Students Conduct Academic Research?"[6] The project continues to investigate the information-finding behaviors and associated research challenges of early adults.[7]

These collective works have exposed many challenges that students experience during information finding. Kuhlthau highlights the uncertainty information seekers feel during the initiation stage (stage 1) and their confusion during exploration (stage 3). Similarly, Project Information Literacy's Head and her colleague Michael Eisenberg find that students have the most difficulty in task definition (stage 1).[8] Andrew Asher and Lynda Duke, of the ERIAL study, report that students have "significant difficulties . . . across nearly every aspect of the search process."[9] Librarians have sought a greater understanding of how users engage with the research process to help their patrons overcome the challenges associated with finding and using information.

Upper-Division Student Researchers: Changes and Challenges

A limited number of studies refer specifically, though not exclusively, to upper-division undergraduates' experiences in the research process, identifying strengths and challenges.[10] Comparing the research process for first-generation first-year and senior students via interview responses, Elizabeth Pickard and Firouzeh Logan found that seniors operate at a higher level than their first-year counterparts but still struggle to develop topics or manage their time.[11] Through examining written reflections and research essays from a cohort of predominately upper-division undergraduates and a few graduate students, Eleonora Dubicki discovered that most students report growth in their research skills and increased confidence in the research process. Yet, finding keywords and creating search strategies remain key challenges.[12] Using surveys and follow-up telephone interviews with college students, Head and Eisenberg explored undergraduates' research practices for both personal and course-related information needs.[13] As noted earlier, they found that students struggle to get started on research assignments.[14] Yet, when they compared sophomore responses to those of juniors and seniors, Head and Eisenberg discovered that upper-division students were less daunted by the stages of the research process than were their sophomore counterparts.[15] These studies suggest that upper-division students have grown in their ability to navigate the research process but still encounter difficulties.

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The Apprenticing Researcher: Novice to Expert

This study uses the concept of apprenticeship to think about the research experiences of upper-division students. While the idea of an apprenticing researcher is not explicitly stated in the Framework, the document describes what both novice and expert learners might understand and do for each of the six frames or core concepts. The developing, or apprenticing, nature of a learner's information literacy is also prefaced in the Framework's sections on "Knowledge Practices" and "Dispositions."[16] Based on the

Framework's content and its adaptability, Lisa Hinchliffe and Laura Saunders propose an additional frame titled "Information Apprenticeship in Community," in which novices, apprentices, and experts develop their IL abilities and learn from the expertise of others.[17] This frame points to Jean Lave and Etienne Wenger's theory of situated cognition, where learning takes place within communities of practice, groups of people with a shared area of interest who learn from one another. Apprentices' interactions with experts function as "legitimate peripheral participation," moving them from the position of an outsider to that of an insider displaying specialized knowledge and practices.[18] As individuals in a community of practice, they gain expertise.[19]

Upper-Division Researchers: Apprenticeship Variations

Apprenticeship is also reflected in the work of James Nichols, who conducted case studies with upper-division students (nine seniors and one junior) completing a research paper.[20] He reports that all these students moved from observers on the sidelines of their academic discipline to those participating in the conventions of their scholarly community.[21] Jennifer Bonnet and her colleagues describe the characteristics of apprentice or advanced undergraduate researchers based on an analysis of students' reflective essays submitted for their institution's undergraduate research award.[22] These primarily upper-division students are referred to as apprentice undergraduate researchers due to their "high degree of sophistication in their research process."[23] Juniors and seniors show signs of having entered a scholarly community by gaining field knowledge, creating a research network, and adapting to the nature of scholarly inquiry.[24] Of note, though, is that both studies relate to exceptional student populations. Some of Nichols's participants were recruited through an honors program, and all reported a grade point average of 3.0 or higher,[25] while Bonnet and her colleagues examined reflective essays from a self-selected group of students who were highly motivated to complete a research project.[26]

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Mónica Colón-Aguirre and Rachel Fleming-May report greater variation in upper-division students' approach to information gathering, including their use of free and subscription-based resources. Based on interviews of primarily juniors and seniors, the investigators outline three library user types and associated actions.[27] They found that upper-division students could be divided into the avid, occasional, and avoider categories, with the majority as occasional library users.[28] Their findings also suggest that upper-division students primarily engage in novice researcher practices.

In another set of categories, Michelle D'Couto and Serena Rosenhan describe the stages of research skill development from first-year students through faculty, based on extensive focus groups and interviews with 125 participants.[29] They identify four levels of researchers: (1) Gen-Req-ers, working to complete general education course requirements; (2) Domain Learners, engaging in research to learn a discipline's methods; (3) Apprentices, aspiring to make an original contribution to their field; and (4) Scholars,

contributing experts in their field. Upper-division students will most likely be represented in the first two levels, either as Gen-Req-ers driven by a desire for efficiency and a professor's requirements or as Domain Learners becoming familiar with a discipline and its resources. The authors' descriptions of the research activities at the Apprentice and Scholar levels suggest that these final two categories apply mostly to graduate students and faculty.[30]

Overall, these studies point to a great range in upper-division students' research practices, from novice to expert-like behaviors, and reveal variation in how a researcher's apprenticeship might be categorized and described. This study adds to the literature on upper-division students' research practices and also analyzes this population's research competencies, challenges, dispositions, and developments in light of the Framework.

Methodology

Pre-Survey and Focus Group Interviews

To explore students' IL experiences, the library literature relies heavily on qualitative research and, often, mixed methods. In this study, the authors employed qualitative methods with structured interviews in focus groups to document learning in a holistic way,[31] exploring students' dispositions, skills, and knowledge. With Institutional Review Board approval, the authors recruited upper-division undergraduates through SONA, the University of California, Merced's Web-based system by which students volunteer to become research subjects. In spring 2017, the authors conducted two 50-minute focus group sessions, one with 10 students and the other with 4. Each session started with a brief seven-question online survey to capture basic information about the students, including their year of study, major and minor, and frequency of information finding for academic purposes. (See Appendix A.) The authors then asked the participants predetermined interview questions, inviting them to comment on the knowledge, attitudes, and abilities they used during their information-gathering experiences, to reflect on where they had acquired those strategies, and to articulate any changes over time. (See Appendix B.) The authors recorded the sessions and had them transcribed. From transcripts, the authors built a code tree, informed by the existing categorization of the focus group questions and distilled IL dispositions proposed in the Threshold Achievement Test for Information Literacy (TATIL) developed by Carrick Enterprises, a firm specializing in assessment of students' IL learning.[32] After applying these codes to the transcripts, one author employed an iterative process to revise and recode the transcripts. The other author independently coded the same transcripts to identify and confirm patterns. Results and analysis were organized into six sections, starting with how students searched for information and evaluated their sources and concluding with how they acquired research competencies.

The NSSE Experiences with Information Literacy (EwIL)

The authors also drew on data from local senior students' responses to selected questions from the Experiences with Information Literacy (EwIL) topical module within NSSE.[33] Senior students at the authors' campus took the survey in spring 2017, the same semester

as the focus groups. The EwIL module "asks students about their use of information and how much their instructors emphasized the proper use of information," with a total of 13 questions providing a picture of information literacy practices and expectations on campus.[34] The authors chose to include students' responses for selected questions from the EwIL section of NSSE alongside focus group results to provide another line of evidence illuminating upper-division students' experiences using information. Hereafter, these results are referred to simply as NSSE.

Limitations

The NSSE results, which provided context about IL experiences and research expectations, are aggregated rather than linked to participants. In the authors' focus groups, they occasionally asked students to consider their responses individually before speaking; however, most questions invited immediate response. Not all students responded to all interview questions, and some spoke more extensively than others. Because focus groups allow students to elaborate on what other participants say, group members may be influenced by others despite being asked to articulate their own perspective and experience. This study relies on indirect evidence with a small sample size.

Participants

Through a pre-survey, the authors gathered participant data from 14 upper-division students, 9 seniors and 5 juniors. These students represented the three schools at the University of California, Merced—Social Sciences & Humanities, Natural Sciences, and Engineering—with majors in biological sciences, chemistry, cognitive science, management, mechanical engineering, political science, and public health.

All the students found that an ability to find and use information contributed to their academic success, and all expressed confidence in their skills for locating resources for coursework. Yet, not all conveyed strong or uniform enthusiasm for research.

All participants had experience finding resources for an academic assignment, though their encounters varied in frequency. Five participants (37 percent) reported finding material often (weekly), six participants (43 percent) reported doing so sometimes (monthly), and three participants (21 percent) reported this activity as rare (maybe once or twice during the semester). All the students found that an ability to find and use information contributed to their academic success, and all expressed confidence in their skills for locating resources for coursework. Yet, not all conveyed strong or uniform enthusiasm for research.

Results and Analysis

Results from the focus groups and selected responses from NSSE comprise the results, divided into six parts: (1) finding and evaluating sources; (2) meeting or exceeding source requirements; (3) articulating research challenges; (4) identifying researcher dispositions;

(5) reflecting on changes in research practices; and (6) acquiring research competencies. Each section concludes with observations of apprenticing students, which are then comprehensively integrated as three themes, with recommendations, in the closing section.

Finding and Evaluating Sources

When asked to reflect on approaches to locating material needed for an academic assignment, respondents focused on information finding and tended to initially convey this process in a linear and simplistic fashion. For instance, one student divided the process into three steps: visiting the library website; using PsycINFO, the American Psychological Association's database of article abstracts; and then reading articles. Another undergraduate reported finding a database, typing in a topic, and "then all the articles just come out." A couple of students paired their approach with other strategies, including seeking research help from librarians or relying on thinking and investigating.

As students elaborated, however, they started to describe an iterative, self-reflective process that included ongoing questioning to move from a broad research interest to a strategically scoped topic. In this discussion, students identified the skills and knowledge needed to successfully conduct academic research, revealing detail about the practices they employed and valued during information-finding sessions. They noted the importance of knowing how to use a database; searching precisely with Boolean operators, such as AND and OR; and narrowing search results through filters. Students recognized the value of appropriate keywords to retrieve desired search results and reflected on how keywords could both narrow and expand results. They also called attention to needing to know "which databases you have at your disposal," to asking professors for research guidance, and to using references from a relevant paper or previous work. Likewise, according to NSSE data, 58 percent of seniors reported often or very often looking for a reference cited in something they read.[35]

Students recognized the value of appropriate keywords to retrieve desired search results and reflected on how keywords could both narrow and expand results.

More specifically, students were asked how they would decide if information was useful or credible. Most often, they identified articles from peer-reviewed journals or those retrieved from library databases as trustworthy and high-quality. Sometimes, they mentioned other features of authority, such as a reference list. A focus on using scholarly sources and library databases also surfaced in NSSE data. Senior student respondents (82 percent) reported that instructors often or very often emphasized the use of scholarly and peer-reviewed sources for assignments and that they had often or very often (57 percent) completed an assignment using the library's electronic collection.[36]

Beyond their reliance on reference lists and library databases to identify credible sources, students leveraged targeted reading strategies to locate relevant information. They commonly referred to skimming for connections between articles or to the area of investigation, and some mentioned using abstracts or other sections (such as the methods, results, discussion, or conclusion) to determine if an article was worth reading. A

couple of students located keywords via the keyboard shortcut "Control + Find." In addition to selecting sources through targeted reading, students spoke of higher-level analysis, including posing questions and recognizing arguments. Ultimately, they were engaged in decision-making, which one student described as "trying to filter out the things you need to know and things you don't need to know."

In addition to selecting sources through targeted reading, students spoke of higher-level analysis, including posing questions and recognizing arguments.

Students' discussion of finding and evaluating sources aligns most closely with the frames related to search, inquiry, and authority and points to a mix of novice and emerging expert practices. Students reported taking advantage of available databases and employing keywords, Boolean operators, and filters in their searches. Some employed more sophisticated strategies, such as reviewing a source's references. Overall, their research strategies were primarily novice-like. However, they had begun to gain "a greater repertoire of investigative methods" ("Research as Inquiry")[37] without yet reaching the depth and breadth expected of experts ("Searching as Strategic Exploration").[38] A similar pattern of primarily novice practices with some more advanced features emerged as students discussed determining the credibility of sources. Many relied heavily on scholarly articles and database peer-review filters to obtain "authoritative voices" ("Authority Is Constructed and Contextual"),[39] but a few discussed higher-level thinking and critical analysis in this process.

In discussion, focus group participants referred to a composite of skills and knowledge necessary for academic research, including the mechanics of finding materials, an awareness of resources, reading literacy, and critical thinking. Their reflections reiterate that the research process includes behaviors that extend far beyond information-seeking[40] and align with the Framework's definition of information literacy as "an integrated set of abilities."[41] Part of the complexity of this novice-expert dynamic is that students are in a liminal position, a transitional state between stages. Sometimes, their description of the research process is fairly mechanistic, while other accounts are sophisticated and analytical. Both approaches may be at play. See Table 1.

The number of references students used rested on a variety of factors, especially the rigor of the instructor's expectations for required sources, a desire to lend additional quality or authority to the project, a need for background knowledge, and the level of effort required to find and use relevant materials.

Meeting or Exceeding Source Requirements

Students' decisions to meet or exceed the source expectations articulated by their instructors were driven by highly situational and practical considerations, often described as "it depends." The number of references students used rested on a variety of factors,

Table 1.

Observations of students as apprenticing researchers: finding and evaluating sources

- Tend to describe information findings in a linear and simplistic way yet mention some analytical strategies.
- Draw on a range of abilities, including reading strategies, for academic research.
- Often identify credible information via source type and database filters rather than a judgment of context or quality.

especially the rigor of the instructor's expectations for required sources, a desire to lend additional quality or authority to the project, a need for background knowledge, and the level of effort required to find and use relevant materials.

Generally, students sought out the number of sources defined in the assignment and seldom exceeded an instructor's requirements. However, a strong motivation for going beyond expectations was to increase the caliber of their work, with nearly half of respondents noting a desire or need for information as part of improving authority and quality. Over one-third discussed how adding citations enhanced and supported veracity, with one student noting the importance of a range in sources: "I tend to get more information than what I need so I can actually, like, pull things from different sources."

However, students weighed practical concerns when considering whether a project required additional sources to enhance quality or authority. About half the participants noted that their preexisting knowledge or understanding influenced the amount of research required for a topic. Interestingly, when students discussed needing background on a subject (for example, writing a paper in an unfamiliar field), the preliminary research was for the edification of the author and not the audience: "I found that having a lot of knowledge background to explain something I liked was better for me." When students thought about an audience, they focused mostly on the teacher as the reader and creator of the assignment.

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Yet, some students voiced ambivalence about exceeding the number of required resources. One respondent noted that more references meant more explanation and that, while additional sources might increase quality, the bare minimum requirements set the foundation. Two students remarked that adding sources did not make the paper or argument any more convincing, and so they hesitated to "add fluff" or dilute topic focus.

The tendency to default to minimum source requirements may align with other novice practices outlined in the Framework, such as emerging "investigative methods" ("Research as Inquiry"),[42] consulting limited resources ("Searching as Strategic Exploration"),[43] and "developing familiarity with the sources of evidence . . . in the field" ("Scholarship as Conversation").[44] This reluctance to go beyond source requirements may also reflect a limited capacity to meaningfully integrate new materials or to synthesize a large volume of information, suggesting a novice orientation to both finding and using information.

Students seldom spoke of meeting broader disciplinary expectations that might be expected in more expert orientations. They tended toward an analysis of audience, purpose, and context limited to the classroom, relying heavily on assignment parameters and an instructor's authority in determining credibility standards. More expert engagement would have considered rhetorical knowledge, "the ability to analyze and act on understandings of audiences, purposes, and context in creating and comprehending texts."[45] When the students discussed audience analysis, it was most often relative to the assignment and the perception of the teacher as reader. This view aligns with Dan Melzer's longitudinal analysis of writing assignments, which concludes that most such tasks are informative in purpose and presuppose a teacher-examiner as audience.[46] Undergraduates are often well-practiced in this information-telling approach to writing, which could limit their information-gathering strategies and their motivation to gather and incorporate additional sources. This mind-set might explain why keeping to assignment parameters was common. When participants exceeded requirements, they spoke of strengthening paper quality and enhancing credibility—perhaps considering a broader audience and recognizing the value of others' work "in their own information production" ("Scholarship as Conversation").[47] Yet, the general reluctance to go beyond requirements suggests predominately novice research practices, though students recognized at times a need for more information and were willing to engage with additional resources, suggesting more developed research behaviors. See Table 2.

Articulating Research Challenges

Students were also asked to comment on the challenges encountered while finding, evaluating, and selecting information. All but one participant spoke of one or more research challenges. In the realm of information finding, over a third of the students reported difficulties accessing materials, including problems requesting or receiving interlibrary loan requests, locating full-text versions of articles immediately and easily, using databases, and maintaining proficiency between database use and reuse. Yet, the most common information-finding challenges were associated with identifying suitable keywords in efforts to locate relevant information. Students recounted situations in which search results seemed completely disconnected from the keywords. Sometimes, the sources retrieved came from unrelated disciplines or were an undesirable type or format—for example, literary analysis versus statistics. Difficulties locating relevant information could be compounded when coupled with requirements that sources be peer-reviewed.

Students expressed additional challenges with selecting and using resources. While difficulty choosing sources sometimes stemmed from scoping problems, resulting in

Table 2.

Observations of students as apprenticing researchers: meeting or exceeding source requirements

- Exhibit a strong tendency to meet, rather than exceed, source expectations outlined in assignment parameters.
- Recognize the potential of sources to lend quality and authority to their work.
- Decisions to enhance quality or authority with sources are often pragmatic, taking into account the level of effort required.

too many or too few results, most challenges revolved around reading, comprehension, and synthesis. Students referred to difficulties reading articles with a "doctoral tone," a lack of visual clues, or unfamiliar vocabulary, including acronyms and jargon. Yet, in NSSE results, a majority of students (74 percent) reported instructors emphasizing practices of a specific field of study, such as terminology or methods.[48] Focus group participants expressed challenges comprehending sources both related and unrelated to their area of study due to new concepts or an incomplete understanding of familiar ideas, such as the meaning of the terms *correlation* or *standard deviation* in statistics. Reading presented a time challenge, and abstracts were not necessarily sufficient for making decisions about source selection. One student spoke of learning how to analyze and synthesize information, noting the challenge of connecting sources with one another and using them ethically rather than "trying to incorporate them [sources] into my idea."

Focus group participants expressed challenges comprehending sources both related and unrelated to their area of study due to new concepts or an incomplete understanding of familiar ideas

While some of the information-finding challenges students discussed, such as using databases and locating full-text articles, indicate a need for improvements in local services and search tools, the results also suggest that students have an emerging, but incomplete, view of the information environment, both at large and via the academic library. This pattern is akin to novice, rather than expert, practices as outlined in the frames "Information Creation as a Process" and "Information Has Value."[49] Students' use of databases suggests "increasingly sophisticated choices when matching information products with their information needs,"[50] yet they may still have unclear or unrealistic expectations regarding what material is immediately available due to the complexity of "an [information] environment where 'free' information and related services are plentiful."[51] Their access to a rich range of resources due to their status as a college student may

contribute to this complexity. Students need opportunities to find and use information to retain and grow their research competencies. This need for ongoing reinforcement suggests that students are in an apprenticeship where their practices are still developing and novice-like.

Not only do students' comments suggest an incomplete view of the information environment but also their remarks reflect limited disciplinary knowledge, which can make the research process a challenge. In both searching for and selecting sources, students were stymied by irrelevant results—not an atypical finding. Pickard and Logan reported that the majority of students in their study had problems turning up relevant resources and specific types of data, such as statistics.[52] The fourth most difficult task for students in Head and Eisenberg's study was filtering out irrelevant results.[53] While difficulty finding relevant results could be due to lack of familiarity with databases, student participants emphasized ineffective keywords, suggesting insufficient disciplinary knowledge for some information needs. Nichols noted that effective keyword searching "can hinge on the degree of a student's familiarity with the vocabulary and discourse in a discipline, especially when it comes to using the search to identify materials that are appropriate to the field and to the level of the student's work."[54] This aligns with Dubicki's report that keyword identification was one of the students' greatest challenges, particularly for interdisciplinary topics.[55] As novices increase "familiarity with the sources of evidence, methods, and modes of discourse in the field," they can better participate in "Scholarship as Conversation."[56]

In both searching for and selecting sources, students were stymied by irrelevant results . . .

A lack of disciplinary knowledge not only makes finding relevant results difficult but also impacts understanding and using information. However, apprenticing students increase in their reading and critical thinking abilities, figuring out how to navigate new ideas and experimenting with novel ways of working. New practices may develop, as illustrated by a student who began to use information at a deeper level by analyzing and synthesizing resources rather than having a predetermined use for a source. This student's progress suggests development in the "Research as Inquiry" frame as the student synthesized multiple sources to explore varied perspectives, reflecting overall growth as an apprenticing researcher.[57] See Table 3.

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Identifying Researcher Dispositions]

To focus on students' affective learning experiences, they were asked to identify attitudes that they believed helped them successfully conduct academic research. The codes applied to their responses originated from the four dispositions identified on the Threshold Achievement Test for Information Literacy (TATIL),[58] as derived from an analysis of

Table 3.

Observations of students as apprenticing researchers: articulating research challenges

- Locating relevant information involves multiple challenges, most commonly related to using effective keywords.
- Reading comprehension poses the greatest challenge in source selection.
- Limited knowledge of the information landscape and subject disciplines complicates both finding and using information.

the Framework.[59] The four dispositions are (1) mindful self-reflection, (2) productive persistence, (3) toleration of ambiguity, and (4) responsibility to community.

Students most commonly noted the disposition of mindful self-reflection, which involved preparation, readiness to learn, and an open perspective. During conversation, they often emphasized maintaining a critical eye and using caution to weigh information. Students' responses also highlighted persistence, a willingness to accomplish a task or goal, and readiness to spend the time needed. This perseverance required patience during the research process since "it does take a lot of time to look and thoroughly analyze." Occasionally, students described dispositions as a kind of coping strategy, with persistence needed to grapple with the emotional and intellectual experience of research and writing. Participants also emphasized toleration for ambiguity along with an ability to adapt, demonstrate flexibility, and maintain curiosity. This adaptiveness often involved creativity and allowed expectations to change. Students spoke of alterations, such as modifying search terms and topics in light of new information. One participant specifically noted the need to "mold your research question over time" and "be open to what other articles kind of bring in." Above all, students independently and fully discussed three of the four affective domains associated with information literacy, underscoring the importance of mindful self-reflection, toleration of ambiguity, and productive persistence. The one piece missing in their discussion was any reference to responsibility to community.

A renewed recognition of the importance of the affective domain for student learning expands information literacy's former focus on skills and knowledge to include dispositions in the Framework. A habit of mind, as defined by education researchers Arthur Costa and Bena Kallick, is "a disposition toward behaving intelligently when confronted with problems,"[60] with critical thinking as a key element. In academic work, research and writing processes are important and often complex, requiring students to think critically. Dispositions can be a key component for applying "thoughtful intelligent action" and "skillful problem solving" to the challenges that emerge in a student's college career.[61]

Costa and Kallick's definition of a disposition as "behaving intelligently when confronted with problems" may explain why students might not always enjoy research yet can still fully engage in it. Participants' descriptions of research dispositions emphasized mindful self-reflection, persistence, and flexibility as ways to stay motivated and productive. Pre-focus group survey data indicated that students who had to more often find resources for academic work would more likely view information literacy as valuable to their academic success. Yet, no patterns appeared linking the frequency with which participants found and used sources for coursework and either their confidence in information finding or their research enjoyment. Students might not be interested in research or might face numerous challenges in the process but nevertheless return to known strategies and rely on research dispositions to make progress. These mind-sets may be necessary for developing what composition professor Richard Hal Hannon refers to as a "scholarly temperament."[62] As noted by the inclusion of dispositions and habits of minds in writing and library studies frameworks,[63] these attitudes are important in achieving learning goals, whether as a novice or an expert.

Participants' descriptions of research dispositions emphasized mindful self-reflection, persistence, and flexibility as ways to stay motivated and productive

Though students referred to the dispositions of mindful self-reflection, flexibility, and persistence, they were notably silent about responsibility to community. One possible explanation may be that their research processes were highly influenced by their coursework. They will have been exposed to one or more disciplines by their junior or senior year, but their knowledge of an academic subject area may still be limited. Students at this level of study may have only a fledging understanding of information's value because they do not yet entirely participate in "a community of scholarship."[64] Since these students are not yet fully speaking to and with a discipline, responsibility to community is not yet a common disposition. See Table 4.

Reflecting on Changes in Research Practices

When students were asked what had changed most about their research process since entering college, they called attention to their use of library databases and often contrasted this to indiscriminate use of Google in their high school searches. They also spoke of using scholarly sources, though not exclusively. This emphasis on use of academic writing also appeared in NSSE results, as noted earlier.[65] In addition to use of library databases and scholarly sources, some students referred to growth in their knowledge of information source types and availability. For instance, they reported becoming familiar with "which articles can come from which database," differentiating between popular and scholarly articles, and recognizing the characteristics of various source types.

Students also recounted changes in their source-selection abilities, both in terms of evaluative skills and efficiency. One student had learned "what is actually appropriate to use and not just a random source," another spoke of scrutinizing the analysis of scholarly articles, while a third strongly emphasized critical thinking and questioning as a key lesson learned in college. Some emphasis on evaluating sources was apparent in NSSE

Table 4.

Observations of students as apprenticing researchers: identifying researcher dispositions

- Mindful self-reflection, with a focus on preparation and a critical lens, is most commonly noted as necessary for successful academic research.
- Emphasize three of four research dispositions: mindful self-reflection, persistence, and flexibility to stay motivated and productive.
- Rely on research dispositions to make progress in research processes despite challenges.

results: 34 percent of seniors reported often or very often deciding not to use an information source due to its questionable quality, while 74 percent reported that their instructors encouraged them quite a bit or very much to question the quality of sources.[66] While students spoke of becoming better able to select credible or relevant materials, they also emphasized the speed with which they could select suitable sources through skimming and reading strategically. One student remarked, "Knowing what to look for in the articles . . . not having to read from top to bottom . . . that's what helps." Overall, participants often expressed that they could more critically and quickly choose sources.

While students spoke of becoming better able to select credible or relevant materials, they also emphasized the speed with which they could select suitable sources through skimming and reading strategically.

When reflecting on changes in their research practices during their undergraduate work, students primarily discussed differences in where they searched. Their responses emphasized an awareness that their precollege search practices and sources were not sufficient for academic work and that library resources are valuable and should be utilized.[67] As noted earlier, this perception points to the developing yet novice practices outlined in the Framework's "Information Creation as Process" frame. As students progress in their courses and in meeting academic demands, they develop their knowledge of available resources and an ability to select "information products" most suitable for their needs.[68] NSSE results suggest that students adapt their information-finding practices and sources to meet academic requirements outlined by faculty. This aligns with other qualitative studies that point to instructors' "overwhelming" preference for use of scholarly references by their students[69] and their strong influence on students' choice of sources.[70]

In addition to changes in where they searched, students identified source evaluation as an area of development, though most gave little detail about how they might assess

a source. As suggested earlier, students may have used the scholarly article format as a proxy for determining credibility, suggesting a novice view of authority ("Authority Is Constructed and Contextual").[71] However, two students appeared to practice more developed evaluation practices, using high-level analysis rather than relying on "basic indicators of authority."[72] Most of the students' discussion around source evaluation focused on the increased speed with which they could work their way through materials by reading and skimming. At this juncture of source selection and evaluation, they spoke of efficiency gains, likely due to time pressures[73] and as a strategy "for managing and controlling all of the information available to them on college campuses."[74] Though the Framework does not refer to increased efficiency when differentiating between novice and expert researchers, reading and skimming strategies might be considered a necessary part of the novice learners' repertoire ("Research as Inquiry") as they learn to manage the research process effectively ("Searching as Strategic Exploration"), select information, and draw conclusions.[75] See Table 5.

Acquiring Research Competencies

When asked where they had acquired the skills, knowledge, or attitudes to conduct research, students referred to library sessions and services, along with faculty and peer feedback. Library instruction featured heavily, with participants referring to the usefulness of library sessions for identifying keywords, creating search strategies, and selecting and using databases effectively. Two students mentioned using the library's chat service, available 24 hours a day, 7 days a week, and found it helpful for obtaining search and database suggestions and for locating sources since they had not retained research skills covered in an earlier library session. The same students who used the chat service took advantage of meeting with a librarian. Another participant located suitable databases from an online library guide. While library support was mentioned most frequently, two students referred to the value of feedback from instructors, such as help prioritizing the focus of a paper, and one appreciated peer feedback on writing. Overall, students most often mentioned interactions with experts as contributing to their research competencies.

Overall, students most often mentioned interactions with experts as contributing to their research competencies.

Some studies have noted that students consult more often with faculty or peers than with librarians.[76] However, the focus group question was not couched in terms of asking students where they went for research help but instead asked them to reflect on where they had acquired their research abilities, knowledge, and attitudes. Their responses point to the role of "those more expert in the field as well as those with allied expertise (e.g., librarians)" in developing learners' knowledge and abilities, as articulated in Hinchliffe and Saunders's proposed "Information Apprenticeship in Community" frame.[77] For instance, students' remarks focused largely on the classroom community, where they had regular access to faculty feedback and where librarians provided tailored instruction in support of research assignments or projects. The classroom and larger academic environment function as a community of practice where learning takes place. As students engage with librarians and faculty in "legitimate peripheral participation,"

Table 5.

Observations of students as apprenticing researchers: reflecting on changes in research practices

- Where searches occur is the greatest change, with heightened attention to academic information needs.
- Source evaluation is commonly a significant area of development, often in the context of increased use of scholarly sources.
- Efficiency is emphasized and valued, particularly when selecting and analyzing information.

Table 6.

Observations of students as apprenticing researchers: acquiring research competencies

- Library instruction sessions provide a foundation for information-finding skills and resources.
- Research competencies increase as students learn from the expertise provided by librarians and faculty.
- The classroom community largely influences students' access to faculty and librarian support.

they apprentice—transitioning from novice to more expert practices.[78] Though students mentioned reference services and library guides less often, these services and resources offer them additional opportunities to directly or indirectly engage with librarians to accomplish a specific task. See Table 6.

Summary Analysis: Three Key Themes

Results and analysis across all questions surfaced three key themes.

Theme 1: Curriculum's Impact on IL Development

Apprenticing upper-division undergraduates adapt and develop their research practices in response to curricular requirements and in interactions with a community of practice to meet academic expectations, such that:

- They are highly influenced by faculty expectations and assignment parameters.
- They value resources yet weigh their use of them against assignment requirements and the time needed to find and analyze them.
- They benefit from interactions with librarians and library services and can most easily access this expertise when it is closely connected to their coursework.

Theme 2: Emerging (Yet Insufficient) Knowledge of the Information Environment and Disciplines

Apprenticing upper-division undergraduates have expanded, yet limited, knowledge of both the information environment and their discipline. Their growing knowledge results in new research practices, ongoing challenges, and a bounded approach to source evaluation, such that:

- They value and use library databases and scholarly sources yet experience challenges in using databases optimally and fully understanding academic sources.
- They regularly use and analyze scholarly resources but may not practice source evaluation on varied types of materials.
- They have limited familiarity with disciplinary knowledge, which influences their ability to both find and understand information.

Theme 3: Information Literacy's Scope and Development

Apprenticing upper-division undergraduates' IL development includes activities and abilities ranging from information finding to strategic reading. They need ongoing opportunities to practice both lower- and higher-level skills and abilities associated with information literacy, such that:

- They employ strategic reading practices to locate relevant information in an efficient manner.
- They require ongoing guidance, practice, and reinforcement to retain and hone their research practices and IL competencies.
- They rely on dispositions to engage in research processes and achieve learning goals.

Recommended Priorities

Librarians need to identify strategies and practices that contribute to academic apprenticeship. They should seek opportunities for collaboration with faculty and programs to bring IL development into authentic academic experiences, especially in the curriculum. Thus, students can have sustained practice with a range of research activities allowing for substantial IL progress, which is not possible in one-shot library instruction sessions.[79]

Librarians might find flexible opportunities for partnership with other campus entities in activities like the following:

- Partner with the writing program to integrate information literacy into coursework. A focus could include cocreating and identifying resources (for example, lesson plans or tutorials) for use in courses prior to in-person library instruction.
- Collaborate with campus assessment coordinators, department chairs, or both to partner with programs in evaluating IL outcomes.

Explore general education partnerships, particularly upper-division requirements, such as writing across the curriculum or in the disciplines.

- Engage in dialogue with staff at centers of teaching excellence to encourage faculty to consult with librarians on assignment design.
- Seek funding to support a learning community among librarians and faculty.

These collaborations might provide an expanded opportunity to discuss IL not only as a set of mechanical skills but also as a discipline with core concepts and dispositions.

Strategic approaches are also needed to meet students' immediate research needs and develop their IL knowledge, abilities, and dispositions. When planning instructional priorities, librarians should address both students' current questions and a broader understanding of information literacy's core concepts. Though librarians want to move beyond instruction sessions that focus on mere mechanics (for example, database searching), apprenticing undergraduates still value basic instruction, which suggests that librarians may need to function as both trainers and educators. However, training might be minimized in face-to-face instruction by shifting "how-to" information into online tutorials for use in flipped classrooms, where students are introduced to new content independently and use class time for projects and discussions. Tutorials have the added benefit of being available at any time for on-demand learning.

When planning instructional priorities, librarians should address both students' current questions and a broader understanding of information literacy's core concepts.

Conclusion

Through this study, the authors gained insight into upper-division students' research competencies, challenges, dispositions, and development by analyzing focus group

transcripts, examining them in light of the Framework's novice and expert practices, and placing them in the context of local NSSE results. Students at this stage in their undergraduate career conduct their research in the context of course requirements and develop their knowledge and abilities in response to curricular expectations, often supported with faculty and librarians' expertise. While these students use and value new strategies and sources in college, they still experience challenges finding, using, and understanding information. These challenges seem to stem from knowledge gaps, especially a limited (though growing) view of the information environment and of disciplinary fields. Apprenticing undergraduates' research practices expand information literacy's definition in keeping with the Framework's focus on a "set of integrated abilities" and demonstrate "critical self-reflection," which may be key in overcoming research challenges.[80] Even in upper-division work, students as apprenticing researchers value both lower-level and higher-level skills and require ongoing practice to hone their research abilities. As students apprentice at the university, librarians should continue to collaborate with faculty and other campus partners to integrate information literacy into students' academic experiences.

Even in upper-division work, students as apprenticing researchers value both lower-level and higher-level skills and require ongoing practice to hone their research abilities.

Future research could compare research practices of lower-division and upper-division students, examining their research practices in greater depth using a combination of direct and indirect evidence as well as identifying expert-like practices for those at the upper-division level. Another line of investigation would be to explore the findings about upper-division students in more detail, since the literature is limited regarding this population. Gathering and analyzing assignment parameters, with attention to genres, would provide insight into the extent to which students are asked to engage in simply relaying information versus participating in authentic inquiry for knowledge-making purposes. This analysis could lead to opportunities to design curriculum that is more agency-driven, with the goal of promoting student engagement.[81] Longitudinal research would be valuable, too, including conversations with beginning graduate students to explore IL in their upper-division years and the required competencies and dispositions for their graduate work.

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Appendix A

Survey Questions

1. What is your student status?
   - Junior
   - Senior
   - Other _____

2. What is your major?

3. If applicable, what is your minor? (If no minor, please leave blank.)

4. Think back to your last semester (overall time at UC Merced). How often did you find resources for an academic assignment (paper, lab report, presentation etc.)? Choose the statement that most closely fits your experience.
   - Regularly (daily)
   - Often (weekly)
   - Sometimes (monthly)
   - Rarely (maybe one or twice during the semester)
   - Never

5. To what extent has your ability to find and use information (conduct library research) been important to your academic success? Please explain.
   - Very important
   - Important
   - Somewhat important
   - Not very important

6. Overall, how confident are you in your ability to find the information you need for your class work?
   - Very confident
   - Confident
   - Somewhat confident
   - Not at all confident

7. Please indicate the degree to which you agree with the following statement:
   I enjoy doing research.
   - Strongly agree
   - Agree
   - Neutral (sometimes agree, sometimes disagree)
   - Disagree
   - Strongly disagree

Appendix B

Focus Group Interview Questions

Finding and Evaluating Information

1. Think of a specific academic assignment that required you to find resources. What approach (or steps) did you take to locate what you needed?

    a. What did you find most challenging about finding the resources you needed?

2. As you were finding sources, how did you decide what information was useful and credible?

    a. What was most challenging about selecting and evaluating resources?

Confidence and Motivation

3. Have you ever gone beyond assignment expectations by using more resources than were required of you? Why or why not?

4. In order to be successful in your academic research, what kind of skills and knowledge have you needed?

5. What attitudes do you have that you believe help you successfully conduct academic research?

Developing and Transferring Research Strategies

6. Where have you learned (or acquired) your research skills, knowledge and attitudes that you mentioned earlier? (Questions 5 and 6)

    a. Prompt/Rephrase: What classes, individuals, tools, experiences or resources have helped you become better at research?

7. Think back to your Writing 10 class (fall 2014 or other semester). Is there anything you remember learning/doing in Writing 10, related to finding and using information that you have since used for other academic assignments? If you don't have examples from Writing 10, feel free to think of another course.

    a. Follow-up: Why do you think it (the activity, discussion, assignment, feedback) stuck with you? Why has it been helpful?

Closing Reflection

8. What do you think has changed most about your research process since becoming a college student?

9. Before we wrap up, is there anything else you would like to add?

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