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An Assessment of Information Literacy Curriculum in a Family Science College Course

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ABSTRACT. As misinformation proliferates in social media and news, information literacy skills are increasingly important for family science professionals and scholars. Family science courses' focus on controversial issues may contribute to dispositions and practices that support information literacy. However, it is unclear whether there is any added benefit to incorporating an information literacy-focused curriculum. This study presents the pre-and post-test assessment of a family science course on poverty and discrimination that integrated an information literacy curriculum. Repeated-measures ANOVAs tested whether there were significant increases in information literacy dispositions and practices over the semester and whether students in the treatment groups improved more than the control group. Six-week online summer versions of the course, with and without an information literacy curriculum (n = 8 students in each group), did not see significant changes in related attitudes or practices, possibly due to small sample sizes or ceiling effects. However, students in fifteen-week fall courses—in both online (n = 12) and hybrid (n = 21) formats—reported significant improvements over time, particularly in their self-reported information literacy habits and feelings of self-efficacy, though less so in attitudes. Quadratic effects in the online courses suggested a Dunning-Kruger effect, wherein students overestimated their abilities and initially experienced a decline in self-efficacy and habits before experiencing improvements by the end of the semester. Family science educators are encouraged to work with librarians to develop a pragmatic and practice-oriented curriculum to help students increase their confidence and competence in information literacy.

Keywords: information literacy, curriculum assessment, scholarship of teaching and learning, family science

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Human Development and Family Science professionals are employed in a variety of environments and serve diverse populations, especially vulnerable and marginalized groups. Unfortunately, misinformation on family science topics is ubiquitous. Self-proclaimed experts and gurus who make dubious claims about parenting, relationships, aging, and policy abound in news and social media. This media environment requires family science educators, both in Family Life Education and college classrooms, to counterbalance misinformation with evidence-based knowledge and practice, especially considering the diversity and vulnerability of the clientele that family science graduates often serve. In addition to substantive knowledge, family science education increasingly requires cultivating students' information literacy skills. Well-rounded service providers, scholars, and educators must be prepared to navigate an increasingly complex and politically polarized information ecosystem to resist misinformation and provide ethical, evidence-based practice to diverse clientele (NCFR, 2020, p. 5).

Contrary to popular belief, most college students interact regularly with news media. Moreover, professors and the college classroom strongly influence their social media and news consumption habits (Head et al., 2019), suggesting that engaging students in critical analyses of news and social media content in college courses is an indispensable approach to improving information literacy. Therefore, the first two authors—a Human Development and Family Science (HDFS) faculty and subject librarian—collaborated to integrate an information literacy curriculum into CDFS 4710[1], a course guided by critical pedagogy (hooks, 1994) about poverty and discrimination. We assessed whether incorporating this curriculum improved students' information literacy attitudes and practices, as we hypothesized. This paper describes our pedagogical approach, information literacy curriculum, quantitative assessment results, and recommendations. We hope to inspire other educators to incorporate information literacy curriculum into family science classrooms.

Literature Review

Theoretical Framework

In 2016, the Association of College and Research Libraries (ACRL) adopted a revised *Framework for Information Literacy for Higher Education* (i.e., *Framework*), a critical guide for understanding information literacy as a complex set of interrelated competencies. Learners are positioned as active contributors to the information landscape and scholarly conversations. Six frames outline varying components of information literacy, each with a set of knowledge practices and dispositions that further describe the actions and attitudes students need to become information literate. Table 1 describes the six frames and provides an example disposition (i.e., attitude) and knowledge practice as listed in the *Framework*.

[1] During this project the program name was changed from "Child Development and Family Studies" (CDFS) to "Human Development and Family Science" (HDFS). However, course prefixes at the time of this manuscript remain "CDFS" despite the program name change. Therefore, in this manuscript, references to the course are "CDFS 4710," but references to the program will be "HDFS."

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Table 1

ACRL's Information Literacy Framework with Example Dispositions and Practices

Code	Frame	Description	Example Disposition	Example Practice
1	Authority is Constructed & Contextual	Information resources reflect their creators' expertise and credibility and are evaluated based on the information need and the context in which the information will be used. Authority is constructed in that various communities may recognize different types of authority. It is contextual in that the information need may help to determine the level of authority required.	Recognize and question traditional indicators of authority, including formal and informally packaged information	Use research tools and authority indicators to determine source credibility
2	Information Creation as a Process	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.	Resist the tendency to equate format with the underlying creation process	Recognize that information may be perceived differently based on the format in which it is packaged
3	Information Has Value	Information possesses several dimensions of value, including as a commodity, as a means of education, as a means to influence, and as a means of negotiating and understanding the world. Legal and socioeconomic interests influence information production and dissemination.	Understand systematic marginalization with information production systems	Give credit to the original authors through proper citation
4	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.	Maintain an open mind and a critical stance	Critically evaluate others' contributions in participatory information environments
5	Scholarship as Conversation	Communities of scholars, researchers, or professionals engage in sustained discourse with new insights and discoveries occurring over time as a result of varied perspectives and interpretations.	Understand the responsibility that comes with entering the conversation through participatory channels	Contribute to scholarly conversation at an appropriate level, such as local online community, guided discussion, undergraduate research journal, conference presentation/poster session
6	Searching as Strategic Exploration	Searching for information is often nonlinear and iterative, requiring the evaluation of a range of information sources and the mental flexibility to pursue alternate avenues as new understanding develops.	Exhibit mental flexibility and creativity	Seek guidance from experts

Note. The numeric codes in the table are used throughout this manuscript to note alignments with course components.

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The *Framework* is tied to the overarching model of metaliteracy, first proposed by Jacobson and Mackey (2011; 2013). Metaliteracy refers to a larger framework beyond traditional information literacy that incorporates multiple types of literacy (e.g., visual, media, digital). It considers what it means to be literate in a dynamic, fast-moving information ecosystem. Like the Framework, the metaliteracy model emphasizes that students and other learners are active participants in information evaluation, creation, and dissemination, rather than passive content receivers. Metaliterate learners are well-informed, analytical, self-reflective, and willing to collaborate with peers and other information producers (Metaliteracy, 2024).

Information literacy skills align with Family Life Education Content and Practice Guidelines (NCFR, 2020). For example, the tenth content area, Family Life Education Methodology, requires Certified Family Life Educators (CFLE) to be able to "identify and utilize appropriate sources for evidence-based information," which includes skills like the ability to "recognize and locate reliable sources of information (i.e., scholarly journals, government agencies, etc.)," and "evaluate sources of information" (p. 7). These are reflected in the ACRL frames (1) Authority is Constructed and Contextual, (2) Information Creation as a Process, (4) Research as Inquiry, and (6) Searching as Strategic Exploration (see Table 1). Additionally, as part of the ninth content area, Professional Ethics and Practice, CFLEs should "recognize and deconstruct personal bias" (p. 6), which aligns with frames (1) Authority is Constructed and Contextual, (2) Research as Inquiry, and (5) Scholarship as Conversation. The same frames are pertinent to a CFLE's ability to "analyze policy resources for evidence of bias (e.g., unintended, inherent, political, and self-interest)" (Family Law and Public Policy content area, p. 5). Finally, two other CFLE ethical practice content goals are "recognizing and respecting the diversity of values and the complexity of value choice in a pluralistic society; [and] examining value systems and ideologies systematically and objectively" (p. 6), which align with (2) Research as Inquiry and (5) Scholarship as Conversation. Family science students who develop metaliteracy skills are better prepared to strategically search for and critically evaluate sources of information to inform evidence-based practice with a keen awareness of their own and others' biases in creating and interpreting that information within a diverse society. As such, the Framework was our theoretical guide in developing course learning objectives and their corresponding assessments.

Controversial Class Topics and Information Literacy

Our first research question investigated to what extent studying controversial topics, such as poverty and discrimination, increased students' information literacy (RQ1). Since the time of Protagoras and Aristotle, debate has been applied to develop students' abilities to think critically and engage with controversial issues (Vo & Morris, 2006; Dutilh Novaes, 2021). Critical thinking skills form the foundation of information literacy and are significant predictors of whether students can discern reliable and unreliable information (Orhan, 2023). According to the National Council for the Social Studies (2010), a curriculum incorporating controversial issues promotes several attitudes and practices that overlap with information literacy, such as "making informed decisions or conclusions"; "critical analysis and evaluation in considering ideas, opinions, information, and sources of information"; and "recognition that differing viewpoints are valuable and normal" (p. 334). Thus, educational experiences that sharpen students' critical thinking skills might also contribute to their information literacy skills, such as evaluating source credibility and contributing responsibly to public debate.

Given people's strong feelings about contentious issues, discussing controversial topics provides opportunities for students to explore the relationship between reason and emotion. Controversial issues also require students to consider multiple conflicting perspectives (Kraatz et al., 2022), encouraging skepticism and curiosity. In addition to promoting critical thinking skills, small-group discussions about

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controversial issues foster prosocial outcomes such as socially accepting classmates, more harmonious peer relationships, less aggression, improved communication skills, and better group work strategies (Lin et al., 2022). These prosocial attitudes and behaviors foster information literacy skills that, in turn, support continued productive engagement in public debates and scholarship. Moreover, discussing contentious topics in classrooms also promotes civic engagement and critical news consumption (Barton & McCully, 2007; Tannenbaum, 2013).

More specifically, social issues such as racism, classism, sexism, and discrimination (discussed throughout CDFS 4710) have a unique potential to foster critical thinking. Perspectives on these topics are diverse and emotionally charged, which requires students to be critical of their own ideas, listen to opposing views, and question dominant ideas and practices (Noddings & Brooks, 2017). Many educators have published articles on leveraging curriculum and discussing social issues to promote students' critical thinking and positive civic engagement (e.g., Caldwell, 2012; Husband, 2012; Milner, 2003; Welton et al., 2015). Therefore, because CDFS 4710 students engaged in multiple in-depth small group discussions about controversial topics such as poverty, racism, sexism, and discrimination, our first hypothesis was that even students enrolled in the course without an information literacy curriculum would see increases in information literacy attitudes and practices over the course of the semester (H1).

Information Literacy Curriculum Efficacy

Our second research question was to what extent an information literacy curriculum improved students' information literacy attitudes and practices over the course of the semester beyond the impact of the curriculum on controversial topics (RQ2). Research suggests that instruction in evaluating social media and digital news content can affect students' critical thinking, improve information literacy skills, and increase abilities to detect misinformation (Al Zou'bi, 2022; Alexander & Wood, 2019; Chyne et al., 2023). Young adults are more likely to get their news from social media, but they are also ill-equipped to evaluate what they encounter on those platforms (Evanson & Sponsel, 2019; Orhan, 2023). Fake news runs rampant on social media, and the inability to evaluate social content can lead to sharing misinformation, increased divisiveness, and reinforced biases. Information literacy interventions on these topics encourage students to be critical consumers of social media content and to be skeptical about what they encounter online (Chen et al., 2015).

Critical evaluation of news and social media can take many forms. Cowles et al. (2024) created an information literacy course on visual health misinformation to teach students how to spot images used out of context, discern AI-generated content, and identify manipulated visual data. Kamela and Carpenter (2023) advocated using TikTok to teach students about scholarship as conversation, openness to collaboration, and contributing to communities of shared inquiry. Boyle (2022) proposed using memes to teach information literacy skills in the library classroom, mainly because students are familiar with the format. Though memes may seem trivial, they are often vehicles for fake news and political polarization (Huntington, 2020). They can spread rapidly online, making them a vital source for teaching strategic information-seeking and evaluating credibility.

Studies have also shown that fact-checking or lateral reading (i.e., going outside a source to verify claims or locate contextual information) interventions impact students' abilities to determine source credibility and evaluate claims with supporting evidence (Brodsky et al., 2021; McGrew et al., 2019; McGrew, 2020). Students typically struggle with assessing information quality and investigating online sources beyond a cursory glance despite their familiarity with social media, Google, and other digital sources (Mahmood, 2016; Breakstone et al., 2021). Reading laterally moves students away from relying on a superficial, simplified checklist to evaluate information. It encourages them to employ the

same tactics as professional fact-checkers when interrogating a potential source (Wineburg & McGrew, 2019). Movement away from checklists, such as the CRAAP test, synchronizes well with the metaliteracy-informed *Framework* (2015; Jacobson and Mackey, 2011; Meriam Library, 2010). This journalistic model of source evaluation—asking who, what, when, where, and why—also forces students outside of a yes/no or good/bad binary and requires them to view information through a more critical lens (Elmwood, 2020).

Indeed, students benefit from practicing lateral reading in a classroom environment. Addy (2020) modeled lateral reading strategies in librarian-led information literacy sessions and found that students reported feeling more skeptical about sources of misinformation after engaging in lateral reading activities with fake news sources. Brodsky and colleagues (2021) incorporated lateral reading instruction into a general education course and assessed the efficacy through pre- and post-tests. Students exposed to the lateral reading curriculum scored higher on source evaluation assignments and self-reported more reliance on lateral reading strategies. Axelsson et al. (2021) used online tutorials centered on principles of civic online reasoning (including lateral reading and click restraint, i.e., mindfully pausing to review search results instead of clicking the first link in the list) with students in control and intervention groups. The intervention group overwhelmingly outperformed the control group in given assignments, particularly their ability to assess source credibility through fact-checking after completing assigned tutorials.

Xiao et al. (2021) posited that critical consuming—the ability to analyze, synthesize, and evaluate online content and new media—is one of the best defenses for young individuals as they navigate increasingly complex information environments, especially social media networks rife with misinformation. Lateral reading and source evaluation are key critical information consumption and creation skills. Students must be allowed to practice these strategies, ideally as part of thoughtful, well-planned interventions. Given the inclusion of information literacy curriculum and practice in some sections of CDFS 4710 (i.e., treatment group), our second hypothesis was that students exposed to this information literacy curriculum would see significant improvements in their information literacy practices and attitudes over the course of the semester (H2).

Methods

Curriculum Assessment

We used a multimethod design to assess curriculum impacts, wherein quantitative and qualitative methods were applied separately to answer different research questions (in contrast to mixed-methods research where methods are integrated to answer a single research question; Plano Clark & Ivankova, 2016). Multimethod designs are common particularly when part of the study is quasi-experimental, as is the case for this study (Mark, 2015). This article will report findings from the quantitative assessment that evaluated research questions and tested hypotheses regarding to what extent the curriculum intervention was effective, making comparisons between groups and across time. The Institutional Review Board approved this study at the university where it was conducted (Protocol 21-1198). We asked students to complete three anonymous online surveys: one at the beginning (i.e., before the social media module), one in the middle (i.e., right before the news media module), and one at the end of the semester. Data in this study were from two summer online courses (the 2021 control group and a 2022 treatment group), two fall hybrid courses in 2021 and 2022, and a 2023 fall online course (all treatment groups). Students were given extra credit for completing each survey via Qualtrics. Qualtrics sent emails notifying the instructor which students had completed each survey phase. Qualtrics randomly assigned students participant ID numbers that they could enter on follow-up surveys, allowing us to pair their data

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across time points. To preserve anonymity and promote honest responses, Qualtrics did not record these IDs, so the instructor could not pair students with their responses. After the Summer and Fall 2021 data collection, the instructor awarded an additional extra credit bonus to any student who completed all three surveys, which helped improve completion rates.

Sample

The initial sample included 96 students, not including invalid responses. Responses were considered invalid and removed from each phase if they either (a) did not consent at the beginning of the survey (12 instances), (b) completed less than half of the survey (e.g., stopping after demographic questions; 4 instances), or (c) failed at least two of the three attention check items in the survey (0 instances). Repeated-measures ANOVAs remove participants who are missing data, so 47 participants were not in these analyses because they did not complete all three phases of data collection. Therefore, the final sample was 49 students. Although this sample is small, previous studies evaluating educational interventions with similarly sized samples have provided valuable insights (e.g., Kaelin et al., 2008; Upshur et al., 2014), though results should be interpreted cautiously .

All participants were women. Ages ranged from 20 to 36 (M = 22.6 years, SD = 3.1). The class was racially diverse, captured in the sample used for analyses. About half (49%, n = 24) racially identified as White, 25% (n = 12) as Black, 14% (n = 7) as Latina, 2% (n = 1) as Asian, 2% (n = 1) as Middle Eastern/North African (i.e., Kurdish), and 8% (n = 4) as multiracial/multiethnic (e.g., Iranian-Black). Students came from a bell-shaped distribution of socioeconomic backgrounds. When asked to click on an image of a 10-rung ladder representing their family of origin's collective economic, educational, and social status, 16% of participants selected rung three or below, 37% were between rungs three and five, 33% were between rungs five and seven, and 14% selected rung seven or above.

Religiously, most students were Christian, with over half identifying as Protestant (61%, n = 30) and another 10% (n = 5) identifying as Catholic. One student was Muslim (2%). A sizable minority were religiously unaffiliated—11 students (23%) described themselves as spiritual without affiliation, and two students (4%) were agnostic or atheist.[2] On average, students were fairly religious—mostly agreeing on a 4-point scale that religion was "important in their life" (M = 3.4, SD = 0.8) and attending religious services at least once per month (M = 3.6, SD = 1.7, range = 1 to 6).

Politically, students were only slightly liberal in their views on social (M = 3.2, SD = 1.7) and economic issues (M = 3.4, SD = 1.6), wherein 1 = extremely liberal and 7 = extremely conservative—though the full range of the scale was represented in the sample. Although about 47% of students (n = 23) said they essentially agreed with their parents' political leanings, 4% (n = 2) said they were at least somewhat more conservative, and 39% (n = 19) said they were at least somewhat more liberal than their parents. Five students (10%) did not answer this question. At the beginning of the semester, almost half of the students identified with left-leaning political parties, such as the Democratic Party (41%, n = 20), the Green Party (4%, n = 2), and the Socialist Party (2%, n = 1). Another 22.5% identified as Republicans (n = 11), and 8% identified as Libertarian (n = 4). Two students identified as independent/moderate (4%), and nine were missing responses (18.5%).[3]

[2] Each survey phase asked students about their religious affiliations. These values represent Phase 1 responses. Two of the spiritual but unaffiliated students changed their identifications by the final survey—one to Protestant and the other to Catholic.

[3] Each survey phase asked students about their political party affiliation. The two students who switched their party identification on follow-up surveys did so evenly—one switched from Republican to Democrat, and the other switched from Democrat to Republican.

Students reported their course experience on six 5-point Likert scale items: (1) their anticipated grade (i.e., F to A), (2) how much they enjoyed the course, (3) how much effort they put into the course, and (4) how much of the (a) readings, (b) participation activities, and (c) small group discussions they completed. Overall, it appears that students who gave moderate or high scores on these items were well-represented in the sample, whereas students who did very poorly in the course (e.g., all respondents expected to make at least a B in the course) or did not enjoy it (e.g., only five students, 10%, rated it less than three on the 5-point enjoyment scale), were underrepresented.

CDFS 4710 Overview

Each year, twenty to thirty juniors and seniors take CDFS 4710 *Economic and Social Contexts of Individuals and Families*, a required course for Human Development and Family Science (HDFS) majors. The only prerequisite for this course is the introductory HDFS course, *Family Relations*. However, by the time they enroll in CDFS 4710, many students have already taken several HDFS courses, such as those on human development, parenting, family violence, and resilient families. In each module, students completed independent learning (e.g., reading journal articles or textbook chapters, watching videos, completing activities, taking quizzes) followed by a recorded online small-group discussion to process their learning.

In 2021, a hybrid version of the course was offered during fall semesters as the summer online version was phased out (last offering was in 2022). This hybrid format allowed the whole class to meet weekly for student-led, in-person discussions about each module to follow up on small-group online discussions. Weekly meetings also created opportunities for additional information literacy in-class activities compared to online-only versions of the course. In 2023, an online version of the fall course was offered because the regular instructor was on medical leave. Table 2 summarizes the course offerings during data collection and the final number of students included in the sample for this study.

Given the changes in class format during data collection, we tested two versions of Hypothesis 2 for CDFS 4710 fall and summer versions of the course. The only control group for this quasi-experimental study was an online six-week summer course. There was no control group for the fifteen-week fall version of CDFS 4710, which was offered once as an online course and twice as a hybrid course (with additional assignments and activities).[4] Thus, we could compare control and treatment groups from two summer semesters, but we did not have a control group to compare the fall or hybrid versions of the course.

For all semesters, students completed surveys at three time points (beginning, middle, and end of the course). Therefore, for the summer semesters, we compared the control and treatment groups' self-reported information literacy change over time. We hypothesized that summer students in the control group, without an information literacy curriculum, would demonstrate less improvement in information literacy attitudes and practices over the course of the semester than summer students in the treatment group who were exposed to an information literacy curriculum (H_{2a}). Since the fall semesters had no control group, we limited our analyses to whether those students significantly improved over time. We hypothesized that fall students who went through an information literacy curriculum would report increased information literacy practices and attitudes from the beginning to the end of the semester (H_{2b}).

[4] Having implemented the information literacy curriculum before the online summer section was phased out and before the first hybrid fall version of the course meant there was never a hybrid fall course without information literacy curriculum. Positive student feedback (both informal and formally on written-response survey questions) created an ethical issue of withholding this curriculum from students for the purposes of generating a hybrid fall semester control group.

Table 2

*CDFS 4710 Course Offerings (*N= *49)*

Year	Semester	Treatment Group	Format	*n*
2021	Summer	Control*	Online	8
2021	Fall	Treatment	Hybrid	8
2022	Summer	Treatment*	Online	8
2022	Fall	Treatment	Hybrid	13
2023	Fall	Treatment	Online	12

Note. Asterisks (*) note which semesters were compared as pre- and post-test groups in statistical analyses (H2b). The n represents the number of students in the final sample of this study based on whether they provided data at all three phases of data collection.

CDFS 4710, in both content and design, was already well-suited for enhancing critical thinking, which lays the foundation for information literacy (Orhan, 2023). Course content focused on issues of systemic power structures such as poverty, race, and discrimination, which created multiple opportunities to ask critical questions regarding who is an "authority" on such topics inside and outside of the classroom (ACRL frames 1, 3, 5; see Table 1). Repeatedly, students were required to identify and apply competing theories of poverty that shape much of U.S. political discourse (Davis & Sanchez-Martinez, 2015), analyze which theory most aligns with their own worldview, and reconsider their perspective in light of research and alternative narratives (frames 1, 4, 5, 6). Consistent with metaliteracy, CDFS 4710 implemented a critical pedagogy (hooks, 1994) and community approach to learning: (a) guided readings (frame 5); (b) reflective (frames 1, 4, 6) and analytic (frames 3, 4, 5) assignments; (c) group discussion (frames 1, 3, 4, 5); and (4) a "facilitator" rather than "instructor" role (frame 1). These pedagogical alignments with the ACRL *Framework* (2015) support our expectation that, even without the information literacy curriculum, students' related attitudes and practices would improve (H_1).

In 2021, the course instructor and HDFS subject librarian received a grant from the university library to integrate information literacy curriculum into CDFS 4710. They closely collaborated, using the *Framework* to strengthen the existing curriculum, create new assignments, and develop assessments. Table 3 outlines how revised course learning objectives align with the dispositions and practices from the *Framework*. We added or revised several course components to improve students' information literacy. CDFS 4710's curriculum, activities, assignments, and examples are in the appendices.

Description of CDFS 4710 Course Components

Information Literacy Modules

We added two new modules to the course curriculum—one at the beginning of the semester about social media literacy and a second module halfway through the semester about news media literacy. Modules covered subjects such as cognitive biases, logical fallacies, media persuasion, propaganda, misinformation, disinformation, peer-review process, journalism ethics/process, fact-checking, lateral reading, click restraint, and media literacy skills. Although we used multiple sources to curate these modules, two particularly useful curriculum sources were CrashCourse's (2018) Media Literacy video playlist and Civic Online Reasoning (2020) videos. These videos and the information literacy skills covered in them have been effective in improving students' ability to critically evaluate the veracity of content online (Wineburg et al., 2022).

Table 3

Course Learning Objectives Alignment with Information Literacy Frameworks

Type	Learning Objective	ACRL Information Literacy Framework Alignment
Content	1. analyze micro- and macro-level forces that promote or threaten economic security for diverse individuals and families across the lifespan	
	2. critique individual, community, and societal mechanisms of discrimination and inequity.	
Dispositions	3. adopt a skeptical yet open stance toward new information and ideas	[1]Develop awareness of the importance of assessing content with a skeptical stance [3,5]Understand systematic marginalization with information production systems [1]Recognize and question traditional indicators of authority, including formal and informally packaged information [4]Maintain an open mind and a critical stance [6]Exhibit mental flexibility and creativity
	4. practice intellectual humility and reflexivity	[1]Develop awareness of the importance of assessing content with a[…]self-awareness of their own biases and worldview; frequent self-evaluation [4]Demonstrate intellectual humility
Practices	5. critically evaluate the credibility and assumptions of various information sources	[1]Use research tools and authority indicators to determine source credibility [5]Critically evaluate others' contributions in participatory information environments [6]Seek guidance from experts
	6. support one's claims and opinions with evidence and citations	[1]Acknowledge they are developing their own authoritative voices in a particular area and recognize the responsibilities this entails, including seeking accuracy and reliability [3,5]Give credit to the original authors through proper citation [4]Draw reasonable conclusions based on analysis of information
	7. listen and contribute as a member of a diverse community of inquiry	[3]See themselves as contributors to the information marketplace, not merely consumers [5]Guided discussion

Note. Notations indicate frames for information literacy: 1 = *Authority is Constructed & Contextual*, 2 = *Information Creation as a Process*, 3 = *Information Has Value*, 4 = *Research as Inquiry*, 5 = *Scholarship as Conversation*, 6 = *Searching as Strategic Exploration.*

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Discussion Questions and Guidelines

Discussion is a central learning modality in CDFS 4710. In online and hybrid versions of the course, students engaged in recorded online small-group discussions (Coffey, 2012). The questions that guided these discussions were revised to encourage more information-literate attitudes and skills (e.g., critical self-reflection, evidence-based reasoning). Additionally, on the first day of the hybrid course, the instructor led a discussion about how to have responsible and productive conversations about controversial issues, starting with a video about the unique purposes of safe versus brave spaces (True Colors United, 2019). After discussing the video, the instructor and students collaboratively crafted "Brave Space" discussion guidelines that enumerated student responsibilities, instructor responsibilities, and recommendations on how to disagree (e.g., Brazill, 2020).

The Fight (or Folly) for $15

We added a new assignment to the course to allow students to evaluate claims on a controversial topic using evidence from reputable sources. This assignment combined skills such as referencing high-quality sources to inform opinions through lateral reading, which is often used in information literacy programs (Brodsky et al., 2021), and argument formation, as in a debate class (Scott, 2008). For this assignment, we asked students to watch two videos about arguments for and against raising the federal minimum wage to $15 per hour. They were to list each argument from the video as "pro" or "con" in a table. Next to each argument, they were asked to fact-check that claim using reputable data from a non-partisan or scholarly source and include a working hyperlink to that source. We provided some data sources in advance, but students were allowed to find their own sources if desired. Then, students would mark whether the data did or did not support the claim made in the videos. Finally, we asked students to take a stance on this policy issue and explain how they came to their conclusion based on data and evidence. The instructor's feedback on this assignment asked students to resubmit for errors or poor-quality data sources. In the hybrid course, a peer-led, in-class debate on this issue followed.

Newsday Tuesday

Newsday Tuesday was a new assignment series for the hybrid version of this course. Students were encouraged to pay more regular attention to reputable news outlets (as opposed to receiving all news filtered through social media algorithms). Thus, we asked students to listen to NPR's *Morning Edition* or *All Things Considered*. For ten of the fifteen weekly class meetings (on Tuesdays), they were required to submit hand-written answers to questions about one of the news stories they heard that was related to course content: (1) summarize the story, (2) explain the relation to the course, (3) share what they learned, (4) ask follow-up questions, and (5) critique news coverage quality (similar to Katz, 2024). For every class period, the instructor randomly selected a few of the submitted Newsday Tuesdays for students to share with the class.

Librarian Guest Lectures

In the hybrid version of the course, immediately following each information literacy module, the HDFS librarian led an in-class guest lecture and activity. The instructor and subject librarian collaborated closely on each classroom visit's lecture and activity. Research shows that collaboration between librarians and instructors on shared learning objectives and meaningful assignment design can significantly impact students' abilities to practice and retain critical information literacy skills (Bene & Murphy, 2022; Gibson & Massey, 2024; Smith & Daley, 2013; Stellwagen et al., 2022).

The social media literacy lecture began with a discussion of cognitive biases and logical fallacies commonly seen in online content (e.g., confirmation bias, framing effect), with examples of how these

biases and fallacies allow misinformation to thrive on social platforms. The librarian introduced students to lateral reading through the SIFT method (Stop; Investigate the source; Find better coverage; Trace claims, quotes, and media to the original context), coined by digital literacy expert Mike Caulfield (2019). The instructor and subject librarian modeled lateral reading strategies for students using an example of social media about a timely topic (e.g., a convincing-looking Facebook post about vaccines), explaining step-by-step how to investigate a source and question its credibility and accuracy. After guided practice, students were divided into groups and asked to evaluate political memes using the lateral reading strategies they had just learned. Groups presented their findings, and a robust dissection of each meme followed. At the end of class, the instructor introduced students to their forthcoming Meme of the Week assignment (described below), which followed the same basic outline as the in-class practice activity.

The news media literacy lecture was structured similarly. Class began with a continued discussion of lateral reading, reinforcing the SIFT method for fact-checking news sources. The subject librarian and instructor discussed click restraint, journalistic ethics, news outlet and author bias before modeling how to laterally read a news article using the SIFT method. Students again had the chance to practice lateral reading in class by analyzing one of two news articles. Like the previous social media literacy lecture, the news media literacy lecture and in-class activity prepared the students for the Current Event Analysis Paper (CEAP) assignment introduced at the end of class.

Meme of the Week

Information literacy curricula have incorporated memes as a learning tool in many creative ways (Boyle, 2022). For CDFS 4710, a new assignment for the hybrid version of this course was Meme of the Week. Each week, a group of students led a class discussion regarding student-selected social media content germane to the most recent course curriculum. To prepare for class, presenting groups would use the SIFT method and lateral reading to critique the social media post. During the weekly in-person class meetings, they led their classmates in applying the SIFT method and critically discussing the social media content.

Current Event Analysis Paper

The Current Event Analysis Paper (CEAP), an existing assignment in the course, was revised for treatment groups. For this paper, students analyzed a current event related to the course curriculum. Identifying bias is essential to the source evaluation process (Platts, 2018). Students who can comfortably identify an author's perspective can better assess the quality of the author's writings (Burkholder & Phillips, 2022). Before information literacy curriculum revisions, despite scaffolded assignments wherein students practiced applying the theories of poverty, they often did not recognize how those biases implicitly influenced news reporting. Moreover, many students could not evaluate journalistic quality and, thus, struggled to select appropriate news outlets for this assignment. Therefore, we redesigned this paper assignment to include lateral reading wherein students were also required to (1) explicate how clues in the news media indicated the author's theoretical leanings, (2) provide background information about the credibility of the author, (3) use lateral reading to learn more about the current event or to find differing perspectives, and (4) evaluate the original news source's journalistic integrity.

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Measures

Information Literacy

We assessed information literacy concepts embedded in the ACRL-inspired course learning objectives (Table 3) by using a modified version of Foster et al.'s (2018) 36-item Student Perceptions of Information Literacy Skills (PILS) scale. The original measure has six subscales, one for each ACRL frame (see Table 1). This scale has demonstrated internal reliability and convergent and discriminant validity in a sample of graduate students (Doyle et al., 2019). However, the face validity of some questions is poor for undergraduate respondents or those who are not actively involved in research (e.g., "I feel comfortable calling myself a researcher, and am confident as an authority on my topic."). Therefore, we dropped or revised some items to make them pertinent to our undergraduate sample (details in footnotes).

A priori concept definitions were based on ACRL frames and the PILS. However, we refined definitions to reflect patterns developed in qualitative analysis (not presented in this manuscript) and to improve conceptual clarity and distinctiveness. A single item best represented some concepts, either because it conceptually aligned with the concept's qualitative coding scheme or because Cronbach's alpha was poor when including other items. In contrast, other subscales were best measured with a composite score using multiple items.

Skepticism. We defined skepticism as a disposition wherein students approached new information or perspectives with caution, ready to question critically. The PILS item that best captured skepticism was "Not all information sources are credible" (1 = *Strongly disagree* to 7 = *Strongly agree*), with a higher score indicating more skepticism.

Empiricism. Most information literacy subscale concepts were present at the study's outset and in course learning objectives. However, empiricism was the only concept we developed later during qualitative coding because of its distinctiveness and prevalence in written responses. We defined empiricism as a disposition wherein students value grounding claims and opinions in evidence and credible sources. Empiricism was measured using the mean of three items: "It is important that evidence informs my opinions[5]," "It is important that my opinions are informed by credible sources," and "I understand why it's important to cite sources of information," rated from 1 = *Strongly disagree* to 7 = *Strongly agree*, with a higher score indicating more empiricism (Phase 1 $\alpha = .66$, Phase 2 $\alpha = .69$, Phase 3 $\alpha = .73$). Although the internal reliability for some of the phases was in questionable ranges, we retained all three items for the composite score because (1) they had strong conceptual overlap with our definition (i.e., face validity), (2) they provided a more comprehensive assessment of empiricism (i.e., content validity), (3) alpha reliability dropped when removing any one item, and (4) the low Cronbach's alpha may be an artifact of only having three items (Cortina, 1993).

Openness. We defined openness as a curious disposition wherein students are ready to momentarily suspend judgment to facilitate considering new information or perspectives, particularly those that contradict their current knowledge or understanding. We measured this concept using the mean of students' ratings from 1 = *Strongly disagree* to 7 = *Strongly agree* on two PILS items: "I am open-minded when seeking information," and "I am curious when seeking information," with a higher score indicating more openness. Kendall's tau tested internal reliability instead of Cronbach's alpha

[5] This item was not originally on the PILS. We created it by modifying the PILS question, "It is important that my opinions are informed by credible sources," which was also used in this subscale.

because there were only two items—both ordinal variables—with a small sample size (Field, 2013). For all three phases, the correlation was a small to medium effect size (τ = .44 to .64, $p < .001$).

Intellectual humility. We defined intellectual humility as a disposition wherein students view their perspective as one of many potentially valid viewpoints because they realize there are limits to their knowledge. We developed a single item to measure intellectual humility because the PILS did not directly measure this concept: "I recognize when I do not know enough to form an opinion on a topic" (1 = *Never* to 7 = *All the time*). A higher score indicated more intellectual humility.

Reflexivity. We defined reflexivity as a practice wherein students could identify their specific biases and how those biases could limit their perspective or shape their opinions (e.g., recognizing their tendency toward confirmation bias). We measured reflexivity using a modified PILS question[6], "I critically evaluate my own perspectives and understanding of a topic" (1 = *Never* to 7 = *All the time*). A higher score indicated the student practiced reflexivity more often.

Critically evaluating source credibility. We defined this practice as students actively critiquing the trustworthiness of an information source. The mean of two items—"I evaluate info and media (news, social media, books) that I encounter to identify potential biases[7]," and "I critically evaluate others' perspectives that inform my own understanding of a topic[8]" — rated on a scale from 1 = *Never* to 7 = *All the time* were used to measure this practice. A higher mean score indicated the student practiced critically evaluating information sources more frequently. For all three phases, the correlation was a small to medium effect size (τ = .42 to .57, $p < .001$).

Strategically seeking information. We defined this concept as engaging in purposeful practices to find information to fill knowledge gaps or verify the credibility of an initial information source. A high mean score of five items[9] meant that students frequently used strategic information-seeking skills (1 = *Never* to 7 = *All the time*): "The first search may not always produce the desired result," "I go beyond the first search result when looking for information," "I refine the results of a search by using different search terms," "I use the appropriate search tool (search engine, library catalog, database) to use when searching for information," and "I use different kinds of sources (news, articles, law, policies, statistical data) when searching for information." Internal reliability for these items across all three phases was very good ($\alpha > .83$).

Supporting claims with evidence and citations. We defined this practice as students fact-checking themselves to ground their claims and opinions in evidence or providing citations to their supporting evidence. Students who reported engaging more frequently in these practices scored higher on a mean of two items[10]: "I support my ideas by using proper citation techniques" and "I support my

[6] The original version on the PILS was, "I critically evaluate the perspectives that I use to develop an understanding of my topic."
[7] We modified this statement from the PILS item, "I evaluate research ideas and practices to identify potential biases."
[8] We modified this statement from the PILS item, "I critically evaluate the perspectives that I use to develop an understanding of my topic." The original wording was better suited for [developing] researchers (e.g., "my topic").
[9] The following are the original items from the PILS. We modified survey questions to emphasize the frequency of student behaviors rather than their attitudes or sense of self-efficacy: "I understand that the first search may not always produce the desired result," "I can refine the results of a search by using different search terms," "I can identify the appropriate search tool (search engine, library catalog, database) to use when searching for information," and "I can identify potential kinds of sources (newspaper, article, laws, policies, statistical data) when searching for information."
[10] We used the following PILS item as the basis for both of these items: "I know how to use the work of others to support my ideas by using proper citation techniques." We separated the components of this item into two distinct practices and reworded it to measure the behavior frequency rather than self-efficacy (i.e., "I know").

ideas using scholarly research and data" (1 = *Never* to 7 = *All the time*). The correlation between these items had a medium effect size for all three study phases (τ = .52 to .65, $p < .001$).

Listening. We broadly defined listening as a practice wherein students actively work to understand others' experiences, information, reasoning, feelings, or opinions to broaden their understanding. This practice could include both listening during interpersonal conversations and actively trying to understand others' perspectives by reading books or consuming other media. The PILS did not have an ideal item to measure listening, so we used the following modified item instead: "I seek out alternative viewpoints and information when forming my opinion on a topic," wherein a higher score indicated more frequent listening (1 = *Never* to 7 = *All the time*).[11]

Contributing to a diverse community of inquiry. This multifaceted learning objective reflected a culmination of attitudes and behaviors that promoted valuing diverse perspectives (i.e., "I value diversity of worldviews and opinions, no matter how unpopular or controversial they may be," 1 = *Strongly disagree* to 7 = *Strongly agree*[12]) in a way that facilitated one's ability to have conversations in communities in which a variety of opinions and experiences are represented (i.e., "I can have constructive conversations with people whose viewpoints differ from mine," 1 = *Strongly disagree* to 7 = *Strongly agree*; an item we developed). Since these two items were significantly correlated in all three study phases (τ = .34 to .62, $p < .01$), a higher mean score indicated a greater capacity to participate in discussions with people whose perspectives differed from one's own.

Information literacy self-efficacy. We used seven items to measure students' confidence in performing various information literacy-related skills. On three items, participants indicated how frequently they were confident doing specific tasks (1 = *Never* to 7 = *All the time*): "I can make sense of conflicting opinions," "I feel comfortable evaluating the evidence that supports differing perspectives,"[13] and "I can organize and combine the information I locate into a coherent conclusion." On four items, participants indicated how much they agree with statements about their abilities (1 = *Strongly disagree* to 7 = *Strongly agree*): "I understand how to evaluate the credibility of sources,"[14] "I can create search strategies to locate and collect the information I need," "I understand how to cite information," and "I understand when to cite information."[15] For all three phases, internal reliability for these seven items was very good ($\alpha > .83$). A higher mean score indicated a high sense of information literacy self-efficacy.

Analysis

We ran repeated-measures ANOVAs in SPSS version 29. Our first hypothesis was that even students enrolled in the course without an information literacy curriculum would see increases in information literacy attitudes and practices over the course of the semester because of their opportunity to learn about and discuss controversial topics (H_1). We tested this hypothesis with the Summer 2021 six-week online course subsample (n = 8 students who completed all three surveys), the only students who did not receive the information literacy curriculum (pre-test control group). Our second hypothesis was that students whose course curriculum included information literacy would see better improvement

[11] We adapted this item from the PILS item: "I seek out multiple perspectives when developing an understanding of a topic."
[12] We adapted this item for a more general audience from the PILS item: "I value diversity of worldviews and opinions within my discipline."
[13] We adapted these two items by splitting up the following PILS item: "I feel comfortable with conflicting opinions in research and evaluating the evidence that supports differing perspectives."
[14] We created a simplified version of the PILS item: "I understand how to select and evaluate authoritative sources to develop credibility for their arguments."
[15] We took these two items directly from the PILS.

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in information literacy over the semester than those who did not receive the curriculum (H_{2a}). For an apples-to-apples comparison, students in the Summer 2022 six-week online course (n = 8 students) — the first section implementing information literacy curriculum — were compared to Summer 2021 students (i.e., a treatment group). The fifteen-week fall version of the course had both online and hybrid offerings. The hybrid course included more assignments, librarian instruction, and practice opportunities. There was no control group for the fall course, so these analyses tested our hypothesis that students' information literacy would significantly improve over time (H_{2b}).

Missing Data Analysis

We ran chi-square tests, one independent samples t-test (age only), and Mann-Whitney U tests to determine whether the participants in the final sample (i.e., students who completed all three waves of data collection) significantly differed from the larger sample of 96 students on demographic, course experience, or information literacy variables. Those in the final sample had mothers with marginally lower education (U = 635, p < .10) and reported doing less of the required reading (U = 768.5, p < .05) than those excluded from the final sample. Summer students were more likely to have completed all three survey phases than were fall students [$\chi^2(1, 96) = 4.15$, $p < .05$]. Also, students taking the course when the instructor was on medical leave for the second half of the semester were marginally less likely to complete all three phases [$\chi^2(1, 96) = 3.52$, $p < .10$]. Moreover, those in the final sample reported at least marginally more empiricism (Phase 2 U = 849, p < .10), openness (Phase 3 U = 768.5, p < .10), intellectual humility (Phase 3 U = 784, p < .05), critical evaluation of source credibility (Phase 3 U = 809.5, p < .05), strategic information seeking (Phase 3 U = 760, p < .10), supporting their opinions with evidence and citations (Phase 3 U = 823.5, p < .05), constructively contributing to diverse community conversations (Phase 1 U = 756.5, p < .05; Phase 3 U = 778, p < .10), and information literacy self-efficacy (Phase 3 U = 777, p < .05). Students with lower information literacy scores appear underrepresented, particularly in the final wave of data collection. Therefore, any results supporting the hypothesis that the curriculum improved these scores over time should be interpreted cautiously.

Results

Table 4 presents the means and standard deviations for information literacy outcomes across the entire sample.

Repeated-Measures ANOVAs

Our first question was to what extent studying controversial topics, such as poverty and discrimination, increased students' information literacy. We hypothesized that even students enrolled in the course without an information literacy curriculum would see increases in information literacy attitudes and practices over the semester. To test this hypothesis, we ran a one-way repeated-measures ANOVA for each information literacy dependent variable to determine whether there was a significant change across the three survey phases for the Summer 2021 control group (n = 8). Table 5 presents the results for these ANOVAs.

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Table 4

*Descriptive Statistics (*N = *49)*

	Phase 1		Phase 2		Phase 3	
	M	*SD*	*M*	*SD*	*M*	*SD*
Skepticism	6.59	.79	6.67	.63	6.75	.67
Empiricism	6.35	.70	6.38	.73	6.38	.71
Openness	6.32	.75	6.30	.78	6.50	.75
Intellectual humility	5.88	1.33	6.04	1.14	6.20	.98
Reflexivity	5.78	1.16	5.76	1.03	5.96	.84
Critically evaluating source credibility	5.02	1.41	5.17	1.13	5.61	.92
Strategically seeking information	5.44	1.26	5.60	.96	6.06	.80
Supporting claims with evidence and citations	5.19	1.36	5.09	1.14	5.80	.96
Listening	5.43	1.24	5.20	1.40	5.86	.94
Contributing to a diverse community of inquiry	5.95	1.09	5.92	.99	6.19	.83
Information literacy self-efficacy	5.38	.95	5.57	.95	5.95	.79

Table 5

Control Group Repeated-Measures ANOVA

	Mauchly's Sphericity Test		Multivariate Testing		
	χ^2	ε^a	*F*	*V*	ω^2
Skepticism	1.04	.86	.17	.05	0
Empiricism	3.30	.70	2.36	.44	0
Openness	.89	.88	.06	.02	0
Intellectual humility	8.06*	.58	1.34	.31	0
Reflexivity	1.00	.87	.91	.23	0
Critically evaluating source credibility	2.67	.74	.95	.24	0
Strategically seeking information	7.61*	.58	.89	.23	.05
Supporting claims with evidence and citations	.23	.96	2.04	.41	0
Listening	2.80	.73	1.22	.29	0
Contributing to a diverse community of inquiry	.07	.99	.93	.24	0
Information literacy self-efficacy	3.94	.68	1.97	.40	0

Note. Degrees of freedom for all Mauchly's sphericity tests = 2. The Greenhouse-Geisser ε sphericity estimate is reported. Degrees of freedom for all multivariate tests = 2,6.
*p < .05.

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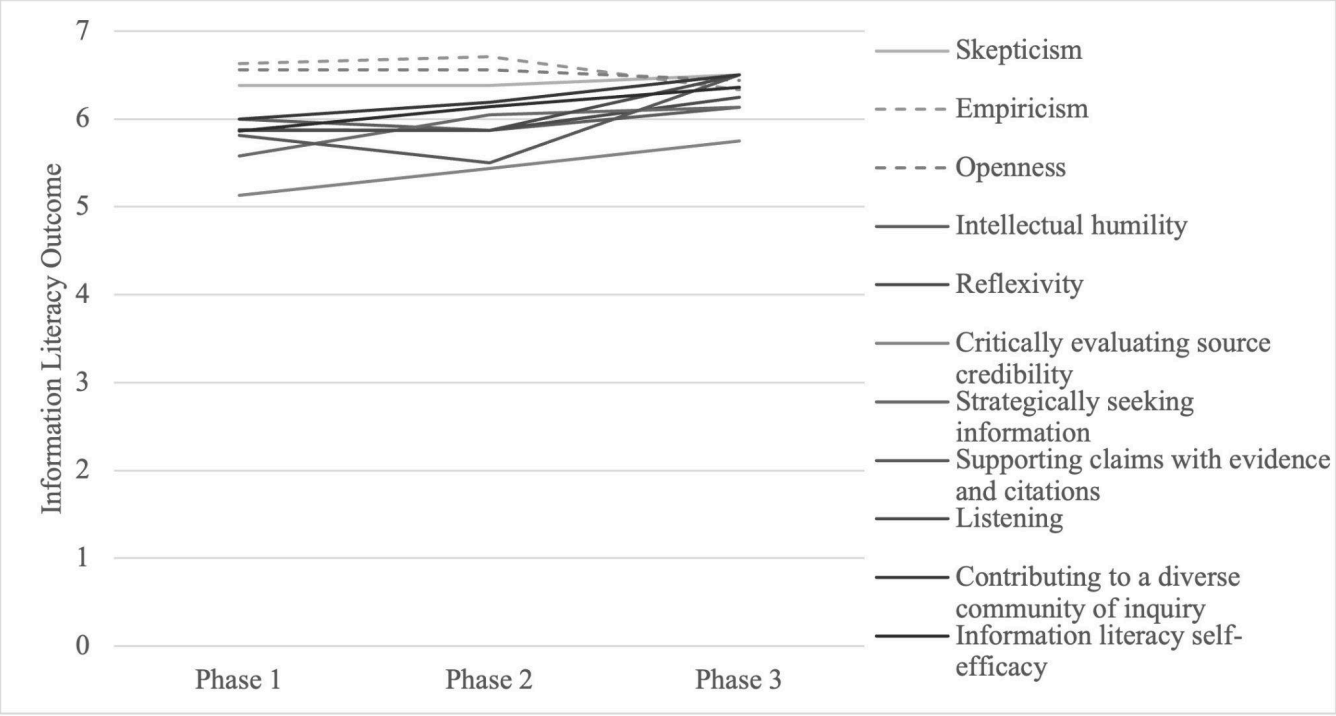
According to Mauchly's test, the assumption of sphericity was violated in ANOVAs for intellectual humility [$\chi^2(2) = 8.06$, $p < .05$, $\varepsilon = .58$] and strategic information-seeking [$\chi^2(2) = 7.61$, $p < .05$, $\varepsilon = .58$]; therefore, we report multivariate tests because sphericity is not assumed (Field, 2013). None of these tests showed significant differences in information literacy outcomes ($V < 4.5$, $F(2,6) < 2.4$, $p > .10$). Therefore, we failed to reject the null hypothesis. Despite learning about and discussing controversial issues with classmates, there was no statistically significant increase in information literacy attitudes or practices without an information literacy curriculum. Although means for outcomes increased over time (Figure 1), these changes were small, due in part to ceiling effects. Failure to detect these small effect sizes could be due to a small sample ($n = 8$) and low statistical power.

Our second question was to what extent an information literacy curriculum improved students' information literacy practices and attitudes during the semester beyond the impact of controversial topics in the curriculum. For the summer semesters, we hypothesized that students in the control group without an information literacy curriculum would demonstrate less improvement in information literacy practices and attitudes during the semester than students in the treatment group who were exposed to an information literacy curriculum (H_{2a}). To test this hypothesis, we conducted a mixed repeated-measures ANOVA.

Figure 1

*Control Group Perceived Information Literacy Practices and Attitudes Over Time (*n = *8)*



Note. Solid lines represent a positive change from Phase 1 to Phase 2. Dashed lines represented a negative change from Phase 1 to Phase 3. No changes are statistically significant ($p > .10$).

Table 6

*Summer Control (n = 8) versus Treatment Group (*n *= 8) Mixed Repeated-Measures ANOVAs*

	Mauchly's Sphericity Test		Box's Test		Multivariate Testing for Time X Group		
	χ^2	ε^a	*F*	Box's *M*	*F*	*V*	η_p^2
Skepticism	1.74	.89	[a]	[a]	.09	.01	.01
Empiricism	.11	.95	2.03†	15.92	3.49†	.35	.35
Openness	.90	.94	1.66	13.05	1.33	.17	.17
Intellectual humility	14.84***	.60	1.44	11.31	.84	.11	.11
Reflexivity	2.32	.86	.72	5.68	.29	.04	.04
Critically evaluating source credibility	5.64†	.74	.95	7.43	.74	.10	.10
Strategically seeking information	4.94†	.76	2.55*	20.05	5.98*	.48	.48
Supporting claims with evidence and citations	.23	.98	1.09	8.53	.18	.03	.03
Listening	1.09	.93	9.50	1.21	.97	.13	.13
Contributing to a diverse community of inquiry	.03	.98	1.43	11.26	.87	.12	.12
Information literacy self-efficacy	.02	.99	9.79	1.25	.45	.07	.07

Note. Degrees of freedom for all Mauchly's sphericity tests = 2. The Greenhouse-Geisser ε sphericity estimate is reported. Degrees of freedom for all Box's test of equality of covariance matrices = (6,1420.075). Degrees of freedom for all multivariate tests = 2,13.
[a] Could not be computed because of fewer than two nonsingular cell covariance matrices.
† p < .10. *p < .05. **p < .01. ***p < .001.

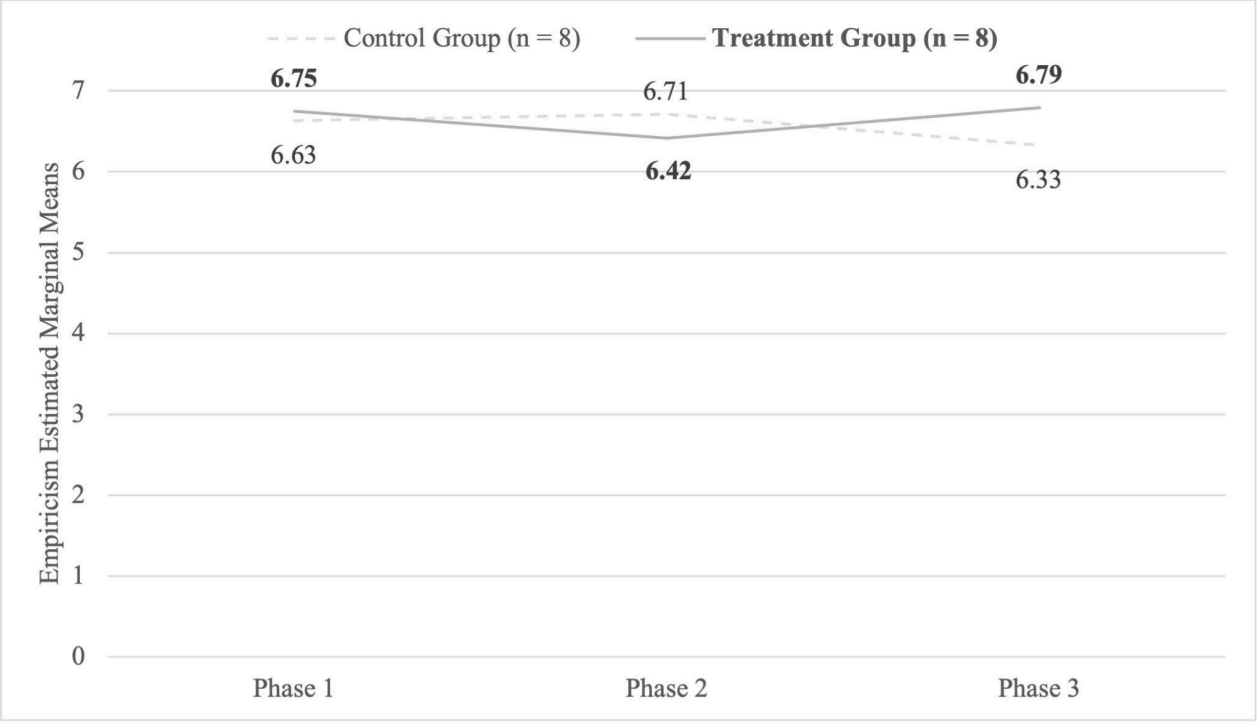
ANOVAs for intellectual humility [$\chi^2(2) = 14.84$, $p < .001$, $\varepsilon = .60$], critically evaluating source credibility [$\chi^2(2) = 5.64$, $p < .10$, $\varepsilon = .74$], and strategic information-seeking [$\chi^2(2) = 4.94$, $p < .10$, $\varepsilon = .76$] violated assumptions of sphericity. Also, Box's test for homogeneity of covariance matrices was at least marginally significant for empiricism [$F(6,1420) = 2.03$, $p < .10$, Box's $M = 15.92$] and strategic information-seeking [$F(6,1420) = 2.55$, $p < .05$, Box's $M = 20.05$]. However, Field (2013) suggests that Box's test can be ignored if sample sizes are equal—which is true in this case—because Pillai's *V* is a robust test. Even still, we report multivariate tests for the interaction between survey phase and treatment group since they are robust against violations of these assumptions (Field, 2013). Only two information literacy outcomes were at least marginally significant—empiricism [$V = .35$, $F(2,13) =$

3.49, $p < .10$, $\eta_p^2 = .35$][16] and strategically seeking information [$V = .48$, $F(2,13) = 5.98$, $p < .05$, $\eta_p^2 = .48$]. Another assumption violation was Levene's test of equality of error variances based on the means for empiricism in Phase 3 ($p < .05$) and strategic information-seeking in Phase 1 ($p > .10$) and Phase 2 ($p < .05$).

Given the violation of assumptions for these two information literacy outcomes, we used the Greenhouse-Geisser correction when examining within-subjects fixed effects to avoid making a Type I error (Field, 2013). Within-subjects fixed effects interaction between time and treatment group was significant for empiricism [Greenhouse-Geisser $F(1.98, 27.77) = 3.85$, $p < .05$, $\eta_p^2 = .22$], such that a combination of change over time and treatment group explained 22% of the variance in empiricism attitudes. There was also a significant quadratic effect [$F(1) = 5.68$, $p < .05$, $\eta_p^2 = .29$]. There were no significant findings among various pairwise comparisons of estimated marginal means based on survey phase, treatment group, phase by treatment group, or treatment group by phase. Thus, to aid interpretation, the estimated marginal means for each group are presented in Figure 2. Although ceiling effects and slight quadratic trajectories characterized both groups, the control group trends slightly downward, whereas the treatment group slopes slightly upward. This lends some support to Hypothesis 2a, such that the treatment group reported better improvements than the control group regarding how much they valued grounding claims and opinions in evidence and credible sources.

Figure 2

Empiricism Estimated Marginal Means for Summer Control and Treatment Groups



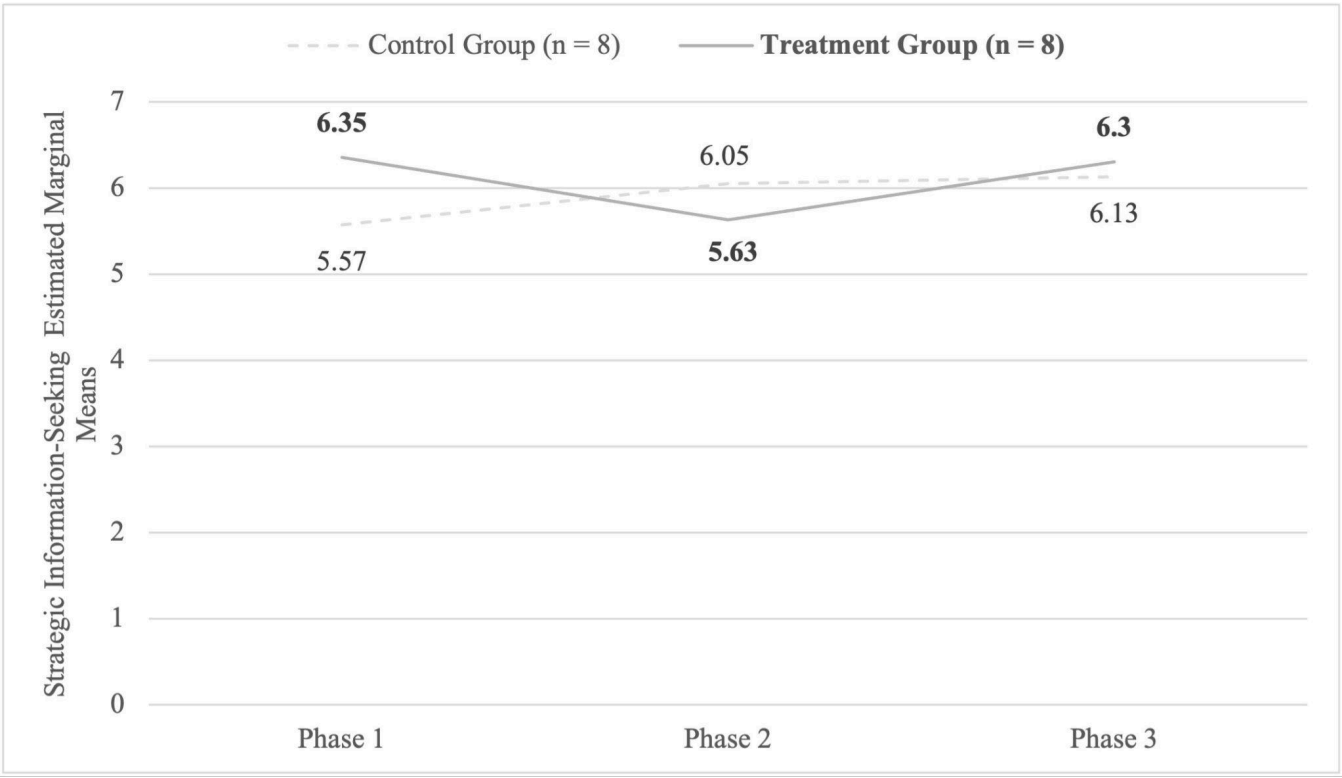
Note. Dashed lines and unbolded values represent control group means. Solid lines and bolded values represent treatment group means.

[16] Given the very small sample sizes in this study and, consequently, weak statistical power, we note marginally significant findings ($p < .10$) to avoid Type II errors. Perhaps with a larger sample size, these findings would meet convention cut-offs of statistical significance ($p < .05$).

For strategic information-seeking, the interaction between time and treatment group had significant within-subjects fixed effects [Greenhouse-Geisser $F(1.52, 21.28) = 5.49$, $p < .05$, $\eta_p^2 = .28$], such that a combination of change over time and treatment group explained 28% of the variance in how often students used strategic methods when seeking information. Again, there was a significant quadratic effect [$F(1) = 12.81$, $p < .01$, $\eta_p^2 = .48$]. Pairwise comparisons of estimated marginal means showed that, only for the treatment group, there was a marginally significant decrease in the frequency of strategic information-seeking behaviors between Phases 1 and 2 [$V = .58$, $F(2,13) = 8.84$, $p < .10$] and a significant increase in these behaviors between Phases 2 and 3 [$V = .58$, $F(2,13) = 8.84$, $p < .01$]. Neither group saw a significant difference between Phases 1 and 3, though the control group increased, whereas the treatment group slightly decreased (Figure 3). The significant main effects for strategic information-seeking behaviors appear to be driven more by the quadratic nature of the treatment group's trajectory than by the overall improvement (or deterioration) of either group's information literacy practices or attitudes. Overall, we failed to reject the null for Hypothesis 2a based on this result. Considering the lack of significant findings (except for a slight, but not significant, increase in empirical attitudes for the treatment group compared to a decrease for the control group), results broadly do not support Hypothesis 2a. That is, implementing an information literacy curriculum did not significantly improve self-reported informational literacy attitudes or practices beyond the control group.

Figure 3

Strategic Information-Seeking Estimated Marginal Means for Summer Control and Treatment Groups



Note. Dashed lines and unbolded values represent control group means. Solid lines and bolded values represent treatment group means.

For Hypothesis 2b, we limited our analyses to whether information literacy behaviors and attitudes for students in the fall courses significantly improved over time because the fall semester did not have a control group to test against. We expected that fall students who went through an information literacy curriculum would see an increase in information literacy attitudes and practices from the beginning to the end of the semester. Again, we ran a one-way repeated-measures ANOVA for each information literacy dependent variable. However, we ran ANOVAs separately for the online (n = 12) and hybrid (n = 21) courses due to differences between their curriculum and overall student learning experience. Table 7 and Table 8 present results for online and hybrid fall treatment groups, respectively.

For all online fall course ANOVAs, Mauchly's test indicated sphericity could be assumed; therefore, we report within-subjects effects without corrections along with Pillai's Trace V. Two results showed significant changes over time: critically evaluating source credibility [$V = .50$, $F(2, 22) = 5.07$, $p < .05$, $\omega^2 = .05$], which had a small effect size, and information literacy self-efficacy [$V = .58$, $F(2, 22) = 8.18$, $p < .01$, $\omega^2 = .10$], which had a medium effect size (Field, 2013). Moreover, evaluating source credibility had a marginally significant quadratic effect [$F(1) = 4.21$, $p < .10$, $\eta^2 = .28$]. Bonferroni pairwise comparisons revealed that students in the online fall course reported a significant increase between Phase 2 and Phase 3 surveys in how frequently students critically evaluated sources' credibility ($p < .05$).

Table 7

Online Fall Treatment Group Repeated-Measures ANOVAs (n = 12)

	Mauchly's Sphericity Test		Within-Subjects Effects		
	χ^2	ε^a	F	V	ω^2
Skepticism	.50	.95	.19	.04	0
Empiricism	.02	1.0	1.46	.20	.01
Openness	.52	.95	.15	.03	0
Intellectual humility	1.75	.86	.10	.03	0
Reflexivity	.23	.99	.31	.06	0
Critically evaluating source credibility	.09	.99	5.07*	.50	.05
Strategically seeking information	2.46	.82	2.06	.41	0
Supporting claims with evidence and citations	1.09	.91	1.41	.26	0
Listening	4.20	.74	1.65	.41	.03
Contributing to a diverse community of inquiry	.27	.97	.63	.09	0
Information literacy self-efficacy	1.57	.87	8.18**	.58	.10

Note. Degrees of freedom for all Mauchly's sphericity tests = 2. The Greenhouse-Geisser ε sphericity estimate is reported. Degrees of freedom for all within-subjects effects = 2,22.
†$p < .10$. *$p < .05$. **$p < .01$. ***$p < .001$.

Table 8

*Hybrid Fall Treatment Group Repeated-Measures ANOVAs (*n *= 21)*

	Mauchly's Sphericity Test		Multivariate Testing		
	χ^2	ε^a	F	V	ω^2
Skepticism	14.59***	.64	2.04	.19	.01
Empiricism	4.57	.82	2.90†	.23	.01
Openness	4.52	.83	1.31	.12	0
Intellectual humility	2.63	.89	1.10	.10	.001
Reflexivity	7.34*	.76	.87	.08	0
Critically evaluating source credibility	10.06***	.71	2.19	.19	.06
Strategically seeking information	11.08***	.69	5.26*	.36	.08
Supporting claims with evidence and citations	1.55	.93	4.08*	.30	.03
Listening	4.73†	.82	4.54*	.32	.03
Contributing to a diverse community of inquiry	5.02†	.81	1.22	.11	0
Information literacy self-efficacy	.87	.95	7.64**	.46	.04

Note. Degrees of freedom for all Mauchly's sphericity tests = 2. The Greenhouse-Geisser ε sphericity estimate is reported. Degrees of freedom for all multivariate tests = 2,19.
†$p < .10$. *$p < .05$. **$p < .01$. ***$p < .001$.

Hybrid fall ANOVAs for skepticism [$\chi^2(2) = 14.59$, $p < .001$, $\varepsilon = .64$], critically evaluating source credibility [$\chi^2(2) = 10.06$, $p < .001$, $\varepsilon = .71$], and strategic information-seeking [$\chi^2(2) = 11.08$, $p < .001$, $\varepsilon = .69$] violated assumptions of sphericity; thus, we report multivariate tests because sphericity is not assumed (Field, 2013). Several information literacy outcomes changed over time: being strategic when seeking information [$V = .30$, $F(2, 19) = 5.26$, $p < .05$, $\omega^2 = .08$], supporting one's claims with evidence and citations [$V = .30$, $F(2, 19) = 4.08$, $p < .05$, $\omega^2 = .03$], seeking out alternative views when developing one's opinion [$V = .30$, $F(2, 19) = 4.08$, $p < .05$, $\omega^2 = .03$], and feeling confident about one's information literacy skills [$V = .46$, $F(2, 19) = 7.64$, $p < .01$, $\omega^2 = .04$]. All of these had a small effect size ($\omega^2 < .06$), except strategic information-seeking, which had a medium effect size ($.06 < \omega^2 < .14$; Field, 2013). Empiricism attitudes also changed over time but were only marginally statistically significant and had a small effect size [$V = .23$, $F(2, 19) = 2.90$, $p < .10$, $\omega^2 = .01$]. Moreover, information literacy self-efficacy had a marginally significant quadratic effect [$F(1) = 3.77$, $p < .10$, $\eta^2 = .16$]. Bonferroni pairwise comparisons showed a significant increase in how confident students felt about their information literacy skills between Phases 1 and 3 ($p < .01$) and Phases 2 and 3 ($p < .01$), but not between Phases 1 and 2 ($p > .10$).

Figure 4 displays statistically significant changes in information literacy outcome means in both the online and hybrid versions of the fall semester. All changes were positive from the beginning to the end of the semester, indicating students reported improving information literacy, as expected. Overall, these findings lend support to Hypothesis 2b, particularly regarding information literacy practices and feelings of self-efficacy, but less so regarding attitudes. Moreover, students in the hybrid course reported significant improvements in a wider variety of information literacy practices than online students.

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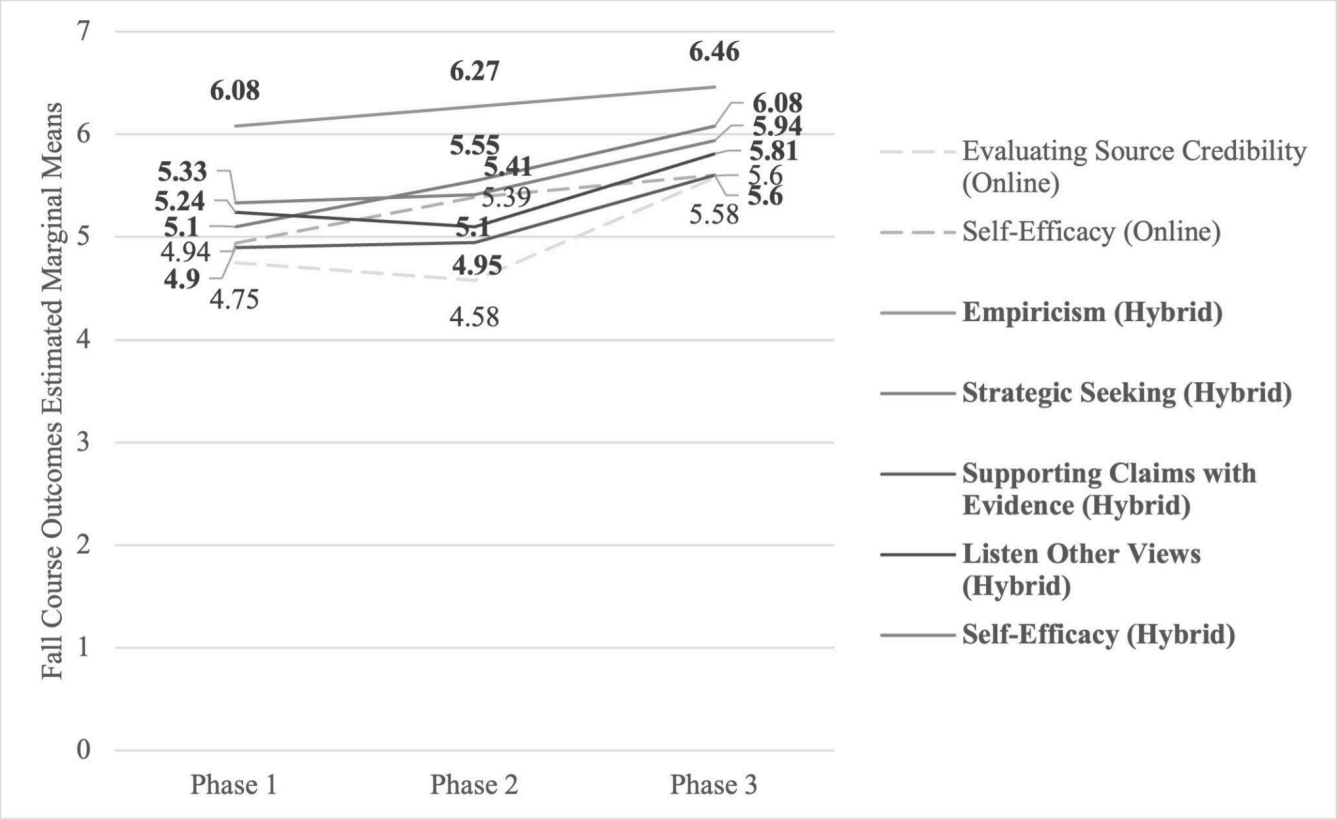
Figure 4

Fall Treatment Groups Self-Reported Information Literacy Practices and Attitudes Over Time



Note. Dashed lines and unbolded values represent online fall course outcomes. Solid lines and bolded values represent hybrid fall course outcomes. Only information literacy outcomes with statistically significant ($p < .10$) changes are presented.

Supplemental Analyses

Summer semester trends largely did not increase over time (H_1), nor were they statistically different from each other (H_{2a}), whereas fall semester trends demonstrated significant changes for at least some variables (H_{2b}). This raises the possibility that the extended length of the fall semester (15 weeks) versus the shorter summer semester (6 weeks) may have had advantages for students' learning. We tested this possibility in supplemental analyses. Since control and treatment summer groups were not statistically different from one another, summer online subsamples were combined ($n = 16$) to improve statistical power. This online summer sample was compared (using the same statistical methods as H2b) to the online fall course ($n = 12$). The only (marginally) significant difference between fall and summer online courses was students supporting their claims with evidence and citations. The within-subjects fixed effects interaction between time and semester was marginally significant [Greenhouse-Geisser $F(1.98, 50.12) = 2.68$, $p < .10$, $\eta_p^2 = .09$], explaining 9% of the variance in supporting one's opinion with evidence. There was also a marginally significant quadratic effect [$F(1) = 3.94$, $p < .10$, $\eta_p^2 = .13$], largely driven by an increase in this practice between Phases 2 and 3 for summer semesters; by Phase 3, the summer average on this measure was significantly higher than that of fall ($p < .01$). Otherwise, comparisons by survey phase and semester group were not significant above conventional levels ($p > .10$). Overall, this suggests the longer fall semester did not offer any advantages for student learning.

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Further supplemental analyses compared hybrid (n = 21) and online (n = 20) versions of the course, which seemed to explain some of the previous results.[17] For example, hybrid students reported a marginally significant linear growth trajectory in empirical attitudes as opposed to the small but linear decline found in online students [Greenhouse-Geisser $F(1.94,75.70) = 3.15$, $p = .05$, $\eta_p^2 = .08$]. Moreover, changes in evaluating source credibility were marginally different between course delivery methods [Greenhouse-Geisser $F(1.66,64.55) = 2.53$, $p < .10$, $\eta_p^2 = .06$], which included a quadratic effect [$F(1) = 6.48$, $p < .05$, $\eta_p^2 = .14$]. Online students saw a slight decrease in Phase 2 and, therefore, a bigger increase from Phase 2 to Phase 3 ($p < .01$); hybrid students increased more gradually from Phase 1 to Phase 3 ($p < .10$). Similarly, strategic information-seeking behaviors were somewhat different between hybrid and online courses [Greenhouse-Geisser $F(1.60,62.52) = 3.10$, $p < .10$, $\eta_p^2 = .07$]. Although both online and hybrid groups had similar Phase 3 averages, the hybrid group saw significant increases between all phases ($p < .01$), whereas the online course only increased from Phase 2 to 3 ($p < .01$). In general, the online students were more likely to decline before experiencing gains than the more linearly progressing hybrid students.

Discussion

Given the prevalence of misinformation about family science topics across media, today's students must develop attitudes and practices that equip them to navigate rapidly changing information ecosystems and maintain evidence-based practice. The ACRL *Framework for Information Literacy for Higher Education* (2015) can help design family science course objectives, curriculum, assignments, and assessments that promote metaliteracy, including essential competencies for CFLEs, human service providers, and family scholars (NCFR, 2020). Many family science courses engage students with controversial issues, which may develop their critical thinking skills and other hallmarks of metaliteracy (Orhan, 2023; Wineburg et al., 2022). However, educators may wonder if including a curriculum designed to develop information literacy is also beneficial. This study sought to determine whether controversial topics alone facilitated the development of information literacy (RQ_1) and whether incorporating a targeted information literacy curriculum had any added benefit (RQ_2). We expected that both courses with and without an information literacy curriculum would improve students' self-reported perceptions of their information literacy attitudes and practices (H_1 and H_{2b}) and that those improvements would be greater in the course with the targeted curriculum (H_{2a}). We found mixed results for these hypotheses.

We did not find support for our expectation that the course wherein students learned about and discussed controversial topics such as discrimination and poverty significantly improved their self-reported information literacy practices and attitudes. Moreover, in a direct comparison of online summer courses with and without an information literacy curriculum, we mostly did not find statistically significant differences in changes of their dispositions and practices. Although students in both groups, on average, reported increases in their information literacy outcomes, the effects were too small to be detected with such small sample sizes.

Importantly, students' perceptions of their information literacy were already very high at the outset of the course, and therefore, ceiling effects limited growth opportunities. Although most of the HDFS juniors and seniors in this course have some experience with thinking critically and discussing

[17] Two versions of this analysis were conducted. One excluded the control group in the online subsample (reported in text because it offers more similar curriculum comparisons), and one included it (n = 28; bigger sample size, more statistical power). Results were similar in supporting the advantage of a hybrid classroom, though estimates' sizes varied. For example, when the control group was included in analyses, there was conventional (rather than marginal) significant difference for empiricism between course delivery formats. Hybrid students reported a significant linear growth in empirical attitudes compared to the slight decline among online students [Greenhouse-Geisser $F(1.97,92.39) = 4.45$, $p < .05$, $\eta_p^2 = .09$]. More information about these findings is available by request.

controversial topics, this semester often marked a significant turning point in academic rigor. Previous courses offered cursory introductions and limited conversations on controversial topics, but CDFS 4710 has an intensive curriculum and ample peer discussion by comparison. Students often begin the semester with room to grow in their critical thinking and communication skills. In qualitative assessments[18], students cited an array of curriculum components that increased critical media engagement and confidence to participate in previously intimidating controversial conversations. Therefore, we suspect these ceiling effects are an artifact of overconfidence, which is common in self-reports. Future research could avoid this methodological limitation by collecting a larger control group sample and, more importantly, using practical assessments of information literacy skills to supplement self-reports. Practical assessments include asking students to perform information literacy tasks with correct and incorrect answers (e.g., Axelsson et al., 2021; Mahmood, 2016).

Anecdotally, for the treatment group, the instructor observed in small group discussions a decline in students' inflated sense of self-efficacy after completing the first module on social media literacy. After learning about the magnitude of challenges in modern media, students in beginning-of-semester discussions commonly expressed feeling overwhelmed and lacking the confidence to navigate information ecosystems critically. Not until the end of the semester did students begin expressing more confidence. Interestingly, an artifact of this dip in confidence appears in some of the statistical analyses in the form of significant quadratic trajectories. For empiricism, strategic information-seeking, evaluating source credibility, and self-efficacy, students in treatment groups initially saw a decline, followed by improvement toward the end of the semester. Our students' overconfidence at the beginning of the semester is consistent with other information literacy research demonstrating the Dunning-Kruger effect, wherein low-performers on practical assessments overestimate their skills on self-reports (Mahmood, 2016). As students learn more about the problem, their confidence initially declines. Not only does this finding reinforce the importance of including practical tests to assess curriculum efficacy, but it is also crucial for educators to understand if they plan to implement an information literacy curriculum. Instructors, particularly those teaching online courses, should anticipate an initial drop in students' confidence and be prepared to equip them with easy-to-use tools (e.g., fact-checking websites; Ad Fontes Media Bias Chart, 2024), specific skills (e.g., lateral reading, SIFT method), guided practice (e.g., librarian-led activities), and independent practice (e.g., Meme of the Week, Current Event Analysis Paper) to increase their confidence and competence. Failure to explicitly acknowledge students' feelings of overwhelm and respond with a confidence-promoting curriculum could leave students more cynical and disempowered than if they had never learned about information literacy in the first place.

Notably, results supported our expectation that an information literacy curriculum would increase student reports of related practices and self-efficacy, but not for most attitudes, and only in the fall course. Specifically, students in the fall online course reported significant increases in how often they critically evaluated the credibility of sources. Students in the fall hybrid course reported significant increases in how much they valued using evidence to support their opinions (i.e., empiricism), how often they used strategic methods to search for information, how frequently they supported their claims with evidence and citations, and how often they sought out alternative viewpoints when forming an opinion. In the fall, both online and hybrid students reported significant increases in information literacy self-efficacy. Compared to null findings for summer semesters, these significant results for the fall have a few possible explanations. First, the fall semesters had somewhat larger sample sizes, which increased the statistical power (although they were still small, < 25 students). Second, supplemental analyses generally suggested that the course format (hybrid over online) impacted students' learning. Students in hybrid fall courses had more face-to-face time with their instructor and librarian. Not only did in-person

[18] Preparing to publish elsewhere.

conversations allow better student engagement and dynamic discussions, but they also created more opportunities for practice and repetition. For example, hybrid semester students benefited from two librarian-guided in-class practice activities, weekly instructor-led discussions about their social media habits and Newsday Tuesday, and two Meme of the Week presentations per group. These weekly conversations reinforced learning and encouraged students to apply these concepts regularly outside of the classroom in their daily habits by keeping them top of mind. Results support the advantages of these curricular differences. The fall hybrid course saw significant increases across the widest variety of information literacy outcomes compared to online groups in the fall and summer. Moreover, the lack of difference between the outcomes of the 6-week and 15-week online courses indicates that the course format was more important than the course duration.

Limitations and Future Research

In addition to those mentioned above (e.g., small sample size, lack of practical assessment), this study had other limitations. First, although the PILS measurement had some psychometric validity with graduate student populations, it had to be altered for this undergraduate sample. These changes could have introduced untested reliability and validity problems with the measurement. Indeed, some of the subscale items, although all significantly correlated, sometimes had small effect sizes. Future research should develop a measure of self-reported perceptions of information literacy habits, skills, attitudes, and knowledge that is better suited for the general public. As mentioned above, given the overconfidence people tend to have in their information literacy skills, future research should include skill-based practical assessment alongside self-reports. Second, we did not have a control group for the fall semesters to test against the treatment group, which precludes our ability to make causal inferences about the impact of the curriculum. Despite this unfortunate methodological drawback, we felt it unethical to withhold education from students who enrolled in later semesters. Future research at universities with stable course offerings should provide control groups across multiple course formats. Third, although fall courses (particularly hybrid sections) demonstrated improvement in students' self-reported information literacy skills and self-efficacy, long-term studies are needed to determine whether such changes are sustainable. Fourth, although the sample was diverse in socioeconomic background and (to some extent) racial-ethnic diversity, it was also exclusively college women, so findings cannot be generalized to people of other genders or age groups. Fifth, data were not missing at random. Students in the final sample used for this study reported higher scores on some information literacy outcomes (particularly at the end-of-semester survey) than students excluded for not completing all three surveys. Therefore, students for whom the information literacy curriculum was less effective may be underrepresented in the final wave of data collection, and efficacy statistics might be inflated. Although it seems this curriculum was effective for some students in our study, one should not infer that it worked equally well for all students.

Conclusions

Our assessment of the information literacy curriculum showed increases in student self-reports of information literacy in a family science course, particularly during the fifteen-week hybrid offering. Specifically, students reported increased self-efficacy as well as how frequently they critiqued source credibility, used strategic information-seeking strategies, supported their opinions with evidence and citations, and sought out alternative viewpoints when forming their opinions. The summer online version of the same course—both with and without an information literacy curriculum—did not show improvements, possibly because of smaller sample sizes, online implementation, or fewer opportunities to practice. Although this course was about poverty and discrimination, discussing those controversial

topics without an information literacy curriculum did not seem to contribute to information literacy attitudes and practices. Metaliteracy is also critical for other family science courses—parenting, romantic relationships, sexuality—where professionals must resist ubiquitous misinformation across media. We recommend that faculty consider collaborating with librarians at their institutions to learn more about information literacy and strategically incorporate curricula and assignments into their courses. These efforts will help prepare family science graduates to best serve diverse populations with critical thinking, evidence-based practice, and humility.

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Appendix: List of Supplemental Materials

These supplemental files can be found on the article landing page or by clicking the individual links below.

1. Social Media Module (PDF)
2. Librarian Social Media Guest Lecture (.ppt)
3. Meme of the Week Assignment and Rubric (PDF)
4. Weekly Class Discussion Slides (.ppt)
5. The Fight (or Folly) for $15 (PDF)
6. News Media Literacy Module (PDF)
7. Librarian News Media Guest Lecture (.ppt)
8. Newsday Tuesday Assignment Series (PDF)
9. Current Event Analysis Paper Interactive Guidelines (PDF)
10. Current Event Analysis Paper Example (PDF)

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