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Community College STEM Faculty and the ACRL Framework: A Pilot Study

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Abstract

This study explores the science, technology, engineering, and mathematics (STEM) community college faculty's perspectives on the Association of College and Research Libraries' (ACRL) *Framework for Information Literacy for Higher Education (Framework*). Previous studies of the *Framework* implementation have primarily focused on the librarians' perspectives and efforts. This pilot project seeks to bridge the gap in the study of STEM faculty's views regarding the *Framework* in a community college setting. STEM faculty were asked to rate the importance of information literacy knowledge practices based on the *Framework* in the spring semester of 2021. This paper discusses STEM faculty's ratings of the knowledge practices from each frame. These preliminary findings can be used by STEM librarians and STEM faculty, as well as administrators in charge of STEM programs or curricula at community colleges, for (re)designing

information literacy instruction, integrating information literacy in programs, or assessing information literacy learning outcomes that utilize frames from the *Framework*.

Keywords: Community colleges, Community college science librarians, Community college STEM faculty, ACRL Framework

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Introduction

The *Information Literacy Competency Standards for Higher Education* (American Library Association, 2000) was replaced with the *Framework for Information Literacy for Higher Education* in 2016 (hereinafter referred to as the *Framework*). The *Framework* outlines six frames that are based on threshold concepts and focuses on metaliteracy (Association of College and Research Libraries, 2016). The six frames from the *Framework* are:

- Authority Is Constructed and Contextual
- Information Creation as a Process
- Information Has Value
- Research as Inquiry
- Scholarship as Conversation
- Searching as Strategic Exploration

Since the adoption of the *Framework*, the literature has explored the importance of librarians' roles in implementing the *Framework* and collaborating with faculty to develop student learning outcomes that are in line with curricula (Click et al., 2021; Gross, et al., 2018; Julien et al., 2020; Palumbo, 2018). In addition to the role of librarians, some studies also highlight faculty's active participation in integrating the *Framework* as playing a key role in student success (Barr et al., 2020; Dawes, 2019). However, most faculty may not have knowledge of the *Framework*. Even if they do, they may find that adopting the *Framework* can be challenging due to the vagueness of the concepts and difficult terminology (Guth et al., 2018; Latham et al., 2019). Despite these challenges, the flexibility of the threshold concepts provides an opportunity for faculty and librarians to develop knowledge practices suitable for any discipline and institutional mission (Holden, 2019; Swanson, 2016).

This pilot study is the first step in gauging community college science, technology, engineering, and mathematics (STEM) faculty's perspectives on information literacy (IL) skills based on the threshold concepts of the *Framework*, as implemented in their courses. This paper does not aim to redefine or reframe the *Framework*. Instead, it attempts to investigate which threshold concepts or frames can be implemented in the community college STEM curriculum by STEM faculty.

Literature Review

The Six Frames and the Education Levels

The *Framework* is based on threshold concepts which can be applied to any discipline. The *Framework* states that the lists of the knowledge practices and dispositions of the frames should "not be considered exhaustive," which offers not only freedom of interpretation, but also room for adding complementary knowledge practices and dispositions into the frames (ACRL, 2016, p. 8). The *Framework* allows enough flexibility so that academic librarians can develop knowledge practices suitable across disciplines, including STEM.

The ACRL (2016) states that the concepts of the *Framework* are interconnected and not a separate set of IL skills. For example, teaching the differences between library databases and online search engines such as Google could be in the frame of "Information Has Value" or in the frame of "Information Creation as a Process."

Perceptions on the value of knowledge practices seems to differ at the level of higher education, that is, undergraduate versus graduate level and the first two years versus the last two years of college. Bohemier (2019) indicates that the concept of proprietary databases could be more of an interesting topic to teach graduate and postdoctoral students than to undergraduate students. Kaletski's (2017) survey of faculty perceptions on the *Framework* shows that they consider "Information Has Value," "Scholarship as Conversation," and "Information Creation as a Process" to be IL skills that students need to develop in the last two years of college. In the meantime, faculty identified "Research as Inquiry" and "Searching as Strategic Exploration" as the important IL skills that the first- and second-year college students need to develop (Kaletski, 2017). Kaletski's study is resonant with Wengler and Wolff-Eisenberg's (2020) survey that explores community college librarians' opinions on the *Framework*, in which "Searching as Strategic Exploration" and "Research as Inquiry" are also selected as important frames for community college students. Thus, both faculty and librarians consider "Searching as Strategic Exploration" and "Research as Inquiry" to be the basic IL skills that students should learn within the first two years of college. One survey on librarians' views on implementing the *Framework* reveals that "Searching as Strategic Exploration" and "Research as Inquiry" are also frequently applied to IL instruction across all higher education levels (Hsieh et al., 2021).

Integrating the Six Frames into STEM Disciplines

Schulte and Knapp (2017) suggest that "Authority Is Constructed and Contextual," "Research as Inquiry," and "Searching as Strategic Exploration" be taught in health science courses even if the *Framework* is less used in health science due to rigid evidence-based practice. Guth et al. (2018) surveyed faculty across all disciplines and discovered that faculty value IL skills for their students' success, and that "Research as Inquiry" and "Information Has Value" were the highest ranked frames of all disciplines. Dawes's (2019) study shows that faculty incorporated the frames without knowing the *Framework* and concludes that "Authority Is Constructed and Contextual," "Research as Inquiry," and "Scholarship as Conversation" are the most taught frames

by faculty across the disciplines. "Research as Inquiry" emerged as the most commonly used frame by faculty from all disciplines whether they are familiar with the *Framework* or not.

STEM librarians have also adopted the threshold concepts and applied them into their teaching and assessment of undergraduate or graduate STEM courses (Holden, 2019; Hosier, 2017; Palumbo, 2018). Holden's (2019) study of students' reflections on the frames indicates that they have a better understanding of "Authority Is Constructed and Contextual" and "Scholarship as Conversation," but the rest of the concepts from the frames were much less understood by them. Bohemier (2019) finds that "Information Has Value" and "Scholarship as Conversation" are well fitted to be taught in STEM undergraduate classes, while the "Information Has Value" is appropriate for physics graduates and postdoctoral scholars. The "Information Has Value" frame was particularly found to draw graduate and postdoctoral scholars' interests, as well as give them a clearer "understanding of paywall" and "access privileges to databases" (Bohemier, 2019, p. 80). Thus, "Information Has Value" and "Scholarship as Conversation," followed by "Authority Is Constructed and Contextual," are the most used frames at four-year college STEM courses and graduate programs.

In some ideal cases, librarians at four-year universities participated in developing STEM programs or curricula using the *Framework*. Palumbo (2018) describes a situation in which a librarian embedded the *Framework* into a credit-bearing program for STEM graduate students to redesign a McNair Postbaccalaureate Achievement Program at Rutgers University. In Sadvari's (2019) study, a librarian aligned the *Framework* to the curriculum of a specific discipline by matching the knowledge practices of *Geographic Information Science and Technology Body of Knowledge* (University Consortium for Geographic Information Science, 2019) with the ones from the *Framework*.

Librarians at community colleges have attempted to apply the *Framework* at the community college level (Craven, 2016; Russo, 2017); however, the views on implementing the *Framework* at community colleges differ significantly from those of four-year colleges. Although community college librarians felt that their feedback was not sought when the *Framework* was developed, most community college librarians agree that the *Framework* is relevant to community college IL instruction (Wengler & Wolff-Eisenberg, 2020). Some community college librarians faced challenges when applying the new *Framework* because they believe threshold concepts may not be suitable at the community college level (Reed, 2015). Swanson (2016), however, claims that the *Framework* is a better fit for community colleges because it can be adopted to meet community college programs and curricula due to its flexibility.

Regardless of the debate on whether the *Framework* can be implemented at the associate level (i.e., community college level), the literature on this topic has stressed the value of collaboration between librarians and faculty on the interpretation and implementation of IL skills based on the *Framework* (Click et al., 2021; Dawes, 2019; Devine et al., 2021; Waity & Crowe, 2019). Studies have also placed an emphasis on the importance of faculty's roles in integrating the *Framework* (Barr et al., 2020; Dawes, 2019; Russo, 2017). However, when faculty integrate the *Framework* in their courses, librarians have not typically been part of curriculum design (Russo, 2017). Moran (2019) points out that

while faculty value IL, they do not frequently collaborate with librarians to design curriculum. Therefore, it is recommended that both faculty and librarians work together to integrate IL across the curriculum for greater impact.

Background

Queensborough Community College (QCC) is one of 25 institutions within The City University of New York (CUNY), the nation's largest urban public university (The City University of New York, 2022). QCC confers 29 associate degrees in the liberal arts and sciences (Queensborough Community College, 2022a). The STEM departments at QCC include Biological Sciences & Geology, Chemistry, Engineering Technology, Mathematics and Computer Science, and Physics.

According to the QCC 2022 fact book, spring 2021 student enrollment was 11,217, out of which 7,506 students were enrolled as full-time equivalent (FTE). QCC is one of the most diverse colleges in the nation with students from 111 countries. In fall 2021, among first year students, Black/African-American students comprised 31%, followed by Hispanic (29%), Asian/Pacific Islander (23%) and White students (9%) (Queensborough Community College, 2022b). A total of 717 teaching faculty (383 full-time and 334 part-time) were employed during the 2021 spring semester (G. Lash, personal communication, November 8, 2022).

There are four general education outcomes at QCC (Queensborough Community College, 2018): (1) Communicate effectively in various forms, (2) Use analytical reasoning to identify issues or problems and evaluate evidence in order to make informed decisions, (3) Reason quantitatively as required in various fields of interest and in everyday life, and (4) Apply information management and digital technology skills useful for academic research and lifelong learning.

QCC also implements six high impact practices (HIPs), including: academic service-learning, common read, global and diversity learning, students working in interdisciplinary groups, undergraduate research, and writing intensive courses (Center for Excellence in Teaching and Learning, n.d.). Faculty are encouraged to incorporate as many HIPs in their courses as possible. Each HIP has a coordinator who is responsible for promoting HIPs and facilitating workshops for faculty who may be interested in participation.

All freshmen and transfer students are required to complete two credit-bearing Writing Intensive (WI) courses to receive an associate degree at QCC. In WI courses, students are expected to write a series of short papers to receive feedback, after which they will write a longer paper. Writing is a significant portion of the final grade, up to 30% (Queensborough Community College, n.d.). Instructors must be trained and earn a certificate prior to teaching WI courses.

Research Objectives

The purpose of this study is to investigate which knowledge practices from the six frames of the *Framework* were valued by STEM faculty, as well as to bring awareness of

the *Framework* to them. This pilot project attempts to fill the gap in our understanding of STEM community college faculty perspectives on the *Framework* by addressing the following two research questions:

(1) What frames from the *Framework* are considered important for STEM courses at the associate level?
(2) What knowledge practices from the frames are identified as important IL skills that could be applied to STEM courses at the associate level?

Methods

The research questions were addressed in a survey of STEM faculty at QCC. The survey was emailed to both full-time and part-time QCC STEM faculty members in the departments of Biological Sciences & Geology, Chemistry, Engineering Technology, Mathematics and Computer Science, and Physics. The list of faculty email addresses was constructed from information found on the college's website.

Survey: Selecting Knowledge Practices and Dispositions from the Framework

The authors met in the fall semester of 2020 to conceptualize knowledge practices from the six frames of the *Framework* and to create the survey questions that would best fit the institutional context (i.e., community college). In the survey, the terms library instruction or library session(s) were used to avoid library jargon such as IL that may not be well understood to non-librarians. The authors believed that students conducting research are more than likely required to write papers and in need of library instruction. Therefore, the survey contained questions regarding HIPs. Faculty were asked if they participated in any HIPs and if they made use of library instructional sessions for their classes.

The survey was administered online via SurveyMonkey® and emailed to STEM faculty three times during the spring semester of 2021. The survey was anonymous and composed of 20 questions, related to faculty background information and knowledge practices associated with the six frames of the *Framework*. With respect to the six frames, STEM faculty were asked to rate the importance of knowledge practices to their courses in a Likert scale: 1= not at all important; 2 = slightly important; 3 = moderately important; 4 = very important; and non-applicable (N/A). The results are reported in weighted average (WA) scores. The category of non-applicable (N/A) is excluded from the weighted average calculations. The pilot study was granted IRB approval in spring 2021 and the survey questions are shown in the Appendix.

Results

Respondents and Demographics

Emails were sent to 214 faculty in the departments of Biological Sciences & Geology (71), Chemistry (32), Engineering Technology (22), Mathematics and Computer Science (67), and Physics (22). Forty-one completed the survey (n = 41) resulting in 19%

response rate. The 41 participants included nine faculty from Biological Sciences & Geology, five faculty from Chemistry, ten faculty from Engineering Technology, ten faculty from Mathematics & Computer Science, and seven faculty from Physics. The majority of participants (35 or 85%) are full time faculty, and the rest are adjunct faculty.

Over the last three years, 23 (56%) have taught WI courses for STEM majors while 16 (39%) answered that they have taught WI courses for non- STEM majors. Thirty-one faculty (76%) have taught WI courses, either for STEM majors or non-STEM majors. The sample size is 41 for all the subsequent analyses unless stated otherwise.

Data Analysis

When data was reported, percentages and WAs were rounded off to whole numbers. All of the survey questions were analyzed except for question 7, which asked faculty members what artifacts they had collected as student assignments. It is excluded from the data analysis because the authors no longer believed that it was relevant to this study.

Incorporating High Impact Practices (HIPs)

Faculty were asked what HIPs they had incorporated in their courses for the last three years. Eighteen (44%) respondents indicated they included "undergraduate research" and 14 (34%) of the faculty used "independent study," while 10 (24%) had "honors program" in their courses. HIPs with less than 10% responses include: 7% for "service learning" and 2% each for "global and diversity learning," "common read," and "students working in interdisciplinary groups." Data indicate that the majority of the faculty incorporated "undergraduate research" and/or "independent study" as part of HIPs in their STEM courses.

Research Components in Assignments

Faculty were asked if they had incorporated research components into course assignments, which included doing research; reading articles; finding sources such as articles, books, or datasets; and submitting a paper, essay, infographic, etc. Thirty-one (76%) replied that their course assignments include research components, while 10 (24%) answered that the assignments do not have research components.

Library Instruction in Courses

Only 13 (32%) replied that they had included library instruction in their courses over the last three years, while 27 (66%) of the faculty had not used library instruction. One faculty member responded with "send students [to] 'research' parties at library." While not library instruction, Research Parties are offered by the library for helping students with their research projects at the end of the semester. A flyer with detailed information on the Research Parties is emailed to both full-time and adjunct faculty each semester. Faculty members who were not able to include library instruction in their syllabus could have found these Research Parties useful.

Faculty were asked how much they think the library instruction helped students complete course assignments if they attended library session(s). Among 18 responses, 17 (94%) reported that library instruction helped their students with the assignments to some degree: significantly helped (44%); moderately helped (44%); slightly helped (6%). One faculty replied that it did not help at all.

Faculty doing undergraduate research with students were asked if they agree that incorporating library sessions improve the quality of peer-reviewed publications co-authored with students. Among 25 responses, 16 (64%) agreed that library instruction improved the quality of peer-reviewed publications co-authored with students: Strongly agree (20%) or Agree (44%). Nine (36%) answered with "neither agree nor disagree." None of them answered with "disagree" or "strongly disagree."

Faculty were asked why they did not include library instruction in their courses if they had not used library instruction. Among 30 responses, 18 (60%) answered "not applicable to my courses." Eight (27%) replied with "I wish I could, but no time to include IL session(s)." Three faculty members wrote, "I wasn't aware library sessions were offered." One faculty wrote "I was vaguely aware of the sessions, but had little awareness with respect to the [sic] their content or potential benefits."

QCC General Education Outcomes

STEM faculty were asked to rate the importance of general education learning outcomes for their courses. As shown in Table 1, faculty members considered all the general education outcomes important to their STEM courses, with WA scores of 3.0 or higher. The highest WA score is 3.9: "Use analytical reasoning to identify issues or problems and evaluate evidence in order to make informed decisions" and "reason quantitatively as required in various fields of interest and in everyday life." The outcomes of

Table 1. QCC general education outcomes and level of importance to STEM courses

General Education Outcomes	Not at All Important	Slightly Important	Moderately Important	Very Important	n	WA[a]
Communicate effectively in various forms	0 (0%)	2 (5%)	8 (20%)	31 (76%)	41	3.7
Use analytical reasoning to identify issues or problems and evaluate evidence in order to make informed decisions	0 (0%)	0 (0%)	3 (7%)	38 (93%)	41	3.9
Reason quantitatively as required in various fields of interest and in everyday life	0 (0%)	0 (0%)	5 (13%)	33 (87%)	38	3.9
Apply information management and digital technology skills useful for academic research and lifelong learning	0 (0%)	0 (0%)	14 (44%)	18 (56%)	32	3.6
[a] Weighted Average						

"communicate effectively in various forms" are 3.7, followed by "apply information management and digital technology skills useful for academic research and lifelong learning" at 3.6.

Six Frames of the Framework

Faculty were asked to rate the importance of IL skills in each frame for their courses.

Authority Is Constructed and Contextual

The results of the survey show that high order cognitive dimensions are considered important in the STEM curriculum (Table 2). Among 38 responses, 34 (89%) replied that "develop critical thinking skills to analyze information" is very important and 4 (11%) said it is moderately important. "Evaluate web resources and identify reliable sources" is rated as the second most important skills related to the frame "Authority Is Constructed and Contextual." Other IL skills such as "keep up with current information" and "recognize different types of sources in different formats" scored a WA of 3.2. Ability to "distinguish between primary and secondary sources" was the lowest (WA=3.0). However, all of the knowledge practices from the "Authority Is Constructed and Contextual" frame are considered important skills.

Table 2. Importance of authority is constructed and contextual

Knowledge Practices	Not at All Important	Slightly Important	Moderately Important	Very Important	n	WA[a]
Develop critical thinking skills to analyze information	0 (0%)	0 (0%)	4 (11%)	34 (89%)	38	3.9
Evaluate web resources and identify reliable sources	0 (0%)	5 (13%)	10 (26%)	23 (61%)	38	3.5
Keep up with current information	1 (3%)	10 (26%)	7 (18%)	21 (54%)	39	3.2
Recognize different types of sources in different formats	2 (5%)	6 (15%)	15 (38%)	16 (41%)	39	3.2
Distinguish between primary and secondary sources	2 (5%)	11 (29%)	11 (29%)	14 (37%)	38	3.0
[a] Weighted Average						

Information Creation as a Process

As shown in Table 3, "differentiate between scholarly sources and popular (non-scholarly) sources" (WA=3.3) and "learn the steps in the research process" (WA=3.2) are considered important skills related to the "Information Creation as a Process" frame. Knowledge of how information is created and distributed (WA=2.8) and knowledge of peer-review process (WA=2.7) are considered to be less important IL skills by the STEM faculty.

Table 3. Importance of information creation as a process

Knowledge Practices	Not at All Important	Slightly Important	Moderately Important	Very Important	n	WA[a]
Differentiate between scholarly sources and popular (non-scholarly) sources	2 (6%)	3 (8%)	14 (39%)	17 (47%)	36	3.3
Learn the steps in the research process	2 (5%)	6 (16%)	12 (32%)	18 (47%)	38	3.2
Learn how information is created and distributed. For example, search engines and library databases are organized and distributed differently	5 (14%)	9 (25%)	12 (33%)	10 (28%)	36	2.8
Articulate what the peer-review process is	4 (12%)	13 (38%)	8 (24%)	9 (26%)	34	2.7
[a] Weighted Average						

Information Has Value

As shown in Table 4, "plagiarism" (78%, WA=3.7) is chosen as a very important topic that students need to learn, followed by "concept of copyright, fair use, open access, and public domain" (WA=3.3). "Legal issues on privacy and personal information" (WA=3.0) is also considered important while learning to "cite sources in a proper style…" (WA=2.8) is considered to be less important than the other IL skills associated with the "Information Has Value" frame.

Table 4. Importance of information has value

Knowledge Practices	Not at All Important	Slightly Important	Moderately Important	Very Important	n	WA[a]
Plagiarism	0 (0%)	2 (5%)	6 (16%)	29 (78%)	37	3.7
Concept of copyright, fair use, open access, and public domain	2 (6%)	4 (11%)	11 (31%)	18 (51%)	35	3.3
Legal issues on privacy and personal information	2 (6%)	8 (22%)	13 (36%)	13 (36%)	36	3.0
Cite sources in a proper style format such as APA, CBE, ACS, etc.	6 (16%)	7 (18%)	14 (37%)	11 (29%)	38	2.8
[a] Weighted Average						

Research as Inquiry

As shown in Table 5, STEM faculty believe that the IL skills "organize information and synthesize ideas in writing" (WA = 3.5) are very important to their courses, followed by "formulate and refine a research question" (WA = 3.1) and "use keywords and related terms when searching" (WA = 3.0). Data suggests that students at the associate level

generally do not need to write a paper in the IMRaD format, which stands for introduction, methods, results, and discussion (WA=2.5).

Table 5. Importance of research as inquiry

Knowledge Practices	Not at All Important	Slightly Important	Moderately Important	Very Important	n	WA[a]
Organize information and synthesize ideas in writing	0 (0%)	3 (8%)	12 (32%)	22 (59%)	37	3.5
Formulate and refine a research question	2 (5%)	5 (14%)	16 (43%)	14 (38%)	37	3.1
Use keywords and related terms when searching	2 (5%)	6 (16%)	19 (50%)	11 (29%)	38	3.0
Write a scientific research paper based on the IMRaD format. IMRaD stands for Introduction, Method, Results, and Discussion	10 (29%)	5 (14%)	11 (31%)	9 (26%)	35	2.5
[a] Weighted Average						

Scholarship as Conversation

As shown in Table 6, "Scholarship as Conversation" is a much less valued frame at the associate level compared to other frames with only one knowledge practice being 3.0 or above. However, more than 30% of the faculty considered "respect other points of view and engage in civic discourse" as a very important skill for their students. Given the fact that some faculty that participated in the survey had incorporated Undergraduate Research in their courses, this is not surprising since their students are expected to learn how to communicate in a civic manner. Knowledge related to presenting at a conference (WA=2.5), publishing (WA=2.3), and the role of editors (WA=2.0) is much less expected for the STEM students to learn at the associate level.

Table 6. Importance of scholarship as conversation

Knowledge Practices	Not at All Important	Slightly Important	Moderately Important	Very Important	n	WA[a]
Respect other points of view and engage in civic discourse	2 (6%)	5 (15%)	14 (41%)	13 (38%)	34	3.1
Present at a conference or professional communities	5 (16%)	14 (44%)	5 (16%)	8 (25%)	32	2.5
Publish conference proceedings or scholarly work	9 (29%)	10 (32%)	5 (16%)	7 (23%)	31	2.3
Role of editors in scholarly journals as well as non-scholarly periodicals	14 (40%)	10 (29%)	9 (26%)	2 (6%)	35	2.0
[a] Weighted Average						

Searching as Strategic Exploration

Faculty indicated that students should learn to use library resources (WA=3.0), while the applying subject headings and controlled vocabularies (WA=2.9) and knowledge of Boolean connectors (WA=2.7) are considered a less important skills (Table 7).

Table 7. Importance of searching as strategic exploration

Knowledge Practices	Not at All Important	Slightly Important	Moderately Important	Very Important	n	WA[a]
Navigate library databases and utilize library resources	4 (12%)	7 (21%)	7 (21%)	15 (45%)	33	3.0
Use subject headings and controlled vocabularies to find a more focused and relevant set of results	1 (3%)	10 (29%)	15 (44%)	8 (24%)	34	2.9
Combine keywords using Boolean connectors (AND, BUT, OR)	3 (9%)	9 (27%)	15 (45%)	6 (18%)	33	2.7
[a] Weighted Average						

Table 8. Knowledge practices with highest weighted average scores (3.0 or above)

WA[a]	Knowledge Practices	Frames[b]
3.9	Develop critical thinking skills to analyze information	ACC
3.7	Plagiarism	IV
3.5	Organize information and synthesize ideas in writing	RI
3.5	Evaluate web resources and identify reliable sources	ACC
3.3	Differentiate between scholarly sources and popular (non-scholarly) sources	ICP
3.3	Concept of copyright, fair use, open access, and public domain	IV
3.2	Learn the steps in the research process	ICP
3.2	Keep up with current information	ACC
3.2	Recognize different types of sources in different formats	ACC
3.1	Formulate and refine a research question	RI
3.1	Respect other points of view and engage in civic discourse	SC
3.0	Distinguish between primary and secondary sources	ACC
3.0	Legal issues on privacy and personal information	IV
3.0	Use keywords and related terms when searching	RI
3.0	Navigate library databases and utilize library resources	SSE

[a] Weighted Average

[b] Authority Is Constructed and Contextual (ACC), Information Creation as a Process (ICP), Information Has Value (IV), Research as Inquiry (RI), Scholarship as Conversation (SC), Searching as Strategic Exploration (SSE)

The results indicate that knowledge practices QCC STEM faculty chose from the ACRL frames are well aligned with one of the highly rated QCC general outcomes, "use analytical reasoning to identify issues or problems and evaluate evidence in order to make informed decisions" (WA=3.9). It is notable that these student learning outcomes are in line with the IL skills faculty selected from the frames, that is, high-order

cognitive IL skills such as analyzing, evaluating information, and synthesizing information in writing (Table 8). Similarly, the ability to analyze, evaluate, and synthesize belongs to the high-order cognitive domains according to Bloom's revised taxonomy (Krathwohl, 2002).

Discussion

Results of this study show that a majority of STEM faculty (76%) at QCC have taught WI courses to STEM majors and/or non-STEM majors. Among the faculty who taught WI courses (76%), only 32% of faculty included library instruction in their courses over the past three years. The major reasons for not including IL instruction are because it is either not relevant to their courses or they do not have additional class time.

Although 31 faculty (76%) answered that their course assignments include research components, 27 (66%) of them had not used library instruction. It highlights the following inconsistency: even if their assignments required conducting research, IL instruction is not perceived as related to their courses. It could then be inferred that STEM faculty do not generally associate library IL instruction with courses that include research. In contrast, the 25 faculty (61%) who were engaged in either undergraduate research or independent study agreed that IL instruction was helpful in their courses.

Faculty chose "Authority Is Constructed and Contextual," "Information Has Value," and "Research as Inquiry" as the most important frames based on the three highest WAs. Contrary to some studies that considered "Research as Inquiry" and "Searching as Strategic Exploration" as important for community college students to have (Wengler & Wolff-Eisenberg, 2020), "Searching as Strategic Exploration" was not chosen as an important IL skill by the QCC STEM faculty. However, this study agrees with others that "Scholarship as Conversation" is not important for STEM students at the associate level but is more suitable for four-year or graduate students (Bohemier, 2019; Dawes, 2019; Holden, 2019; Kaletski, 2017).

IL skills related to high-order cognitive domains are valued greatly by QCC STEM faculty. "Develop critical thinking skills to analyze information" (WA=3.9), "organize information and synthesize ideas in writing" (WA=3.5), and "evaluate web resources and identify reliable sources" (WA=3.5) are chosen as very important skills for their courses. Despite some previous studies indicating that lower-level cognitive skills are more suitable for the associate level (Barr et al., 2020; McGowan et al., 2020), this study reveals that QCC STEM faculty identified higher-order cognitive skills as necessary prowess for their students.

Faculty selected plagiarism (WA=3.7) as one of the most important IL concepts that students need to learn. Plagiarism has been an ongoing and even controversial issue in higher education (Curtis & Vardanega, 2016; Eaton, 2021; McCabe, 2005). Recent studies on plagiarism report that there has been an increased number of cases in plagiarism during the pandemic in community college settings (Kim & Kessler-Eng, 2021; Prentice & Cardona, 2022). During the pandemic, while the library was physically closed and library services were provided online, students may have depended on web resources where they could easily get information. This might have tempted the students to

violate academic integrity. As the survey was conducted during the pandemic, QCC STEM faculty may also have experienced rampant cases of plagiarism when teaching modality was switched completely to distance learning.

It is notable that IL skills, "evaluate web resources and identify reliable sources" (WA=3.5) are rated higher than skills "navigate library databases and utilize library resources" (WA=3.0). Among the IL classes at QCC, most STEM assignments allow students to use web resources in addition to scholarly articles in library databases. Some STEM assignments rely solely on web resources while scholarly sources are not required. Library instruction in STEM courses at QCC includes Google search tips and criteria for evaluating web resources. Anecdotally, one of the coauthors, a librarian, receives much appreciation from faculty and students for teaching how to search the internet effectively and for Google search tips. This may be the reason STEM faculty at QCC value skills about evaluating web resources over using library resources. Faculty believe that it is very important for students to learn how to evaluate web sources and find reliable sources for their research papers.

Other important skills chosen by the faculty are abilities to differentiate between scholarly and non-scholarly sources (WA=3.3), concept of copyright, fair use, open access, and public domain (WA=3.3), followed by knowledge of the research process (WA=3.2), keeping up with current information (WA=3.2), and recognizing different types of sources in different formats (WA=3.2). Knowledge of research process and ability to discern different types of resources, such as scholarly sources, are important skills for community college students if they are enrolled in Undergraduate Research or WI courses. These classes require students to incorporate peer-reviewed articles in their writing, as well as make presentations at a conference. Students should also understand the concept of copyright because they need to use information ethically and legally. Library search skills such as formulating a research question (WA=3.1), keyword searching (WA=3.0), and utilizing library resources (WA=3.0) are important, but less valued by QCC STEM faculty.

Limitations

The small sample size is a limitation of this pilot study, and does not represent the whole college. Further studies would benefit from conducting a nation-wide survey of STEM faculty and librarians to analyze their perspectives on the *Framework* and find out how STEM faculty incorporate the frames into their course curriculum at the associate level. The authors also recognize that each frame from the *Framework* is interconnected and should be considered as a whole, not as an individual skill set. Additionally, the survey questions about the knowledge practices in each frame can be subjective.

Implications

At QCC, most library sessions for STEM courses are held in one-shot sessions, which last only one hour. Critical thinking skills take time to develop and master. It may be onerous to implement the *Framework* and facilitate critical thinking skills in a one-shot library session. Studies demonstrate that one of the most challenging factors affecting inclusion of the *Framework* into library instruction is the limited time in one-shot

sessions (Hsieh et al., 2021; Latham et al., 2019). Hsieh et al. (2021) claim that the *Framework* should be considered for implementation in a credit course rather than in one-shot library instruction. At QCC, library IL classes are not credit-bearing courses. However, it is possible for librarians to be part of teams that develop a program or curricula. To make faculty aware of the *Framework* and incorporate it into a course curriculum, as Jaggars and Folk (2019) suggest, an institutional commitment is required, such as providing faculty incentives, offering workshops, or developing a learning community on IL to motivate faculty. Librarians could be important partners in this institutional endeavor.

Conclusion

Library information literacy instruction is highly regarded by QCC STEM faculty who taught Undergraduate Research, Independent Study, or Writing Intensive courses. However, data indicate that most STEM faculty members who did not include library instruction tended to disassociate library IL instruction from their writing assignments even if the assignments contained research components.

Among the *Framework*, "Authority is Constructed and Contextual," "Information Has Value," and "Research as Inquiry" were selected as important frames. Overall, it is revealed that QCC STEM faculty value higher-order cognitive thinking skills over lower-level thinking skills from the *Framework*. They identified critical thinking as a requisite skill for students at the community college level. In fact, high-order cognitive domains such as critical thinking skills are a core concept of information literacy. It is the educators' responsibility, both faculty and librarians, to prepare community college students to become more self-directed and independent thinkers so that they can apply these skills in their daily lives.

From the results of this pilot survey, it can be concluded that QCC STEM faculty expect community college students to develop critical thinking skills to evaluate web resources, differentiate scholarly sources, analyze and incorporate sources, and use them ethically and legally in their college level research papers.

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Appendix. Survey

Q1. I have read the above statement and I understand my rights. I agree to complete the survey.

Q2. Which Science discipline are you currently teaching at QCC?

Biological Science & Geology
Chemistry
Engineering Technology
Mathematics & Computer Science
Physics

Q3. Please indicate whether you are full-time or adjunct faculty.

Full-time faculty
Adjunct faculty

Q4. What courses have you taught for the last 3 years?

Writing Intensive courses for STEM majors
Writing Intensive courses for non-STEM majors
Other (Please specify)

Q5. What programs have you incorporated into your courses for the last 3 years? Check all that apply.

Honors Program
Independent Study
Global/Diversity Learning
Service Learning
Undergraduate Research
Other (Please specify)

Q6. Have you incorporated research components into your course assignments? Research components mean that the course assignment includes doing research, reading articles, finding sources such as articles, books, or datasets, and submitting a paper, essay, infographic, etc.

Yes
No
Other (Please specify)

Q7. What artifacts have you collected as students' assignments? Check all that apply.

Research papers or essays (6 pages or more)
Research papers or essays (5 pages or less)
Reflective Writing

Factsheets
Flyers
Infographics
Lab Reports
PowerPoints
Publication (abstracts or posters)
Other (Please specify)

Q8. Have you ever used library instruction in your courses within the last 3 years? Using library instruction means that you arrange with librarian(s) to bring your students to the library workshop(s) and librarian(s) provide lessons on how to use library resources. Online library instruction is also included. However, if you've only sent your students to Library Research 101, please answer No.

Yes
No
Other (Please specify)

Q9. If you answered Yes to question 8, how many times have you had library sessions within the last 3 years? If you are not sure, please estimate.

Q10. If you have had library sessions for your classes, how much do you think the library instruction has helped your students to complete course assignments?

Not helped at all
Slightly helped
Moderately helped
Significantly helped
Other comments

Q11. For faculty doing independent/undergraduate research with students, do you agree that incorporating library sessions improves the quality of your peer-reviewed publications co-authored with students?

Strongly disagree
Disagree
Neither agree nor disagree
Agree
Strongly agree

Q12. If you haven't had library sessions, what are the reasons not to include library information literacy (IL) sessions in your courses?

I wish I could, but no time to include IL session(s)
I wasn’t aware library sessions were offered
I was aware of IL sessions, but I didn’t know how to arrange IL sessions
I had IL sessions, but I didn’t think it benefit students
Not applicable to my courses

Other comments

Q13. Indicate the level of importance of general education learning outcomes for your courses.

	Not at all important	Slightly important	Moderately important	Very important	N/A
Communicate effectively in various forms					
Use analytical reasoning to identify issues or problems and evaluate evidence in order to make informed decisions					
Reason quantitatively as required in various fields of interest and in everyday life					
Apply information management and digital technology skills useful for academic research and lifelong learning					

STEM Faculty Survey: Student Information Literacy Competency

The purpose of this study is to investigate which information literacy (IL) skills community college students need to learn to complete the STEM courses at QCC. The questions of the Information Literacy Performance Indicators are formulated based on the six concepts of the Framework for Information Literacy for Higher Education defined by the American College & Research Libraries (ACRL). Knowledge about the Framework is not required to complete this survey.

Q14. Please rate how important each of these IL skills is in your course curriculum.

Frame 1: Authority Is Constructed and Contextual

	Not at all important	Slightly important	Moderately important	Very important	N/A
Keep up with current information					
Recognize different types of sources in different formats					
Evaluate web resources and identify reliable sources					
Develop critical thinking skills to analyze information					
Distinguish between primary and secondary sources					

Other (Please specify)

Q15. Please rate how important each of these IL skills is in your course curriculum.

Frame 2: Information Creation as a Process

	Not at all important	Slightly important	Moderately important	Very important	N/A
Differentiate between scholarly sources and popular (non-scholarly) sources					
Learn how information is created and distributed. For example, search engines and library databases are organized and distributed differently					

Articulate what the peer-review process is					
Learn the steps in the research process					

Other (Please specify)

Q16. Please rate how important each of these IL skills is in your course curriculum.

Frame 3: Information Has Value

	Not at all important	Slightly important	Moderately important	Very important	N/A
Plagiarism					
Concept of copyright, fair use, open access, and public domain					
Cite sources in a proper style format such as APA, CBE, ACS, etc.					
Legal issues on privacy and personal information					

Other (Please specify)

Q17. Please rate how important each of these IL skills is in your course curriculum.

Frame 4: Research as Inquiry

	Not at all important	Slightly important	Moderately important	Very important	N/A
Formulate and refine a research question					

Use keywords and related terms when searching					
Organize information and synthesize ideas in writing					
Write a scientific research paper based on the IMRaD format. IMRaD stands for Introduction, Method, Results, and Discussion					

Other (Please specify)

Q18. Please rate how important each of these IL skills is in your course curriculum.

Frame 5: Scholarship as Conversation

	Not at all important	Slightly important	Moderately important	Very important	N/A
Role of editors in scholarly journals as well as non-scholarly periodicals					
Respect other points of view and engage in civic discourse					
Present at a conference or professional communities					
Publish conference proceedings or scholarly work					

Q19. Please rate how important each of these IL skills is in your course curriculum.

Frame 6: Searching as Strategic Exploration

	Not at all important	Slightly important	Moderately important	Very important	N/A
Navigate library databases and utilize library resources					
Use subject headings and controlled vocabularies to find a more focused and relevant set of results					
Combine keywords using Boolean connectors (AND, BUT, OR)					

Other (Please specify)

Q20. Thank you for filling out the survey. Your input is very important. Please let us know what other library information literacy skills you think are important, but not listed in this survey. Feel free to write as much as you want.