Abstract

This paper explores the connection between critical theory, information evaluation, and the instructional practice of critique for STEM students and librarian instructors. Using an emerging theory and instructional method, the authors examine how to more deeply include voices that have historically been excluded from STEM information critique. The foundational ideas, pedagogical approaches, and scaffolded curriculum used to engender a more inclusive approach to information within third- and fourth-year engineering design classes are discussed to contextualize the application of theory to the practical setting. Rooted in critical theory, this case considers how student information behaviors can ultimately perpetuate or subvert social structures and expectations.
Keywords: Information literacy, Critical theory, Engineering design, Critical evaluation of information

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Introduction

Critical theory attempts to make the foundational social structures and assumptions that underpin how individuals believe the world works explicit. Information at its core is a key component of how people express, disseminate, and replicate existing social dynamics and knowledge and is a necessary foundation for critical thinking. Teaching critical theory in information literacy settings, formally or informally, can be difficult to implement effectively and has traditionally received less emphasis in the existing body of scholarship in library and information science (Cope, 2010).

As educators, we must always consider that all our actions, no matter how much we focus on decolonization and inclusivity, are grounded within a historical context that does not encourage this in our practice (Pirbhai-Illich et al., 2017). The dominant system of thought and practice in academia still has many instances of ignorance and is led by a worldview and approach that perpetuates ingrained social and structural inequities, and it is not ethical to ignore this legacy (Freire, 1970/2002; Masta, 2019). Higher education must “address the failure of people or institutions to identify and integrate diverse individual needs and perspectives within a naturalized and normalized modern framework” (de Oliveira Andreotti et al., 2015, p. 26). This perspective is preemptively internalized by students who commonly enter the academy with an “absolutist or dualistic approach to knowledge” (Swanson, 2010, p. 270). This mindset is advanced by the traditional academic approach to the value placed on peer-reviewed journal articles and textbooks as quality information sources. Limited consideration is given to sources outside of these, and students are typically not given tools to navigate how to contextualize them. In an academic context, students either disregard non-traditional or popular sources of information, or pretend to not use them. By giving students a path that allows them to contextualize sources such as Indigenous knowledge, lived experience, and technical knowledge alongside traditional peer review, we can move to a more equitable and inclusive approach to information.

The case presented in this paper is an important addition to the existing body of literature around social justice in information literacy and critically responsive pedagogy in the higher education classroom (Gregory & Higgins, 2013; Pirbhai-Illich et al., 2017). What makes this work distinct is the focus on applying critical theory within an engineering undergraduate classroom, a pedagogical space where information use is principally mediated by the dictates of accrediting bodies (Alam & Kootookos, 2020). The adaptation of this approach to upper-level undergraduate design contexts situates the instruction to help students address complex problem-solving tasks and better
engender critical thinking dispositions beyond traditional disciplinary norms (Gattie et al., 2011; Hadgraft & Kolmos, 2020).

**Literature Review**

In information science literature, critiques of library structures and practices most often occur under the umbrella of critical librarianship. Applying the writings of critical social theorists to issues, such as access to information, classification systems, and library spaces, critical librarianship encourages information professionals to reflect on ways inequality and outdated ideologies continue to impact our professional practice (Drabinski, 2019; McElroy, 2017). As a subset of critical librarianship, critical information literacy scholars take the concept and practice of information literacy as the object of their analysis, investigating how hidden biases and power dynamics impact the way information literacy instruction is framed and taught (Cope, 2010; Elmborg, 2006).

Regarding applications of critical social theory, critical librarianship and critical information literacy scholars have a broad range of theoretical frameworks and interpretations to draw from. Since Critical Theory was first developed at the Frankfurt School of social thought and critique nearly a century ago, it has undergone a myriad of applications, interpretations, and iterations (Leckie et al., 2010). Although today there are many different critical theories, many of these more specific interpretations share common characteristics, such as a focus on power dynamics, inequality, and oppression. In response to this, some theorists have proposed consolidated versions of critical theory that focus on these shared characteristics and eliminate the need to subscribe to a single, narrower frame of analysis.

Steinberg and Kincheloe’s (2010) “contemporary reconceptualization” of critical theory brings together many different modern and postmodern critical theories, integrating Foucauldian genealogy, feminist theory, postcolonialist theory, hermeneutics, and others to create a “theoretical bricolage” (p. 140). This reconceptualization of critical theory asserts that all aspects of human society and culture are undergirded by a complex web of power relations. Rejecting economic determinism, this theoretical perspective adopts a pluralistic understanding of power, oppression, and domination, placing specific emphasis on issues of race, gender, and experience. Unlike some forms of critical analysis that are vulnerable to nihilism and inaction, Steinberg and Kincheloe’s (2010) critical theory specifically focuses on praxis as a means to emancipate and empower others.

With Steinberg and Kincheloe’s (2010) reconceptualized critical theory encouraging us to view the status quo critically, we can begin to consider whose interests are served by information literacy practices that devalue resources found outside of traditional academic publishing and accessed through an academic library. Ideally, the primary purpose of information literacy instruction should be to equip students with the tools and skills they need to navigate and use information efficiently and effectively; however, instruction that does not address the increasingly complex world of information that exists beyond the boundaries of the library fails students in several ways. As internet natives, today’s students enter their post-secondary studies with
significant experience finding useful information using the internet. In most cases, their personal information seeking experiences have taught them that search engines, such as Google, are incredibly useful tools. By ignoring students’ prior experiences and devaluing a tool they know to be useful, librarians undermine their own credibility. When students perceive an instructor to be overly skeptical of information found outside of library-provided subscriptions and monographs they are more likely to disregard the instruction they receive and/or view the instructor as arbitrarily working to make information seeking more challenging (Mark, 2011a).

When students are willing to accept information literacy instruction that warns against using internet search engines, they remain at a disadvantage. Although these broader resources may provide access to sources that contain misinformation and disinformation, they also provide access to reliable, unique, and insightful information sources that are not typically available through the library, such as lived experience, Indigenous knowledge, Reddit, and corporate common practice [industry blogs, technical specifications, institutional knowledge]. Advising students to avoid Google deprives them of the opportunity to access this information, learn from it, and begin building the skills needed to adequately assess its relevance and trustworthiness (Mercer & Weaver, 2021). In addition, instruction that teaches students to avoid misinformation by deferring to library resources can lead them to believe information found within the library does not require evaluation (Mark, 2011a). In many cases, students enter university with the preconceived notion that library resources always present credible, reliable information (Keba & Fairall, 2020). As librarians, we should be correcting this common misconception, rather than reinforcing it.

If student interests are not best served by this practice, then who benefits when library resources are privileged over other information resources? Mark (2011b) notes that the preference for peer-reviewed sources is deeply embedded in academic culture. When we present scholarly sources as supreme, we are acting from within academic culture while simultaneously perpetuating it. If we conceptualize information and knowledge as power, we can see how this cultural characteristic creates a self-sustaining system of power. Information produced within the academy is granted authority by members of the academy, whereas information created outside academia is framed as inferior. This system is so ingrained, academics who are aware of the power imbalance are still reluctant to allow non-scholarly sources to be used in student papers (Torrell, 2020).

The disproportionate power academia maintains over knowledge and information becomes particularly concerning when we consider the sociocultural and historical context of academic institutions. Although contemporary efforts are being made to diversify and decolonize our institutions, academia’s White, western, colonial, patriarchal origins continue to influence modern academic traditions, structures, and practices. As Masta (2019) explains, modern education systems prioritize western ways of knowing by treating western knowledge as neutral and universal. This leaves non-western viewpoints on the margins, treated more as cultural curiosities than legitimate knowledge. When academic knowledge is privileged, White, western, colonial ways of knowing remain unchallenged. In this way, traditional information literacy approaches that frame library resources as the best sources of information help to silence alternative voices, marginalized viewpoints, and Indigenous ways of knowing.
Libraries interested in creating more equitable, diverse, and inclusive spaces have predominantly focused on diversifying collections by making conscious efforts to purchase materials written by Indigenous researchers and scholars of color. Although this is an important step in the right direction, creating more diverse library collections still requires individuals from marginalized groups to adapt to, excel at, and reach the highest levels of academia before their work will be granted authority in the current scholarly system. As Bhattacharya (2016) explains, navigating the white, western, colonial world of academia as a person of color often requires sacrificing one’s own values, beliefs, ideas, and even dignity to successfully assimilate with academic culture. Although marginalized authors and researchers should absolutely be supported, it is also important to leave space for non-academic voices to join the conversation, on their own terms. In addition to diversifying our collections, we must provide students with the tools and knowledge they need to skillfully access and use internet resources outside of the library. The provision of carefully designed information literacy instruction that empowers students to explore the broader internet is potentially a more effective method for addressing these systemic power imbalances. The following case study presents a more inclusive path forward by outlining how this type of instruction can be used in a sustained, successful manner.

Study Design

For this paper, an instrumental case study design, as defined by Glesne (2016) was used to examine the application of critical theory concepts within third- and fourth-year engineering design courses. This design was selected to allow for a rich level of detail in how the librarians in this case introduced and implemented instruction rooted in critical theory (Maxwell, 2013).

The purpose of this case study was to explore an instructional practice, Critical Evaluation of Information (CEI), where critical theory could be applied within an engineering design classroom. The study sought to extrapolate on pedagogical methods to introduce the theory of CEI (Mercer & Weaver, 2022) and close the gap between information seeking and use in professional engineering practice and academic contexts.

Case Study

This case study examined the connection between critical theory, information evaluation, and the instructional practice of critique in STEM information literacy instruction. Using a newly emerging method, CEI, we examined how to more deeply include voices that have historically been excluded from STEM information critique (Mercer & Weaver, 2022). This work aligns our instructional practice with existing knowledge in the area of critical theory to address how information behaviors can perpetuate or subvert social structures and expectations. We used a case study approach of third- and fourth-year engineering classes to contextualize our theoretical approach in a practical setting.

In our experience, undergraduate students must develop capacity around finding information, evaluating information, and, most importantly, selecting which
information they use to guide their design decisions. Throughout an engineering design process, the basic concept of Engineering as “applied science” should be driving decision making and analysis. Engineers need to be able to justify all aspects of their design process, either through the application of the most appropriate existing standards or scientific knowledge, or self-discovered knowledge, methods, and design specifications within their own project context. This justification and defensible decision making are the backbone of professional practice and the duties and obligations of an Engineer (Canadian Engineering Accreditation Board [CEAB], 2022).

To implement CEI, the librarian visits a class in the first year to give foundational instruction on how to find information relevant to the design process and support students as they begin their academic careers. The focus of this instruction is building an understanding that the information they use grounds them and their future engineering practice. In the third year, librarian instruction intentionally shifts away from information seeking to what we do with the information we are finding. This is carried out in a series of three interactions - an initial discussion-based lecture given to the class in week three, followed by two separate small group consultations taking place in weeks five and ten. The in-class lecture is approximately an hour and engages students with why they use the information they use. It intentionally challenges them on why they choose the sources they choose, why they place value on certain sources above others, and specifically focuses on how they find information to support the users and stakeholders who will interact with the ultimate engineering design output. The small group consultations then mimic the design critique process, with the librarian’s critique specifically focusing on the information sources used for design decision making. For the first consultations we examine several key questions:

- Why did you choose an information source?
- Why did you not choose a different information source - and what did you learn from this?
- What was missing in your search?
- How did you limit your search?

In parallel with the small group consultations with the librarian, students benefit from iterative design critiques with their professor, with the design critique approach mirrored in the design of the library sessions (Borland & Mercer, 2022; Weaver et al., 2022). The critique process begins to consider how to address teaching the knowledge context, and to develop student engagement with information sources:

- Why did you choose this method?
- Why this standard?
- Are there missing experiences or voices that would inform the process?, etc.

Students then work on their designs and meet again as they finalize their end of term reports. The second consultation has a similar focus but contextualizes the information students used in a reporting context. Guiding questions include:
The librarian is involved in two types of assessment for these courses. The critique aspect is assessed without a formal grade. Formal feedback is given after the critique sessions, as a “critique as mentorship” experience (Borland & Mercer, 2022). Using critique as a pedagogical strategy reinforces that critical assessment of student work, ideas, and process is not primarily for grades; intentional implementation of this approach allows students to interact with a design process in a real-world way before they enter the workforce (Borland & Mercer, 2022). The librarian also formally gives grades and feedback along with the teaching team (the course professor, teaching assistants, and capstone supervisor) midway through the course, and during the final presentations.

Discussion

Traditional information literacy instruction in design courses is focused on library-centered information seeking skills, such as how to use a library catalogue to search and how to find a technical document like a standard, and mostly occur in a one-shot guest lecture. In most situations these sessions are aimed at a basic introduction to information seeking, assuming students have no prior experience with, or do not remember, past information literacy sessions, and are focused on general engineering searching, not specific to design (Phillips et al., 2018). Design materials are varied and can exist in many formats [e.g., technical documentation, professional blogs, lived experience, publicly shared code, diagrams, human factors, existing products for modification], most of which are readily available through open search engines. These practices often originate in the established sources within the user experience (UX) field, and help students simultaneously understand existing foundational methods and how to apply them to complex design spaces and problems. Regarding library instruction for finding these sources there are two key things to consider:

1. When focusing on library-held resources only, a large opportunity is missed to engage students with what their professors are pointing to.
2. This practice offers the opportunity to bridge the gap between academic skills and experiential learning approaches in internship, co-op, and other work integrated learning where the use of openly discoverable, readily available information sources is considered standard practice (Weaver et al., 2023).

The necessary brevity of the instruction leads many librarians to focus time and attention on the tools of information seeking and organization, rather than higher level concepts (Badke, 2010). Information seeking for engineering design has long established the need for a greater diversity of information sources beyond those found in traditional academic literature or technical documentation, including speaking to individuals about their lived experiences (Hertzum & Pejterson, 2000). However, pedagogical approaches that allow librarians to openly and intentionally treat information, especially information from outside library-provided collections, as foundationally
equal are not well established. To address this gap in librarian practice and student experience in the third- and fourth-year engineering design courses a partnership was developed between a liaison librarian and two engineering design faculty members. Having the liaison librarian as an official member of the teaching team who is engaged in assessment helps to reinforce the importance of information and holistic information evaluation skills as critical to the design process success.

Using the CEI theory, a threshold concept of information seeking that integrates evaluative frameworks and contextual factors can be developed to support students in STEM information seeking and use (Mercer & Weaver, 2022). In CEI, the instructional focus shifts from how one finds information to an approach of open, unfettered discovery with more intensive evaluation practices (Mercer & Weaver, 2022). CEI centers information literacy pedagogy on the concepts of context, authority, and bias, which allows students to consider information beyond rote evaluation practices of peer-reviewed versus popular sources. This approach integrates with the design critique process by grounding these ideas in the consideration of the design problem space. This approach incorporates their lived experiences, and the needs of diverse stakeholders for which the design is intended - inclusive of end users, corporate mandates, materials limitations, and budgeting. Teaching using CEI allows librarian instructors to show students that the information they use to build or develop their designs is as complex as the stakeholders they are being taught to design for. Like primary, secondary, and tertiary users, students are taught that the information being used is valuable only within the context in which exists. For example, expecting Indigenous knowledge to conform to academic contexts and ways of dissemination inherently continues to uphold colonial practices, and undervalue and diminish this knowledge (de Oliveira Andreotti et al., 2015). Similarly, if you cite a paper on a specific method that is behind a paywall that you cannot access, and therefore do not read, it is better practice to defend your design during a critique using a blog, such as Neilson Norman, which is accepted as industry standard even though it is freely available online. This approach subverts traditional academic expectations and systemic, ingrained power structures that have allowed those in academia to largely represent and advance White, male, cis-gendered perspectives. By intentionally mirroring the design process, CEI builds on foundational knowledge, but also allows for students learning to become experts. By teaching students to critique information in the same way they critique designs, librarians can meet students where they are at and engage with them in a professional context. The Canadian Engineering Accreditation Board (CEAB, 2022) created their graduate attributes to align student learning with professional competence and serve as foundational knowledge that can be continuously built throughout academic experience and a professional career. By aligning with these known graduate attributes, librarians will be better able to understand the context engineering students and faculty members are navigating and frame their teaching to allow for information seeking and use to support students in their growth toward becoming professional engineers. CEI was developed to work with the engineering curriculum taking elements of engineering education and aligned concepts from critical information literacy instruction to engender intentional information seeking and use in an inclusive manner.
Conclusion

Librarians need to approach information literacy instruction through pedagogy that allows for a broad and diverse array of sources, experiences, and perspectives. This is particularly true in the field of engineering where the purpose of information seeking is to inform solutions to design and other real-world problems (Sheppard & Gallois, 1999). Although librarian participation in design courses begins in the first year, the interventions that scaffold upon those earlier experiences offer an opportunity to introduce instruction rooted in critical theory within the classroom. By deeply embedding the librarian throughout the design curriculum, it allows for a holistic extension and deep level of trust between the professors, librarians, and students by the time they are in their third and fourth years. As the world continues to diversify and places a greater emphasis on the ideals of universal design (Preiser & Smith, 2011), student information behavior must become informed by critical theory to address these challenges. The introduction of CEI into the engineering design curriculum allows for a pedagogical approach that integrates critical theory, information literacy instruction, and engineering design processes to instill these values in students and bridge the gap in information use between education and professional practice.

References


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