

***Critical Online Information Evaluation (COIE):
A comprehensive model for curriculum and assessment design***



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Corresponding Author:

Lauren Weisberg
laurenweisberg7@gmail.com

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[Editorial Board](#)

Lauren Weisberg

University of Florida, USA

Xiaoman Wang

University of Florida, USA

Christine Wusylko

University of Florida, USA

Angela M. Kohnen

University of Florida, USA

ABSTRACT

The recent evolution of technology and the Internet has transformed how individuals find and share information. Research shows that citizens of all ages and backgrounds struggle with critical online information evaluation (COIE), which could result in serious societal consequences. Although it is crucial to develop student proficiency within this key information literacy construct beginning in middle school, there is currently no interdisciplinary framework for designing COIE instruction or assessments. To address this gap, we have developed a comprehensive COIE model for curriculum developers, assessment creators, and practitioners to implement at the secondary and post-secondary level. In this paper, we provide cross-disciplinary theoretical context and empirical grounding for our model, offer guidance for its practical application in the 6-16 curriculum, and discuss metacognitive and sociocultural considerations for developing and measuring learners' COIE proficiency.

Keywords: *critical online information evaluation, information literacy, digital literacy, curriculum development, assessment design.*

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INTRODUCTION

For educators and curriculum developers, teaching young people to critically evaluate information found online is an urgent yet vexing challenge. Prior to the widespread adoption of the Internet, content needed to be approved by gatekeepers, like publishers and editors, and required financial backing to be printed and distributed (Graff, 1978). Web 2.0 technology has made it possible for anyone with Internet access to publish and share whatever they choose (Bower, 2016). While this shift can make information sharing more equitable (Gee, 2007; Jenkins, 2009), the current reality is that anyone, regardless of their intentions or authority on a topic, can quickly publish and distribute misinformation (i.e., inaccurate information that is often deliberately intended to be deceptive) with little consequence (Lewandowsky et al., 2012). Amidst this phenomenon, research shows that citizens of all ages and backgrounds struggle to evaluate the trustworthiness of information they encounter online in various formats (e.g., websites, videos, images, advertisements, social media posts) (Breakstone et al., 2021b).

In response, organizations like the Stanford History Education Group (SHEG), the International Society for Technology in Education (ISTE), Common Sense Media (CSM), the American Association of School Librarians (AASL), and the National Council of Teachers of English (NCTE) have developed their own online information literacy guidelines, standards, rubrics, and curricular materials. Although certain frameworks are intended to be interdisciplinary (e.g., library-based frameworks such as AASL), there is an absence of evidence suggesting that a single framework focused on evaluating online information has successfully transcended disciplinary silos to achieve widespread inclusion across the curriculum. In part, we attribute the absence of an agreed-upon framework for navigating the contemporary information environment to the complex and multidimensional competencies required (Bruce, 1995; Lloyd, 2010), which contain aspects of information literacy (Zurkowski, 1974), media literacy (Aufderheide, 1993), science literacy (Hurd, 1958), civics education (Breakstone et al., 2021b), and digital citizenship education (ISTE, 2016), in addition to traditional literacy skills. These areas of focus are situated within separate disciplines (e.g., English language arts, science, social studies, and technology education) with different professional norms and epistemologies, making it difficult to reach a

consensus on what effective curriculum design should look like to address this issue.

There is also a lack of consensus regarding best practices for assessing K-12 students' abilities in this area. Research shows that information literacy-related instruction and assessment occur most frequently in higher education environments as one-shot sessions by librarians who focus only on select parts of the Framework for Information Literacy for Higher Education (ACRL; Gross et al., 2018). Student learning outcomes are typically measured formatively using Classroom Assessment Techniques (CATs) such as online polls taken with mobile devices (Erlinger, 2018), or summatively with standardized tools such as the Standardized Assessment of Information Literacy Skills (SAILS; Blixrud, 2003) or the Information Literacy Test (ILT; Cameron et al., 2017). These instruments may be insufficient for use at the K-12 level because they are targeted towards post-secondary students, are usually not open-access, and cannot authentically measure the complex competencies involved in evaluating online information (Schilder et al., 2016). Furthermore, scholars have argued for local development of assessments across disciplines in both higher-ed and K-12 contexts, rather than exclusively in library settings, and for the development of more progressive strategies like performance assessments to measure students' real-world knowledge application (Oakleaf, 2008; Oakleaf, 2009). Existing frameworks such as the Global Media and Information Literacy Assessment Framework (UNESCO, 2013) and ACRL (2016) lack sufficient guidance for designing such assessments because they do not provide a comprehensive synthesis of all necessary competencies or detailed descriptions of various performance indicators that should be observed.

As scholars representing a variety of disciplines, we recognize that a single curriculum addressing all aspects of information literacy may not be possible or even desirable. However, we believe curriculum developers, assessment creators, and practitioners would benefit from a common understanding and framing of the competencies required to critically evaluate the credibility of online information, which is an inherent yet ill-defined and broadly-theorized aspect of information literacy. We strive to address this issue by proposing a new term for this set of competencies, *critical online information evaluation (COIE)*, and presenting a comprehensive model for COIE that accounts for its nuanced, multidimensional, and cross-disciplinary characteristics.

In the sections that follow, we provide theoretical framing for COIE, describe our process of synthesizing relevant literature in consultation with subject matter experts to build a comprehensive model, identify and explain the model's competencies and proficiency indicators, provide practical guidance for implementation, and address persistent metacognitive and sociocultural obstacles to developing and measuring COIE proficiency in the secondary and post-secondary 6-16 curriculum.

DEVELOPING A COMPREHENSIVE MODEL FOR COIE

Theoretical perspectives

In its most basic form, COIE is a construct of information literacy, which is the skillset involved in locating, assessing, and using information efficiently (ACRL, 2016; Zurkowski, 1974). Information literacy was developed by the field of library and information sciences, with its underlying competencies generally framed in academic (and/or economic) terms. The first use of the term "information literacy" is generally traced to Paul Zurkowski's seminal 1974 report highlighting what he saw as a widespread lack of information literacy skills among the public and focusing on the economic implications of new ways of creating and accessing information. In 1989, the American Library Association (ALA) defined information literate people as those who "know how to find, evaluate, and use information effectively to solve a particular problem or make a decision." As the information ecosystem became increasingly complex and participatory in the years that followed, the Association of College and Research Libraries (ACRL) redefined information literacy in 2016 as "the set of integrated abilities encompassing the reflective discovery of information, the understanding of how information is produced and valued, and the use of information in creating new knowledge and participating ethically in communities of learning" (p. 8).

COIE also closely-aligns with media literacy, which is defined as "the process of accessing, critically analyzing media messages and creating messages using media tools" (Hobbs, 1996, p. iii) with the goal of "promoting autonomy through the development of analysis, reasoning, communication and self-expression skills." Although efforts to incorporate mass media and popular culture in the K-12 curriculum are as old as mass media itself, the organized media literacy movement

gained momentum when the United Nations Educational, Scientific, and Cultural Organization (UNESCO) issued a declaration arguing for universal "media education" at the 1982 International Symposium on Media Education (Bordac, 2014; UNESCO, 1982). Throughout the next several decades, professional organizations dedicated to media literacy education in the U.S. were created (Bordac, 2014), with the field marked by what Hobbs (1998) called "great debates" over fundamental questions such as media literacy education's goals, ideologies, and relationship with mass media producers.

Although the concepts of information literacy and media literacy are similar, the most obvious distinction between the two is that information literacy is concerned with "information," defined by Zurkowski (1974) as "concepts or ideas which enter a person's field or perception" (p. 1), while media literacy focuses specifically on media messages. While information literacy has generally fallen under the purview of librarians, media literacy scholars come from various fields, including communications, cultural studies, and education. Media literacy educators guide students to consider a message's construction (e.g., use of camera angles) and to think about how messages may be perceived differently by various individuals (NAMLE, 2007). Given the current online information landscape, we believe these considerations are essential to COIE. This belief is reflected in the design of newer information literacy frameworks. Given the importance of analyzing not just "information" but the way information is produced and disseminated in the contemporary online ecosystem, newer frameworks incorporate concepts that seem to fall more traditionally under media literacy's purview (e.g., the ACRL framework's assertion that "authority is constructed and contextual"). Likewise, UNESCO now refers to "media and information literacy" as "an interrelated set of competencies that help people to maximize advantages and minimize harm in the new information, digital and communication landscapes" (UNESCO, n.d., para. 2).

Additionally, our work has been informed by sociocultural understandings of literacy more broadly construed, particularly the following three interconnected theories: New Literacies, multiliteracies, and critical media literacy. New Literacies theory is grounded in the notion that the evolution of technology has influenced "social, economic, cultural, and institutional changes" (Alvermann, 2017, p. 100) in society. Multiliteracies theory expands our perception of literacy beyond language and text to promote skill

development in multimodal meaning-making (New London Group, 1996). Critical media literacy theory highlights the relationships between citizens, media, information, and power, and supports both critiquing and leveraging technology to transform dominant ideologies, institutions, and political systems (Luke, 2012). These sociocultural theories all argue that literacy involves both cognitive skills and social practices; similarly, we see COIE as cognitive (e.g., interpreting texts and symbols) and social (e.g., recognizing how social norms influence perceptions of credibility). These theories also highlight the critical nature of COIE as a context-dependent process influenced by social and cultural practices (Perry, 2012; Weisberg et al., 2022).

We sought to create an interdisciplinary model for COIE grounded in the aforementioned theories that could be used to guide the design of curriculum and assessments that teach and measure COIE proficiency in authentic real-world contexts, as opposed to traditional standardized strategies that are ill-equipped to assess complex higher-order constructs (Messick, 1994; Shute et al., 2016). We applied Wiggins & McTighe’s (2005) Understanding by Design (UbD) framework (also known as “backwards design,” or designing instructional activities with a goal or outcome in mind) to develop a model that highlights the desired results for authentic transfer of COIE competencies without being overly rigid or prescriptive. We identified a target age range of grades 6-16, because middle school is a developmentally appropriate period to begin addressing the complexities of online media literacy, and COIE

challenges can persist through secondary school into college (Breakstone et al., 2018).

Identifying existing frameworks

We began by broadly searching the literature for existing frameworks for teaching and assessing information literacy in grades 6-16. Sparks and colleagues’ (2016) Educational Testing Service report emerged as a useful tool for identifying relevant digital information literacy frameworks and assessments that included the construct of “evaluation” (see Figure 1). In addition to the frameworks identified by Sparks et al., (2016), we identified several additional frameworks that we were familiar with due to our previous experiences conducting research in this area. These frameworks were developed by organizations such as SHEG and CSM, and information literacy experts like Michael Caufield.

To ensure broad coverage of our topic, we consulted with eight subject matter experts (SMEs), who reviewed our identified frameworks and recommended additional frameworks to include in our analysis. Our SMEs had the following qualifications: four were professors of information literacy across two different R1 institutions, two were higher-ed librarians specializing in education and journalism respectively, one was a media specialist for a countywide school district, and two were recent Ph.D. graduates in Curriculum and Instruction whose scholarship focuses on information literacy.

Assessment	Define needs	Access	Evaluate	Manage/organize	Integrate/synthesize	Create	Communicate	Apply to solve problems	Ethical/legal issues	Use of digital technologies
Type 1										
ILT	X	X	X		X				X	X
SAILS	X	X	X	~					X	X
RRSA	X	X	X				~	X	X	X
ISS	X	X	X	X	X	X	X	X	X	
ILAAP	X	X	X	X	X				X	X
Type 2										
IC3		X		X		~	X		X	X
ECDL	~	X	X	X		X	X		X	X
Type 3										
CLA+			X		X	~	X	X		~
PIAAC PS-TRE	X	X	X	X	X		~	X		X
ISKILLS	X	X	X	X	X	X	X	~		X

Notes. X = assessment measures this dimension; ~ = assessment indirectly or partially claims to measure this dimension. Blank cells indicate that the assessment does not provide evidence of this dimension.

Figure 1. Constructs for proficiency in Digital Information Literacy (adapted from Sparks et al., 2016)

Table 1. *Information literacy frameworks with an “evaluation” construct*

Author/Sponsor	Framework Title	Year
Association of American Colleges & Universities (AACU)	LEAP VALUE Rubric for Information Literacy	2013
American Association for School Libraries (AASL)	AASL Standards Framework for Learners	2018
Association of College and Research Libraries (ACRL)	Framework for Information Literacy for Higher Education	2016
Australian and New Zealand Institute for Information Literacy (ANZIIL)	Australian and New Zealand Information Literacy Framework	2004
Cisco, Intel, and Microsoft:	Assessment & Teaching of 21st Century Skills (ATC21S)	2012
California Emerging Technology Fund (CETF)	California ICT Digital Literacy Policy Framework	2008
Committee on Information Technology Literacy (CITL), National Research Council	Fluency with Information Technology (FITness) Framework	1999
Common Sense Media	Common Sense Education News and Media Literacy Resource Center	2020
Educational Testing Service (ETS) International ICT Literacy Panel	Framework for ICT Literacy	2002
International Society for Technology in Education (ISTE)	ISTE Standards for Students	2017
Michael Caulfield	SIFT (The Four Moves)	2019
National Council of Teachers of English (NCTE)	Position Statement: Definition of Literacy in a Digital Age	2019
Organisation for Economic Cooperation and Development (OECD)	PIAAC Problem Solving in Technology-Rich Environments (PS-TRE) subscale	2013
Secker & Coonan, Arcadia Project, Cambridge University Library	A New Curriculum for Information Literacy (ANCIL)	2011
Society of College, National and University Libraries (SCONUL)	The SCONUL Seven Pillars of Information Literacy	2011
Stanford History Education Group (SHEG)	Civic Online Reasoning (COR) Curriculum	2016
United Nations Educational, Scientific, and Cultural Organization (UNESCO)	Global Media and Information Literacy (MIL) Assessment Framework	2013

All SMEs resided in the southeastern U.S. at the time of our consultation, introducing the potential for geographic bias in their recommendations. Therefore, in addition to several international frameworks we included from Sparks’ and colleagues’ review, we included the following well-known European frameworks to provide balance: Secker & Coonan’s “A New Curriculum for Information Literacy (ANCIL)” and the Society of College, National and University Libraries’ “Seven Pillars of Information Literacy (SCONUL).” At the point of saturation, we had identified 17 relevant frameworks for analysis (see Table 1).

Synthesizing relevant frameworks

The authors engaged in a content analysis (Cohen et al., 2007) of the relevant frameworks with the objective of synthesizing them into a comprehensive COIE-

focused conceptual model for use across secondary and post-secondary disciplines. Some frameworks covered a wide range of information literacy constructs beyond the scope of COIE (e.g., AASL’s standards framework, UNESCO’s MIL assessment framework), while others provided a much narrower focus (e.g., SHEG’s COR curriculum, Caulfield’s SIFT method).

Guided by UbD recommendations from Wiggins & McTighe (2005), we began data analysis with our end goal in mind. We engaged in an initial cycle of coding by using comparative analysis (Merriam & Tisdell, 2015) to identify and summarize the aspects of each framework that related to the “evaluation” construct of information literacy. In a second cycle of coding, we analyzed our summaries for patterns and similarities across frameworks. We then synthesized our codes and resolved any differences, meeting frequently throughout our analysis to discuss coding categories and emerging themes. Three categories of COIE competencies

emerged from this stage of analysis: investigate, analyze, and synthesize. In a final cycle of coding, we revisited our summaries of each framework’s approach to the “evaluation” construct and reviewed all existing codes, identifying eight total indicators of proficiency for COIE across all three competencies. The Appendix provides a visual representation of our analysis. In the following section, we present our comprehensive COIE model and provide detailed descriptions for each key competency and proficiency indicator.

COIE MODEL OVERVIEW

COIE’s multidimensional competencies situate it as a complex, higher-order construct (Cheung, 2008) that

is challenging to observe and measure using traditional standardized assessment methods (Shute et al., 2021; Shute & Rahimi, 2017). Therefore, we developed our COIE model using Evidence-Centered Design (ECD) theory (Mislevy et al., 2004), which is a systematic process of measuring proficiency in the 21st-century competencies involved in higher-order constructs like COIE that are difficult to observe, such as critical thinking (Almond et al., 2020; Shute et al., 2010). Our model (see Figure 2) is anchored by COIE as a main construct, and consists of three key competencies necessary for COIE proficiency, and eight proficiency indicators that provide observable evidence of COIE behaviors.

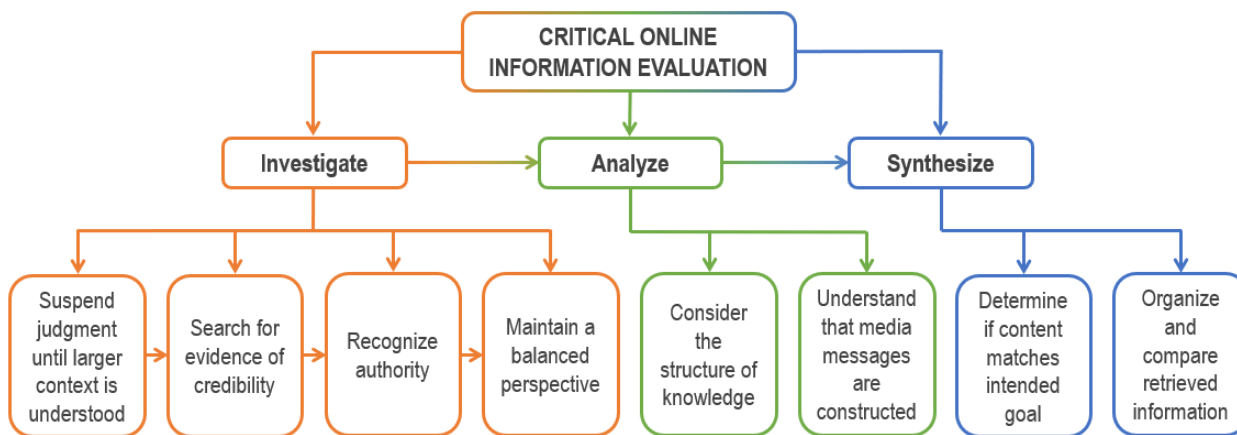


Figure 2. COIE conceptual model

The model reads like a concept map. Downward-facing arrows indicate hierarchical relationships between the main construct (COIE), its three key competencies, and eight proficiency indicators. Right-facing arrows indicate prerequisite relationships, meaning those particular elements should be approached procedurally, whenever possible, when one is developing COIE proficiency.

As individuals become more proficient in COIE, they may naturally begin to approach the process more iteratively. We wish to note that this model is not intended to be used as a checklist approach for evaluation, but rather as a curricular roadmap highlighting COIE’s holistic and recursive nature. In the remainder of this section, we describe COIE’s three key competencies, identify associated indicators of proficiency, and provide scholarly and theoretical context for each indicator from a range of disciplines, such as civics, science, language arts, and the humanities.

Key Competency #1: Investigate

Before judging the credibility of the information one encounters online, it is important to investigate the information, or “study [it] by close examination and systematic inquiry” (Merriam-Webster, 2004). This key competency consists of four proficiency indicators with prerequisite relationships: 1) suspend judgment until the larger context of the information is understood, 2) search for evidence of credibility, 3) recognize authority, and 4) maintain a balanced perspective. Although we have conceptualized this competency as being linear, it should naturally become more iterative with increased proficiency.

Proficiency Indicator #1: Suspend judgment until the larger context is understood. When encountering new information online, one should pause before reading too far so as not to make a quick impulse decision about its credibility. Research shows that individuals default to making credibility judgments quickly, before they have

spent sufficient time gathering additional information or thinking critically about the information. This rush to judgment often causes people to evaluate credibility incorrectly, based primarily on instinct instead of sound evidence (Breakstone et al., 2021b; Caulfield, 2017). One should avoid the tendency to make snap credibility judgments when they encounter information online, and instead engage in a process of inquiry guided by the following proficiency indicators.

Proficiency Indicator #2: Search for evidence of credibility. After suspending judgment, one should immediately search for evidence that the information is credible. To do so, researchers recommend using a strategy widely adopted by professional fact-checkers called *lateral reading*. Lateral reading entails opening additional Internet browser tabs to investigate a source's credibility (Breakstone et al., 2021b; Wineburg & McGrew, 2017) instead of relying on site-specific credibility cues such as sleek interfaces, professional-seeming domain addresses, and lists of scholarly references. Because biased information can be easily disguised in sophisticated-looking websites and widely shared in various formats across Internet platforms, site-specific heuristic approaches to credibility evaluation (i.e., the CRAAP method) have been rendered obsolete. In a series of research studies conducted by SHEG (Breakstone et al., 2021a; Wineburg & McGrew, 2017), participants' abilities to make sound credibility judgments increased significantly after they were taught lateral reading.

Lateral reading has been highly touted by experts as the most robust investigative strategy. However, other methods can be used to triangulate credibility. For instance, companies like Google have begun building techno-cognitive "nudges" into their search engine algorithms to alert individuals to deceptive websites. Similarly, platforms like Twitter and Facebook label content that contains synthetic and manipulated media in an effort to quell the rampant spread of misinformation that has only increased since the onset of the COVID-19 pandemic. Although these credibility cues can be useful, they can also be inconsistent and unreliable across platforms and users. Thus, it is essential for individuals to shoulder the responsibility of investigation rather than offloading this crucial task.

Proficiency Indicator #3: Recognize authority. At the most basic level, one must be able to recognize when an information source is an authority or expert on a topic (e.g., determining if cancer treatment information has been vetted by an oncologist versus a conspiracy theorist). This seemingly straightforward process has

become more complicated in the current iteration of the web since authority can be easily fabricated with site-specific cues such as official-sounding titles, or professional domain names, logos, and graphics (Marsh & Yang, 2017). Scholars have pointed out the limitations of the authority heuristic in our modern information landscape, which is a mental shortcut people use to assign credibility to sources who appear to be official experts on a topic (Hilligoss & Rieh, 2008; Metzger & Flanagin, 2013; Sundar, 2008).

Alternatively, recognizing authority requires understanding that authority is both constructed and contextual (e.g., ACRL, 2015; NCTE, 2019), meaning that although authorities (i.e., experts) can make mistakes, act in bad faith, or genuinely disagree about a topic or event, they maintain integrity, honesty, and transparency in their research and reporting by attributing evidentiary support to a claim (Parse, 2016). How people become authorities on a topic can also vary by discourse community. These aspects are important to consider when investigating the trustworthiness of information so as not to fall deeper down a rabbit hole of misinformation.

Proficiency Indicator #4: Maintain a balanced perspective. When investigating the credibility of information, one must maintain a balanced perspective in order to expand beyond their "filter bubble" (Pariser, 2011), which is a type of intellectual isolation that occurs when Internet algorithms selectively expose people to information that conforms to their existing beliefs. Our filter bubbles are carefully tailored with information (including misinformation) that could alter or reinforce our perspective on a topic.

There are several helpful strategies one can use to maintain a balanced perspective when encountering information online. For instance, one should practice "click restraint" (Wineburg & McGrew, 2017, p. 32), which entails spending time scanning search results and reading various snippets before clicking on a link. This strategy prevents the common occurrence of immediately clicking the first or second link on a search results page, which are often generated by "proprietary search algorithms" (McGrew & Glass, 2021, p. 145) to produce intentionally biased results (Ledford, 2015), or may be algorithmically curated (Noble, 2018) to align with an individual's online profile and behavior. One can also reference well-regarded fact-checking websites like Snopes.com and media bias charts developed by non-partisan organizations such as AllSides and Ad Fontes that classify information about current events across a spectrum of political ideologies (Sheridan,

2021). Additionally, if enough research exists on a topic, one should consider whether the information has scientific consensus (i.e., agreement across a majority of authorities) (van Stekelenburg et al., 2021). In other words, maintaining a balanced perspective does not necessarily mean that one must entertain alternative perspectives, but that they should be aware of potential biases in information sources.

Key Competency #2: Analyze

Although investigating information is a crucial step in the COIE process, it will not always result in a definitive answer regarding a source's credibility. Therefore, one must also critically analyze the information to consider the potential for bias, decontextualization, or misrepresentation. This key competency consists of two proficiency indicators that may occur in parallel: 1) consider the structure of knowledge, and 2) understand that media messages are constructed.

Proficiency Indicator #5: Consider the structure of knowledge. When evaluating information found online, one must consider the structure of knowledge within the current media landscape. First, one should be able to recognize the type of media they have encountered (e.g., newspaper article, blog post, tweet). Next, within these broad categories, one must distinguish between fact and opinion by searching for context clues, such as the use of terminology like “reporting” (i.e., information meant to be informative) versus “opinion” (i.e., information meant to be persuasive) (Breakstone et al., 2021b). One can also look for hallmarks of ethical and quality journalism, which include factual reporting and adequate context (see the News Literacy Project and the Society of Professional Journalists for more information). In addition, acknowledging the potential for decontextualization of information is important, especially when encountering social media posts, images, or videos that lack contextual information to use in investigation.

Understanding the structure of knowledge also includes understanding the “information cycle” (University of Illinois, 2020), or how information moves into the world from event or discovery to dissemination. For current events and fast-moving stories, information may first appear on social media, followed by newspaper and magazine articles. It can take months or years for that information to appear in a peer reviewed journal or an edited book. Across this time span, the coverage of the event or story may change, with earlier

reports having the advantage of speed and proximity (e.g., first person perspectives) and later coverage including more context and points of view. Similarly, scientific discoveries may be first disseminated via press releases or white papers that have yet to be vetted by other experts, but are released to the public much more quickly than a peer-reviewed study. Thus, one must not only consider the type of information they have encountered (e.g., tweet, newspaper article, discussion board; fact, opinion, advertisement, something else), but also its proximity to the original event/topic.

Proficiency Indicator #6: Understand that media messages are constructed. Analyzing information also requires recognizing that all media messages are constructed by human beings (NAMLE, 2007) and are therefore partial and incomplete representations of reality. Depending on the mode of the information (e.g., visual, linguistic), variables such as word choice, camera angle, background music, facial expression, and others influence how information is perceived. This is true of all media, from high quality journalism to pure propaganda, and one should always be aware of how message construction influences their evaluation process. It is also especially important to understand that online information can be intentionally (and nefariously) manipulated by modifying contextual details, adding misleading details, or using media distortion tactics like cropping and visual or audio editing. Even video content can be convincingly altered with artificial intelligence to superimpose one person's mouth onto another person's face, a technique referred to as “deep-faking.” One must also consider the cultural context and publisher motivation of the information (e.g., whether a media message is a sponsored advertisement or paid promotion), and recognize that sociocultural factors influence publishers and assign meaning to media existing in a specific time and context (NAMLE, 2007).

Key Competency #3: Synthesize

The final competency in our model is one's ability to synthesize the content that emerges from the investigation and analysis stages, which closes the loop of COIE. This key competency, which is a hallmark of “expert information seekers” (Kohnen & Mertens, 2019, p. 279), consists of two proficiency indicators that may occur in parallel: 1) determine if the content matches the intended goal, and 2) organize and compare the retrieved information.

Proficiency Indicator #7: Determine if the content matches the intended goal. As part of the COIE process, one must recognize whether the information they are evaluating meets their purpose (e.g., disseminating the information on social media, crafting a research report, storing the information in one's memory).

Individuals engage with online information for a variety of reasons, from idle entertainment to conducting research about serious topics. Rather than uniformly moving through a single checklist for each piece of information (such as "currency, reliability, authority, purpose"), one should utilize goal-dependent heuristics. For instance, author and publication date could be useful for ascribing credibility in certain situations, as long as information has been vetted through investigation and analysis first (Sundar, 2008). For example, an individual may care more about who published the information and when it was published if their goal is to learn how to protect themselves from a rapidly spreading disease, versus learning how to knit or play chess.

Furthermore, one must consider how the content matches their goal in a broader context if they intend to share the information with others. For example, a 2010 CDC report about the low efficacy of face masks in mitigating contagious disease may be useful for a historical summary, but could be dangerous if taken out of context and shared on social media during the COVID-19 pandemic.

Proficiency Indicator #8: Organize and compare the retrieved information. Once relevant information has been identified and retrieved, one must organize and compare that information to make a definitive credibility judgment. This process entails classifying variables such as online platforms, publication dates, and authorities on the information, and looking "across information sources for patterns and contradictions" (Kohnen & Mertens, p. 291). It also entails comparing and integrating new information with one's prior knowledge, and being cognizant of potential information overload, which can trigger anxiety (Bawden & Robinson, 2020).

Decision-making strategies such as "satisficing" (Bawden & Robinson, 2020, p. 2) can help address this issue, which entails accepting when the amount of information one has compiled is good enough to satisfy one's intended goal. Lastly, the recursive nature of COIE is a crucial aspect of organizing and comparing information that involves monitoring one's own comprehension, and may result in the decision to search for additional information (Kohnen & Mertens, 2019).

This entails reengaging with the COIE process in its entirety.

DISCUSSION

We developed a model for COIE to provide curriculum developers, assessment creators, and practitioners with an interdisciplinary framework for designing secondary and post-secondary instruction and assessments. The model highlights key competencies and proficiency indicators for COIE that can guide the design of authentic learning activities, informative lessons, and progressive assessments. Implicitly interwoven throughout the model are perspectives associated with New Literacies, multiliteracies, and critical media literacy theories. The model's purpose is grounded in a New Literacies perspective advocating for a redefinition of literacy in light of technology's rapid expansion and influence (Leu et al., 2017), and it spotlights a foundational critical media literacy viewpoint regarding the consideration how truth is presented, by whom, and for what purposes (Luke, 2012). One's ability to effectively investigate, analyze, and synthesize online information relies on both New Literacies and multiliteracies perspectives regarding how information is shared differently across various discourse communities (e.g., online gamers vs. avid sports fans). Being able to effectively analyze online information requires a multiliteracies perspective that expands on the traditional definition of literacy to encompass "modes of representation much broader than language alone" (New London Group, 1996, p. 64) and requires a critical media literacy approach for "analyzing relationships between media and audiences, information and power" (Kellner & Share, 2007, p. 59).

Practical applications

Curriculum developers can use this model to design discipline-specific learning opportunities to build COIE knowledge, while assessment creators can use it to design progressive assessments, such as game-based stealth assessment (Shute et al., 2021), that are better-equipped to measure proficiency in COIE's higher-level 21st-century competencies. Teachers can also use the model to integrate aspects of COIE into their curriculum across content areas and design their own authentic performance-based assessments where students demonstrate COIE proficiency in various real-world contexts while they are assessed via task observation or judged by the quality of a related final product (Oakleaf,

2008). As students gain COIE proficiency, the flexibility of the model allows for a more discursive and holistic approach to the COIE process where more than one strategy or right answer is encouraged.

For practitioners interested in developing COIE-related curriculum, the COIE model can be easily applied alongside content area standards. For example, a 6th grade science teacher requires a persuasive project as a summative assessment at the end of her “endangered species” unit. In addition to assessing Next Generation Science Standards related to analyzing and interpreting data and constructing arguments supported by evidence (NGSS Lead States, 2013), she can teach and assess her students’ COIE investigation and analysis skills (see Table 2).

Likewise, in an 11th grade civics class, students work in groups to evaluate upcoming ballot measures. Students are required to research the measures themselves, along with information disseminated to the community from various stakeholders. Most civics education standards already include evaluating evidence and creating arguments (e.g., National Council for the Social Studies, 2013), but the COIE model offers more targeted proficiency indicators that the teacher can use to create learning objectives around all three COIE competencies (see Table 3).

Metacognitive and sociocultural considerations

Although the model provides a useful common language and set of skills for COIE, it must be situated within larger conversations about how biases and worldviews intersect with our online information evaluation practices. The model’s clearly articulated competencies may be inadequate in addressing the larger challenges of COIE from metacognitive and sociocultural perspectives (e.g., Gee, 2007; Street, 1984). Literacy is both a cognitive set of skills that can be acquired and a set of practices that make sense within specific social and cultural contexts. Online information, especially information circulated via social media platforms, is often created and shared not only to disseminate content, but to signal affiliation, convey emotion, or generate attention (Livingstone, 2014; Williams, 2011). For many, these social practices may take precedence over critical evaluation, regardless of one’s COIE proficiency.

As a construct, COIE rests on the premise that individuals actually want to evaluate online information accurately. However, motivating individuals to do so will not only require skill development, but a shift in

mindsets. Because evidence of these mindsets cannot easily be observed in practice, we conceptualize them as holistic in relationship to COIE rather than as distinct competencies with explicit indicators of proficiency (see Figure 3).

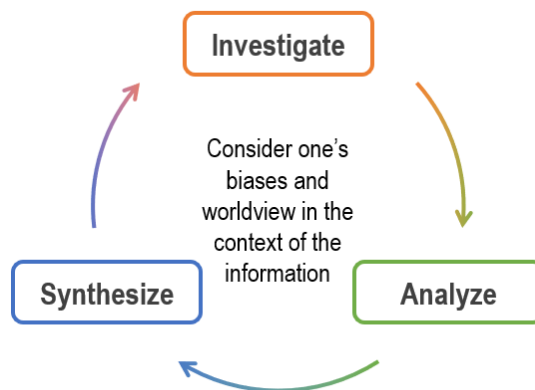


Figure 3. *Metacognitive and sociocultural considerations for COIE*

Future directions

Further research is needed to investigate how metacognitive and sociocultural mindsets can be developed alongside COIE proficiencies. Additionally, we recommend that scholars investigate the model’s utility for designing practical and scalable curricular interventions and progressive assessments across grade levels and academic disciplines. We also recommend investigating how the model can be effectively adapted and modified to design age-appropriate instruction within the wide developmental span encompassing grades 6-16. Longitudinal research could also help determine the potential for such interventions to combat the effects of indoctrination and radicalization that naturally occur over time due to digital literacy deficiencies and increased cognitive decline with aging (Van Bavel et al., 2021).

Our model provides a crucial entry point for research in these areas, as well as a useful roadmap for COIE competency development that seeks to address one of the most important literacy challenges facing today’s schools and society.

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Table 2. Example of COIE model application in a 6th grade science unit

Competencies and proficiency indicators	Aligned objectives (students will be able to...)	Aligned lessons / activities
Investigate: Search for evidence of credibility	Determine if a source represents scientific consensus	Teacher-led instruction on the concept of scientific consensus. Students review the process of scientific discovery and discuss how they learn about new scientific research. The class collaboratively creates a list of strategies for determining if a source is representing scientific consensus.
Investigate: Maintain a balanced perspective	Identify other relevant stakeholders (e.g., land developers, hunters) and consider their perspectives on the topic	Case study activity where the teacher presents small groups with an example of an endangered species. Students brainstorm possible “stakeholders” for this species and share with the class. Students later apply this process to their own endangered species project.
Analyze: Consider the structure of knowledge	Explain how scientific information is created and disseminated online	Teacher-led instruction on the process of scientific discovery and dissemination, including an overview of types of scientific communication (e.g., peer reviewed articles, press releases)
Analyze: Understand that media messages are constructed	Analyze the composition of media messages about endangered species, including the use of emotional elements (photographs, adjectives, music)	Students work in small groups to view and analyze online media messages created by the World Wildlife Fund.
Synthesize: Determine if the content matches the intended goal	Determine the relevance of a source to a specific scientific inquiry	Each student explores various online sources online to investigate whether an issue they are interested in has achieved scientific consensus. They then select several relevant and credible sources on their topic to share with the class.

Table 3. Example of COIE model application in an 11th grade civics unit

Competencies and proficiency indicators	Aligned objectives (students will be able to...)	Aligned lessons / activities
Investigate: Suspend judgment until the larger context is understood	Evaluate the organization or individual behind various online information sources related to a ballot initiative	Gradual release lesson (i.e., teacher demonstration followed by small group work) where students are given social media posts related to an example ballot initiative and taught how to investigate the creator.
Investigate: Maintain a balanced perspective	Identify various stakeholders impacted by the initiative and consider their perspectives on the topic	Case study activity where the teacher presents small groups with a historical ballot initiative related to the public purchase of land for conservation. Students brainstorm possible “stakeholders” for this initiative (e.g., landowners, developers, general public) and discuss where their perspectives might be disseminated. They later apply this process to their projects.
Analyze: Understand that media messages are constructed	Analyze the composition of media messages on ballot initiatives, including the use of emotional elements (e.g., photographs, adjectives, music)	Small group activity using a graphic organizer where students examine social media posts and online advertisements related to their ballot initiative, looking at both the content and the form of the messages.
Synthesize: Organize and compare the retrieved information	Present information about a ballot initiative, by analyzing the initiative’s impact on different groups discussing any misconceptions or misinformation about the initiative	Summative assessment in the form of a “voter’s guide” to the ballot initiative, which includes a description of impact on different stakeholders and a section debunking any misconceptions and/or misinformation about the initiative.

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APPENDIX

Alignment between existing info lit frameworks and our COIE model

Framework	Year	Aspects related to COIE	Proficiency indicator(s)
AASL	2018	<ul style="list-style-type: none"> • Demonstrate an understanding of and commitment to inclusiveness and respect for diversity in the learning community • Make meaning for oneself and others by collecting, organizing, and sharing resources of personal relevance 	<ul style="list-style-type: none"> • Maintain a balanced perspective • Organize and compare the retrieved information
ACRL	2016	<ul style="list-style-type: none"> • Authority is constructed and contextual • Information creation as process • Information has value • Scholarship as conversation 	<ul style="list-style-type: none"> • Understand that media messages are constructed • Recognize authority • Suspend judgment until the larger context is understood
ANCIL	2011	<ul style="list-style-type: none"> • Identify trusted source formats • Who are the experts in the field? How do we know? • Evaluating source material and its appropriateness for your specific purpose 	<ul style="list-style-type: none"> • Search for evidence of credibility • Recognize authority • Determine if the content matches the intended goal
ANZIIL	2004	<ul style="list-style-type: none"> • Access the usefulness & relevance of the information obtained • Define and apply criteria for evaluating information • Reflect on the information seeking process and revise search strategies as necessary 	<ul style="list-style-type: none"> • Search for evidence of credibility • Determine if the content matches the intended goal • Organize and compare the information retrieved
ATC21s	2012	<ul style="list-style-type: none"> • Evaluation • Examine ideas, identify, and analyze arguments • Effectively analyze and evaluate evidence, arguments, claims, and beliefs • Analyze and evaluate major alternative points of view • Ability to process electronic information, data, and concepts and to use them in a systematic way • Understand both how and why media messages are constructed, and for what purposes 	<ul style="list-style-type: none"> • Search for evidence of credibility • Analyze the structure of knowledge • Understand that media messages are constructed • Recognize authority • Determine if the content matches the intended goal • Organize and compare the information retrieved
CETF	2008	Standard 3 - Evaluate <ul style="list-style-type: none"> • Summarize the main ideas to be extracted from the information gathered • Articulate and apply initial criteria for evaluating both the information and its sources • Compare new knowledge with prior knowledge to determine the value added, contradictions, or other unique characteristics of the information • Determine whether the new knowledge has an impact on the individual's value system and takes steps to reconcile differences 	<ul style="list-style-type: none"> • Search for evidence of credibility • Analyze the structure of knowledge • Determine if the content matches the intended goal • Organize and compare the information retrieved
CITL FITNESS	1999	<ul style="list-style-type: none"> • Location, evaluation, use, and organization of information • Searching for and locating information including evaluating the validity of information and resolving conflicting accounts of situations 	<ul style="list-style-type: none"> • Search for evidence of credibility • Analyze the structure of knowledge • Organize and compare the information retrieved • Maintain a balanced perspective

Framework	Year	Aspects related to COIE	Proficiency indicator(s)
COMMON SENSE MEDIA	2020	<ul style="list-style-type: none"> • Slow down and self-reflect • Explore perspectives with curiosity and empathy • Seek facts and evaluate evidence • Envision options and impacts • Take action and responsibility 	<ul style="list-style-type: none"> • Suspend judgment until the larger context is understood • Maintain a balanced perspective • Recognize authority • Maintain a balanced perspective • Understand that media messages are constructed
ETS ICT LITERACY	2002	<ul style="list-style-type: none"> • Make judgments about the quality, relevance, usefulness, or efficiency of information 	<ul style="list-style-type: none"> • Analyze the structure of knowledge • Determine if the content matches the intended goal • Organize and compare the information retrieved
ISTE STANDARD S-S	2017	<ul style="list-style-type: none"> • Evaluate the accuracy, perspective, credibility and relevance of information, media, data or other resources 	<ul style="list-style-type: none"> • Recognize authority • Understand that media messages are constructed • Analyze the structure of knowledge • Maintain a balanced perspective
LEAP	2013	<ul style="list-style-type: none"> • Select sources after considering bias/point of view 	<ul style="list-style-type: none"> • Recognize authority • Understand that media messages are constructed • Search for evidence of credibility
NCTE	2019	<ul style="list-style-type: none"> • Explore and engage critically, thoughtfully, and across a wide variety of inclusive texts and tools/modalities • Promote culturally sustaining communication and recognize the bias and privilege present in the interactions • Examine the rights, responsibilities, and ethical implications of the use and creation of information 	<ul style="list-style-type: none"> • Maintain a balanced perspective • Understand that media messages are constructed • Recognize authority
PIAAC PS-TRE	2013	<ul style="list-style-type: none"> • Evaluation of sources in terms of reliability and the adequacy of information relative to the problem statement, as opposed to mere topical relevance • Integration of information across sources, especially in cases where the sources provide inconsistent information 	<ul style="list-style-type: none"> • Analyze the structure of knowledge • Determine if the content matches the intended goal • Organize and compare the information retrieved
SCONUL	2011	<ul style="list-style-type: none"> • Identify which types of information will best meet one's need • Assess the quality, accuracy, relevance, bias, reputation and credibility of the information resources found • Assess the credibility of the data gathered • Read critically, identifying key points and arguments • Critically appraise and evaluate one's own findings and those of others • Incorporate new information into the context of existing knowledge • Synthesize and appraise new and complex information from different sources 	<ul style="list-style-type: none"> • Search for evidence of credibility • Recognize authority • Consider the structure of knowledge • Determine if the content matches the intended goal • Organize and compare retrieved information

Framework	Year	Aspects related to COIE	Proficiency indicator(s)
SHEG	2016	<ul style="list-style-type: none"> • Who's behind the information <ul style="list-style-type: none"> ○ Lateral reading ○ News vs. opinion ○ Domain names ○ Sponsored content • What's the evidence <ul style="list-style-type: none"> ○ Evaluating photos ○ Evaluating evidence • What do other sources say <ul style="list-style-type: none"> ○ Click restraint ○ Researching a claim ○ Verifying a claim 	<ul style="list-style-type: none"> • Maintain a balanced perspective • Recognize authority • Analyze the structure of knowledge • Suspend judgment until the larger context is understood • Understand that media messages are constructed
SIFT	2019	<ul style="list-style-type: none"> • Stop • Investigate the source • Find better coverage • Trace claims, quotes, and media to the original context 	<ul style="list-style-type: none"> • Suspend judgment until the larger context is understood • Maintain a balanced perspective • Recognize authority • Analyze the structure of knowledge
UNESCO MIL	2013	<ul style="list-style-type: none"> • Assess, analyze, compare, articulate and apply initial criteria for assessment of the information retrieved and its sources • Evaluate media and information providers in society • Evaluate and authenticate information and media content gathered and its sources and media and information providers in society 	<ul style="list-style-type: none"> • Search for evidence of credibility • Analyze the structure of knowledge • Recognize authority • Understand that media messages are constructed