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Reading Comprehension in an Online World: Challenges, Opportunities, and Implications for Education

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ABSTRACT

The Internet has transformed the way we read and the context in which we acquire knowledge. Online reading brings both unique opportunities and challenges. To utilize the full potential of this digital environment and to successfully participate in an online information society, digital reading skills are essential. But what makes online reading so unique, and how can education foster the development of online reading skills? This article will provide a literature review and discuss (a) how online reading differs from reading printed texts, (b) the core competencies involved in online reading and (c) the possibilities and challenges of online reading. Second, based on the knowledge discussed in this review, we provide recommendations for educational practice on how to support students in learning and developing the core competencies of digital reading: navigation, integration and evaluation.

This article synthesizes literature on reading comprehension in an online context, highlighting what makes online reading unique and providing recommendations for fostering the development of online reading skills in education.

The Internet transformed the way we read and the context in which we acquire knowledge (Bråten et al. 2020; Leu and Maykel 2016; Mills 2010; Wolf 2018). It offers unique opportunities to access rich information scenarios and acquire new knowledge, but also presents a more complex environment than the traditional reading environment in which printed texts are read. Online, there is an ever-expanding supply of information that is presented in different formats and varies in quality and reliability (Salmerón et al. 2018). To successfully participate in a digital information society, readers must develop reading skills and strategies to deal with this complexity (Alexander and The Disciplined Reading and Learning Research Laboratory 2012; Goldman 2011; Journell 2019; Leu et al. 2013). Comprehending texts online requires the same comprehension skills and strategies as comprehending printed texts, along with more complex or new skills and strategies specific to online reading (e.g., Afflerbach and Cho 2009; Castek and Coiro 2015; Coiro 2021; Hutchison et al. 2016). Such reading skills are essential in any situation where readers must search for information or acquire knowledge online—throughout their school years and beyond. As these skills are essential for participating in today's society (Buchholz et al. 2020), teaching online reading skills should not be limited to a specific subject in the curriculum or to certain educational levels. *All* students should be proficient in selecting,

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Summary

- What reading skills and strategies do students need to successfully participate in a digital information society and how can they be supported in developing these skills?
- What new opportunities and challenges arise from the transition from reading paper texts in a traditional environment to reading digital texts online?
- How can the online environment be used to benefit students' reading skill development and foster their deep learning of school topics?

evaluating, and integrating/learning from complex digital texts (e.g., Bruner and Hutchison 2023; Goldman 2015; Kim et al. 2022; Leu et al. 2013). Therefore, understanding which reading skills are essential for participating in an online society and how education can foster the development of these skills is increasingly relevant, both for current research and educational practice (Cho et al. 2017; Goldman et al. 2012; Wolf 2018).

This review aims to foster this understanding by synthesizing literature on online reading, while focusing on reading online digital texts—such as web pages, blogs, news sites, or (scientific) articles—in educational settings. We aim to offer educators a knowledge base and practical tools—in addition to their own experience with and knowledge of online reading—to help them shape this aspect of teaching in their own educational contexts. The first section discusses (a) the characteristics of online texts and the online environment that distinguish online reading from reading printed texts in a traditional environment, (b) the core online reading competencies, and (c) the possibilities and challenges of online reading. The second section provides recommendations on how to support students in developing the core online reading competencies: navigation, integration, and evaluation. As these competencies are essential—and challenging—for readers of all ages and all educational levels, we provide general principles and recommendations that can be tailored to individual teaching situations—as the implementation of this knowledge depends on the students' level.

1 | Reading to Learn in a Digital Context

There is little consensus in how different scholars operationalize digital reading (Singer and Alexander 2017), but two definitions are commonly distinguished:

1.1 | Digital: The Medium

Digital reading can refer to 'screen reading' or reading texts from digital devices, such as e-readers, computers, smartphones, or tablets (Baron 2017; Tanner 2014). In this definition, 'digital' is a characteristic of the medium being read from. Researchers adopting this definition focus on how device features affect readers' reading experience and information processing (e.g., Delgado et al. 2018; Kingston 2008; Kong et al. 2018).

1.2 | Digital: The Information Context

Digital reading can also be defined as a range of multifaceted meaning-making experiences whereby readers varying in cognitive capabilities, reading and language competencies, reading dispositions and motivation, and sociocultural identities engage with multiple texts for particular purposes that are situated in diverse contexts (Coiro 2021). This encompasses reading in an online information context, e.g., reading web pages, blogs, news sites, or (scientific) articles. Readers can have many reasons for reading online, but most online reading focuses around inquiry and learning—particularly in educational settings (Kuiper and Volman 2008; Lawless and Schrader 2008). In these settings, students often search for information and read online texts to acquire knowledge, solve problems, or perform specific tasks (e.g., reading Wikipedia documents to answer questions).

This article focuses on the latter definition. Specifically, we focus on online reading in educational settings or online reading for learning. Online reading to learn shares similarities with reading to learn in a traditional printed context. In both contexts, students must select, read, and integrate information from different sources and evaluate the reliability and truthfulness of information and/or informational sources (Afflerbach and Cho 2009; Leu et al. 2015; Salmerón et al. 2018; van der Weel and Mangen 2022). However, the unique characteristics of digital texts, the online environment, and the complexity of information or knowledge acquisition in this environment distinguish online reading from reading printed texts in a traditional environment.

2 | Differences Between Digital and Printed Texts

The term 'digital text' encompasses multiple text types, including digital storybooks, informational books, informational/commercial websites, digital archives, applications, blogs, etc., that are used to gather information (Bruner and Hutchison 2023). Whereas digital texts share some features with printed text, such as being intertextual (i.e., referencing other texts) or multimodal (e.g., include images or diagrams), they are generally presented in formats or have features that are qualitatively different from printed texts (Chen 2009; Hutchison et al. 2016). Printed texts are tangible physical objects with a certain weight, size, and shape. Readers cannot modify text appearance and move through texts by paging in a linear, fixed order determined by the author. Because printed texts contain a fixed amount of text per page, readers can associate what they read to a specific physical location in the text (e.g., where particular content is located on the page).

Digital texts, in contrast, have no physical form that is tied to the surface of the medium, and—in addition to paging—allow readers to navigate through long documents or web pages by scrolling. Furthermore, they are often dynamic and multimodal: They allow readers to modify the shape, size, location, and color of a text on the webpage (Cho 2014; Coiro 2011; Dalton and Proctor 2008) and combine a wider range of modalities, including text, images, animations, interactive elements, videos, and sound. Finally, digital texts are often non-linear or multi-linear

(i.e., there is no fixed order in which the content should be read) and contain hyperlinks (Chen 2009). When reading online, readers jump between sources using hyperlinks and must select what to read and in what order to read it (Cho and Afflerbach 2015; Fesel et al. 2015; Landow 1991; Salmerón and García 2011).

Hyperlinks not only provide different 'routes' through texts (e.g., Burbules and Callister 1996; Chen 2009; Nielsen 1995; Sutherland-Smith 2002), but also create different types of text structures. Most online texts are networks of text parts connected by hyperlinks to each other and to (parts of) other texts, without a clear structure or hierarchy (e.g., Blom et al. 2018; Cangoz and Altun 2012; Segers 2017). Readers can move freely through the text and a mouse click transports them to a different location on the page, a separate page on the same website or document, or even to a different text by another author.

3 | The Complexity of the Reading Environment

Compared to the traditional reading environment in which printed texts are read, the online reading environment provides a richer, more complex environment for acquiring knowledge, with an ever-expanding supply of online information (sources) presented in different formats (e.g., interactive multimedia documents; Salmerón et al. 2018). Moreover, anyone can put information online—usually without evaluation by third parties. This offers unprecedented opportunities for collecting and exchanging information and acquiring knowledge, but due to these relaxed publishing parameters the quality and reliability of the available information vary widely (e.g., Britt et al. 2017; Rouet 2006; Salmerón et al. 2018). Therefore, students may encounter diverse, potentially diffuse, or even contradictory sources of information. They can access online information that is biased, false, or, worse, harmful. Opinions can be presented as facts and deliberate falsehoods can be spread (e.g., fake news and disinformation campaigns; Journell 2019).

4 | The Complexity of Information- Or Knowledge Acquisition

In educational settings, students frequently read with specific goals, such as acquiring knowledge (e.g., searching for specific information) or performing tasks related to certain texts (e.g., answering questions). These tasks can be performed in both environments, but performing them online is often more challenging because of the richness and complexity of the online environment. Therefore, searching and selecting texts that are relevant to the reading goal requires more and different actions (Cho 2014): In addition to finding and comprehending texts, students must use search engines, select relevant webpages and hyperlinks, ignore irrelevant or distracting information, navigate between different informational sources, and adjust their task based on information they encounter during their search (Brand-Gruwel et al. 2009; Cho and Afflerbach 2015). Additionally, assessing quality and reliability is more important online: Whereas there is usually some form of pre-existing quality control in a traditional context (e.g., by editors, publishers, or teachers), professional gatekeeping is often lacking online—making readers themselves the gatekeepers (Britt and Gabrys 2001; Flanagin and Metzger 2008).

5 | Important Skills and Competencies for Online Reading

Theoretical models of reading comprehension state that successful text comprehension requires readers to connect individual text elements to each other and to their own background knowledge by meaningful relations (see McNamara and Magliano 2009 for an overview). These relations result from various passive and strategic processes that occur during reading, such as activating meaning from long-term memory, making inferences, connecting newly read text elements with other text elements and with relevant background knowledge (Kintsch 1988; McNamara and McDaniel 2004; van den Broek and Helder 2017) and validating message consistency (Isberner and Richter 2014; O'Brien and Cook 2016; Singer 2013). These processes result in a mental representation that is accessible after reading and goes beyond the meaning of individual words or sentences by capturing the meaning of the text as a whole (e.g., Kintsch 1988; Kintsch and van Dijk 1978; van den Broek et al. 1999).

Such models originally focused on comprehending single printed texts, but in recent decades comprehension research has expanded its focus from single texts to include learning from multiple sources (e.g., Goldman and Scardamalia 2013). When reading multiple texts on a topic, readers must understand the content of each individual text *and* how the different texts support, complement, or contradict each other (e.g., Bråten et al. 2020; Rouet 2006). Hence, they need to build a representation of each individual text and an overarching integrated representation containing information from the multiple texts as well as their interrelations (e.g., Perfetti et al. 1999; Rouet and Britt 2011). These relations indicate whether ideas are unique to a text or recur in more texts and whether texts corroborate or contradict each other (Afflerbach et al. 2015; McCrudden et al. 2010; Stadtler et al. 2013). Successful integration of multiple texts involves connecting, combining, and organizing the contents of the texts (Bråten et al. 2011; Strømsø et al. 2013) and, when texts present conflicting or contrasting viewpoints, comparing, contrasting, and reconciling diverse perspectives to form a coherent mental representation. Furthermore, readers should store source information (i.e., parameters that identify the origin of a text's content) from each text in this overarching representation, including information about the author (e.g., name, characteristics and motives), the context of content production (e.g., editor, date and cultural context of the publication), the type of document (e.g., blog, textbook, scientific article) and the communicative intentions of the message (e.g., inform, persuade, disinform, etc.; Britt et al. 2012; Leinhardt and Young 1996; Rouet et al. 1996). To illustrate, students writing a paper on climate change may encounter multiple relevant texts during their search (Figure 1). An integrated representation of these texts should include representations of the individual texts, their source information, and their interrelations (e.g., it must include that Texts 1 and 2 contradict each other and that Texts 2 and 3 are linked because Text 2 uses Text 3 as evidence to support their conclusion) to achieve aims such as understanding the issue or drawing reasonable conclusions (e.g., Barzilai et al. 2018; Rouet and Britt 2011).

Text 1	Text 2	Text 3
Source: Website Authors: Highschool students A website created by students about human activity and climate change, in which it is concluded that climate change is largely the result of natural changes.	Source: Online news magazine Authors: Journalists A news report on new research from the University of Minnesota, demonstrating that human activity causes climate change.	Source: Academic research paper Authors: Scientists from the University of Minnesota A scientific article presenting new (empirical) evidence that human emissions of greenhouse gases likely contribute to climate change.

FIGURE 1 | Three examples of texts students may encounter when searching for information about climate change. This figure was adapted from Rouet and Britt (2011).

6 | Three Main Competencies of Comprehension Processes in Online Reading

There are three main competencies in online reading: navigation, integration, and evaluation (Salmerón et al. 2018; Figures 2 and 3). These competencies are closely related: Readers' engagement in any one of them may support or trigger the other two during task performance. For example, when investigating a topic, students often start by googling the term(s) (navigation). When encountering search results with different theories on the issue, they must identify whether these theories complement or contradict each other (integration) and evaluate whether the sources seem relevant and reliable (evaluation) or whether they will continue searching. The evaluation partly determines which information is integrated and what they will read next. Thus, there is a reciprocal relation between the three competencies. The degree to which each competence is needed depends on the task. Furthermore, the effort students invest in using these competences depends on their desired comprehension level in a specific reading situation (i.e., their standards of coherence; van den Broek et al. 2011, 2015; Van den Broek et al. 1995): Students with interest in a topic or a challenging reading task may strive for deeper comprehension and, thus, put more effort in evaluating relevance and reliability (e.g., by further investigating sources).

These competencies are not unique to online reading: Students also need these skills to successfully navigate within and between printed texts, make considered choices about which texts to read and in what order, comprehend and integrate information from different sources, and evaluate the relevance and reliability of information and informational sources. However, the unique online context (1) makes applying these skills more challenging and (2) requires additional skills, such as navigating search-engine results pages (e.g., Bråten et al. 2020; Cho et al. 2018; Coiro 2011; Salmerón et al. 2018).

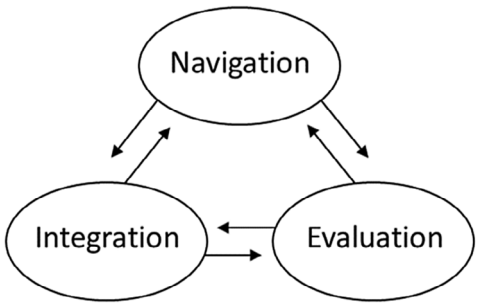


FIGURE 2 | The three main competencies of reading comprehension in a digital context. This figure was adapted from Salmerón et al. (2018).

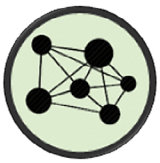
6.1 | Navigation

Navigating within and between both online and printed texts involves defining what information is needed, searching for relevant information, making connections between texts that contain related information, and keeping track of one's own 'path' through the texts (i.e., where you are, what you have viewed, and what you still need to view; Cho 2014; Salmerón et al. 2005). However, the abundance of online information and distractions makes online navigation more challenging. For example, tracking one's path is harder because webpages contain different links or menus to click on, links may not be located in logical places, and websites often contain distracting information (e.g., advertising or irrelevant information) that divert attention from the original search. To handle the information overload, avoid distractions, and not get lost in cyberspace readers need additional reading strategies compared to navigating printed text. They must not only be skilled at moving within and between online texts, but also be able to use the website structure to construct meaning and navigate search-engine results (Afflerbach and Cho 2009; Salmerón et al. 2018).

Navigating search-engine results involves scanning search results to select relevant websites based on factors including the website's position in the search results, whether it contains relevant terms and whether its source is reliable (Cho 2014; Salmerón et al. 2018). Readers must also keep their reading goal in mind and assess the relevance of information to that goal (Lehman and Schraw 2002; McCrudden et al. 2010; McCrudden and Schraw 2007). Moreover, when the search produces irrelevant results readers should adjust search terms based on their knowledge or information encountered during the search (e.g.,

Navigation

- ✓ Define what information is needed and select appropriate search terms.
- ✓ Scan search results to select relevant websites based on e.g., the website's position in the search results, whether it contains relevant terms and whether its source is reliable.
- ✓ When the search produces irrelevant results, adjust search terms based on their knowledge or information encountered during the search (e.g., when searching for 'planets' one may encounter names of planets and use these as new search terms).
- ✓ keep the reading goal in mind and assess the relevance of incoming information to that goal.
- ✓ Keep track of the 'path' through the texts (i.e., where they are, what they have viewed and what they still need to view)
- ✓ Identify meaningful connections between texts that contain related information.



Integration

- ✓ Organize, connect, compare, and contrast ideas from different sources to build a coherent understanding of an issue/topic
- ✓ Integrate information within a text or between texts and integrate information across different formats (e.g., pictures, animations, or video's)
- ✓ Notice (in)consistencies between different texts and decide which information to integrate into one's mental representation
  - ✓ When texts agree: recognize, prioritize, and synthesize important information from across texts.
  - ✓ When texts disagree: label and weigh, qualify, or reconcile discrepancies to correctly characterize the alternative views
- ✓ Determine whether sources using different terminologies discuss the same concept and whether sources using the same terminology actually discuss the same concept

Evaluation

- ✓ Examine the relevance of information by looking for substantive similarities in the detailed search result descriptions.
- ✓ Evaluate the reliability and accuracy of information by using one's own knowledge and by investigating the source, the information quality and the text context.
  - ✓ Source: examine author expertise, purpose (i.e., possible ulterior motives or biases), and point of view (i.e., how their worldview compares to the reader's worldview).
  - ✓ Information quality: examine whether other sources confirm the information and/or whether its accuracy is guaranteed (e.g., by quality checks by the organization itself or external parties).
  - ✓ Text context: consider the temporal, social, and political context of a text, alignment with particular values or narratives, and evaluate whether information may be selectively presented, inaccurate, or incomplete, and consider potential reasons for such imprecisions or omissions.

FIGURE 3 | Three core competences in online reading and their subskills.

when searching for 'planets' they may encounter names of planets and use these as new search terms).

6.2 | Integration

To achieve good comprehension, students must integrate information from multiple sources by organizing, connecting, comparing, and contrasting ideas from different sources to build a coherent understanding of an issue/topic (Cho and Afflerbach 2015; Rouet 2006; Strømsø et al. 2013). They must decide which information to integrate into their mental representation and notice (in)consistencies[1] between the different texts to build an integrated representation of how they support, complement, or contradict each other (Goldman and Scardamalia 2013; Rouet 2006).

Integration processes are important for building a coherent understanding of one or more texts in both environments, but they are generally more challenging online: Students must not only integrate information within a text or between texts, but also across different formats (e.g., pictures, animations, or videos; Salmerón et al. 2018). Moreover, they may encounter texts on the same content from dissimilar perspectives, yielding differences, discrepancies, or even flagrant contradictions across accounts (e.g., Bråten and Braasch 2018; Perfetti et al. 1999). When texts agree, students must recognize, prioritize, and synthesize important information from across texts. When texts disagree, they must label and weigh, qualify, or reconcile discrepancies to correctly characterize the alternative views (Braasch et al. 2018; Stadtler and Bromme 2014). Furthermore, as texts vary in style and terminology, students must determine whether sources using different terminology discuss the same concept (e.g., traffic light or stoplight) and whether sources using the same terminology actually discuss the same concept (Rouet and Britt 2011). Ultimately, they must organize and integrate this information into a coherent mental representation to achieve good comprehension (Cho and Afflerbach 2015; Rouet 2006; Strømsø et al. 2013).

6.3 | Evaluation

Good evaluation skills are essential for the successful use of online information (Barzilai et al. 2020), as readers decide whether

they will use information by critically evaluating its accuracy, reliability, potential biases, etc. (Leu et al. 2013; Magliano et al. 2018; Mahlow et al. 2020). Such evaluation takes two distinct forms:

6.3.1 | Relevance Evaluation

Students must evaluate whether information is *relevant* for their information seeking purpose by examining the overlap between the information and the task's subject. They can do so by looking for superficial similarities between search terms and search results (e.g., whether they contain the same words) and/or substantive similarities in the detailed search result descriptions (Hahnel et al. 2020; Lehman and Schraw 2002; Mahlow et al. 2020; McCrudden et al. 2010; McCrudden and Schraw 2007).

6.3.2 | Reliability Evaluation

Students must evaluate whether information is *reliable and correct* by comparing what they read with what they think is true based on their own knowledge[2] and by investigating the source and the text context (Barzilai et al. 2020; Stadtler and Bromme 2014). When they have sufficient topic-relevant knowledge, they can use this knowledge to evaluate the reliability of information, the quality and coherence of the arguments presented, and the strength of the evidence (e.g., whether the author relies on scientific or anecdotal evidence). When they lack sufficient topic-relevant knowledge, students should evaluate using source information—as the trustworthiness of the source informs the reader's evaluation of the information itself (Barzilai et al. 2020; Stadtler and Bromme 2014). This requires more effort and cognitive capacity than the relatively 'easy' knowledge-based evaluation, as it requires investigating author expertise, purpose (i.e., possible ulterior motives or biases), and point of view (i.e., how their worldview compares to the reader's worldview), whether other sources confirm the information, etc. (e.g., Kammerer and Gerjets 2014; Keck et al. 2015; List 2024; Paul et al. 2017; Sinatra and Lombardi 2020). Finally, readers must engage in critical literacy practices (e.g., take on the 'text analyst' role described in the Four Resources Model; Freebody and Luke 2003) and evaluate the temporal, social, and political context of a text (Forzani et al. 2022), assess alignment with particular values or as forwarding dominant narratives, evaluate whether information may be selectively presented, inaccurate, or incomplete, and consider potential reasons for such imprecisions or omissions (List 2024; List and Oaxaca 2024). This is especially important when assessing online content on contentious issues that lack clear answers or expert consensus.

Both forms of evaluation are particularly important for selecting promising webpages while navigating. Students' judgments about whether to select, process, and use particular documents are often based on their assessment of relevance and reliability. Ideally, they should consider content relevance, information quality *and* source credibility (Goldman 2011; Lucassen et al. 2013; Rouet and Britt 2011), but generally their judgments are primarily based on content relevance (Britt and Aglinskas 2002; Goldman et al. 2012). When they do take reliability into account they often treat the order of search results as a proxy for trustworthiness or focus on superficial characteristics (e.g., whether websites look 'professional') instead of source information (e.g., Breakstone et al. 2021; Gerjets et al. 2011; McGrew et al. 2018; Strømsø et al. 2013).

Thus, successful evaluation requires students to know good criteria for assessing the quality and reliability of information and information sources. Moreover, they need to *consciously apply these criteria* when they evaluate information. They should use their own knowledge, but –especially when their topic-relevant knowledge is limited– also assess whether the source has relevant expertise, whether it has an interest in sharing the information, what the sociocultural context of the information is, whether the accuracy of the information is guaranteed (e.g., by quality checks by the organization itself or external parties), and whether the information is intended to manipulate or deceive (Kammerer and Gerjets 2014; Keck et al. 2015; Paul et al. 2017). Additionally, students must apply these criteria when comparing and evaluating competing knowledge claims that may be linked to various sources (Bråten et al. 2011).

7 | Opportunities and Challenges of Online Reading

The internet provides readers with important opportunities, but also presents new challenges. Understanding these opportunities and challenges is crucial for readers to make optimal use of the opportunities and for teachers to successfully guide students in navigating this complex environment.

7.1 | Opportunities

When searching for information, students can easily access countless websites containing information related to the original search query through hyperlinks—offering unprecedented potential for accessing information and acquiring knowledge. Moreover, they can access contributions from a wide range of socially and linguistically diverse authors, promoting varied perspectives and inclusive dialogue. Students' freedom to choose their own 'path' through these sources and decide which pages to visit, what to view on those pages, and where to navigate to next are –together with the richness of information– major advantages of online reading. They can construct their 'own' text based on information from different sources (Cho and Afflerbach 2015). Moreover, they can adapt their reading behavior to their needs, motivation, or knowledge at that moment (e.g., Jonassen 1986), allowing them to experience the same content in different ways depending on their approach and the purpose of a specific reading session. Such individualization of the reading experience gives students more freedom to make choices and interpretations and adapt texts to their individual needs—which can benefit comprehension (Cho and Afflerbach 2015).

Moreover, the online environment makes information more accessible: it allows readers to adjust the appearance of texts

(e.g., font, font size, spacing between letters or sentences, etc.) to their preferences, which helps with reading and understanding texts—especially for readers with technical reading difficulties (e.g., Marinus et al. 2016).

7.2 | Challenges

First, reducing the abundance of available information to a manageable quantity is challenging. To do this, students must navigate multimodal web pages and pages with search results and hyperlinks. As they are reading, they must remember where they are in the text, where they have been (i.e., the 'path' they followed), and where they want to go to find information relevant to their goals (Coiro and Dobler 2007; DeStefano and LeFevre 2007)—resulting in a high cognitive load while reading.

Second, there is more variation in how online information is presented and how coherently it is presented. Whereas printed texts only contain text or text combined with images, online texts can contain many formats, including text combined with images, audio, or video. This allows for deepening activities (e.g., through hyperlinks with explanations) that provide more challenge and depth compared to printed texts but can also distract or confuse students—making it harder to achieve a coherent understanding from multiple sources (Coiro 2011).

Finally, the internet offers unprecedented opportunities for sharing and disseminating information. Anyone can post information online, usually without review by third parties. This provides opportunities to exchange knowledge, discover different perspectives, and become authors of publicly accessible information—which can motivate students (e.g., Kuiper and Volman 2008). But it also causes students to encounter conflicting perspectives and online texts that vary in quality, accuracy, and reliability (e.g., Britt et al. 2017; Rouet 2006). Students can access incomplete, inaccurate, or even misleading information. These developments make evaluating online texts more important, but also more challenging. Whereas professionals (e.g., editors, publishers, or teachers) often act as gatekeepers to ensure quality and accuracy in printed texts, this is generally not the case with online texts. Some websites have gatekeepers (e.g., Wikipedia, reputable newspapers, etc.), but often readers themselves have to determine whether texts are useful and reliable (Britt and Gabrys 2001; Leu and Maykel 2016; Lucassen et al. 2013). The general skill of critically evaluating texts appears challenging for students: Even when they know the criteria they should use to evaluate the reliability of information, they often fail to apply these when evaluating texts in a complex online environment and base their judgment on superficial information (e.g., whether websites look professional; Gerjets et al. 2011; Strømsø et al. 2013; Walraven et al. 2009).

8 | From Theory to Practice: Supporting Readers in Developing Online Reading Skills

Based on the knowledge discussed in this article, we offer recommendations on how to support students in developing the core competencies of online reading: navigation, integration, and evaluation (Figure 4). As the application of this knowledge is relevant for all educational levels, we provide general recommendations that –combined with teachers' own knowledge of and experience with the internet- can be effectively implemented and tailored to the student's level.

8.1 | Navigation

First, students must learn to select appropriate search terms. To do this, they can write down the topic, the questions to be answered and the facts to be researched and base their search terms on this information. Furthermore, students need to understand that the type and quality of information they encounter is partly determined by the search terms they choose. For instance, searching for 'proof that cold weather causes colds' yields one-sided results with mostly confirming evidence that cold weather can cause colds—even if this is false. Similarly, searching for 'effective medicine for hay fever' yields qualitatively different results than searching for 'treatment allergic rhinitis' (the medical term for hay fever symptoms). Moreover, students must understand that search results are personalized based on search histories and may include sponsored links. This personalization may limit the information they see, creating an echo chamber or filter bubble where they primarily encounter information that aligns with their existing views and, thus, are offered fewer perspectives (Pariser 2011).

Second, students must learn to successfully navigate search-engine results. Generally, they tend to focus on the first results and evaluate their relevance based on the ranking of the results or superficial similarities between search terms and search results (Brand-Gruwel et al. 2017; Granka et al. 2004). Consequently, they may overlook (lower-ranked) relevant results that have fewer superficial similarities with the search terms (e.g., Keil and Kominsky 2013). To illustrate, when investigating why people catch colds students may be attracted to a top-ranked item titled 'Cold weather poses health risks' because the word 'cold' overlaps with the search query, but they may miss a lower-ranked but more relevant result titled 'Dress warmly or you'll get sick' (Keil and Kominsky 2013). Thus, students must learn that top-ranking search results may not be the best or the most relevant and that they should look for *substantive* similarities (e.g., in the detailed descriptions) rather than relying on *superficial* similarities when assessing relevance.

To help students develop good navigation skills, teachers can model how they select search terms, explain their reasoning and demonstrate how they choose and evaluate search results. By demonstrating how they create their own 'path' while navigating from page to page they can illustrate how different choices impact search outcomes. Additionally, they can illustrate bias in search-engine results, e.g., by having students search with different search terms or execute the same query on different devices and compare results. This helps students understand the workings of the internet and their own influence on search results.

8.2 | Integration

Teaching and developing integration skills in online and traditional environments are partially similar: Teachers can demonstrate how to establish connections between different

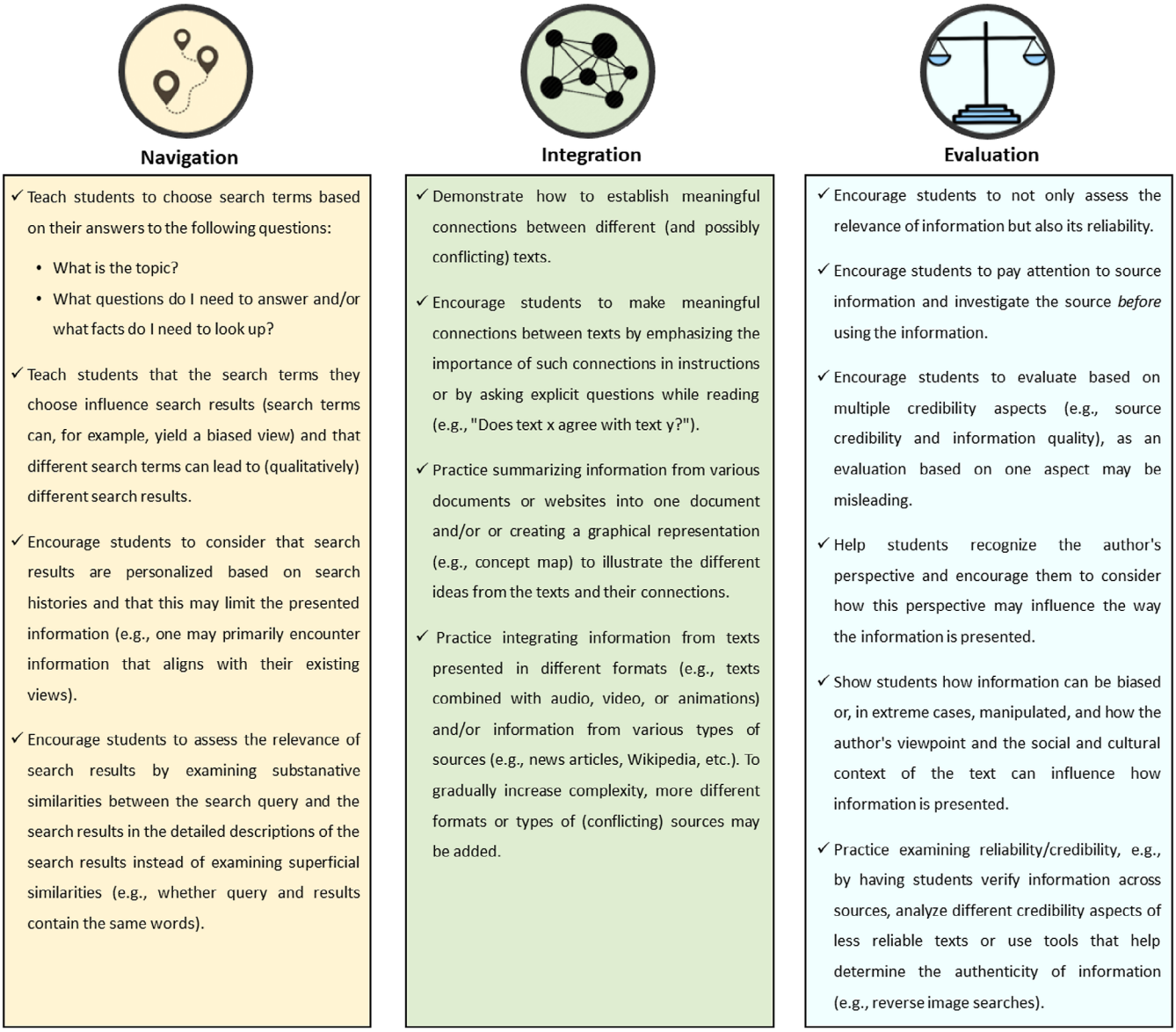


FIGURE 4 | Examples of how students can be supported in developing the three core competencies of online reading. This figure was adapted from Van Moort et al. (2023).

(conflicting) texts and encourage students to establish connections by explicitly instructing them to do so before reading or by asking questions during reading (e.g., 'Do text x and text y agree?' 'What are similarities/differences between what is stated in the texts?') (e.g., González-Lamas et al. 2016). Furthermore, students—individually or in groups—can practice selecting relevant information and getting an overview of the texts and their interrelations by summarizing information from different documents or websites into one document (Barzilai et al. 2018) or creating a graphical representation (e.g., concept map) to illustrate the different ideas from the texts and their connections (Hilbert and Renkl 2008; Kingsley et al. 2015).

To acquire the specific integration skills required in online reading, students can practice integrating information from texts presented in different formats (e.g., texts combined with audio, video, or animations) or from different source types (e.g., news articles, Wikipedia, etc.). To gradually increase complexity, different formats or types of (conflicting) sources may be added.

8.3 | Evaluation

When evaluating search-engine results, students often prioritize usability over reliability (e.g., Walhout et al. 2017). To encourage them to consider both relevance and reliability of information, search instructions should explicitly emphasize evaluating both aspects. Assessing both relevance and reliability is complex; therefore, it may help to break down the skills into manageable steps. For instance, students may search for relevant information from a selection of reliable sources *only* before adding reliability evaluation by varying the reliability of the sources.

Students across educational levels often overlook source information or, when they do evaluate reliability, focus on superficial characteristics (e.g., Coiro 2021; McGrew et al. 2018). Thus, students must be encouraged to focus on source information. Moreover, they need to learn how to investigate different credibility aspects, such as examining source credibility (e.g., investigate whether URLs look credible and whether authors have relevant expertise

and/or conflicts of interest) or checking whether information also appears elsewhere and whether its accuracy is guaranteed by third-party quality checks (e.g., editors; Kammerer and Gerjets 2014; Keck et al. 2015), and synthesize the results of these investigations to make judgments about the trustworthiness of information. Finally, they must understand that evaluating multiple credibility aspects is important, as an evaluation based on one aspect may be misleading (e.g., Kohnen and Mertens 2019). These skills can be practiced through activities that involve carefully analyzing different credibility aspects of less reliable texts and connections between these aspects. For instance, while searching online, teachers may ask students to identify less credible texts and justify why they find them less credible (Kiili et al. 2023) or to compare more and less credible texts (Braasch et al. 2018). Additionally, students can practice using tools that help determine the authenticity of information, such as using reverse image searches (e.g., search engines like Google or www.reverseimagesearch.com) or external fact-check websites.

To help students recognize biased or misleading information, teachers can demonstrate how online information can be biased or, in extreme cases, manipulated, and how the author's viewpoint and the social and cultural context of the text can influence how information is presented (Coiro 2021). Explicit modeling may foster students' understanding of how authors word and image choices reflect their intentions and underlying beliefs. Furthermore, teaching students that authors of misleading information often use specific strategies to persuade readers (e.g., by using educational tools like the 'Bad News Game'; Basol et al. 2020) can help them recognize such psychological manipulation.

In addition to acquiring the aforementioned knowledge and skills, students need to learn to utilize them *at the right time*. Ideally, when they encounter potentially relevant information, they should investigate the source *before* utilizing the information. Tools like the SIFT evaluation method (Figure 5; Caulfield 2020) can help teach students to stop reading (news) messages that evoke strong emotions and examine the information and the source before continuing to read and share the message (Brodsky et al. 2021).

9 | Conclusion

To utilize the full potential of the online environment, students must develop both traditional and online reading skills. They

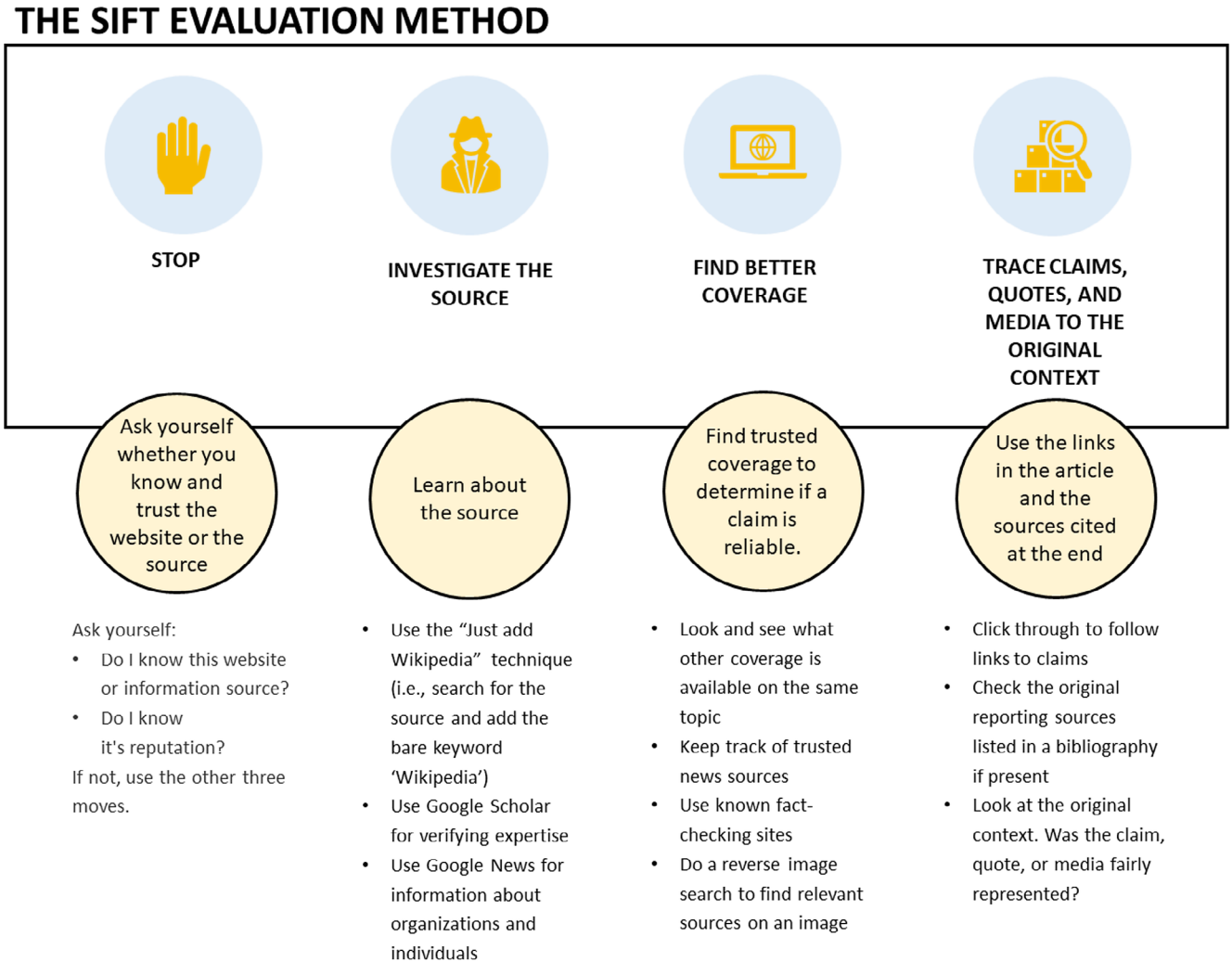


FIGURE 5 | The four steps of the sift evaluation method: stop, investigate the source, find better coverage, trace the original context. This figure was adapted from Caulfield (2020; https://clark.libguides.com/evaluating-information/SIFT).

must be able to successfully navigate webpages and search engine results, comprehend and integrate information from diverse sources, evaluate the relevance and reliability of information and informational sources, and make informed choices about what to read and in what order, and whether, when, and where to search for additional sources (e.g., Salmerón et al. 2018). Furthermore, teachers across educational levels need to understand the complexities of the online context and the skills that students need to comprehend in this context.

Online reading skills should be integrated into educational programs to ensure that students do not need to rely on their home environment for acquiring these skills –as students may not have equal access to such learning at home. As students bring diverse experiences and prior knowledge of online reading –depending on their home literacy environment and online experience –teachers should assess and build upon students' pre-existing online literacy skills and experiences to help all students become proficient.

Developing good online reading skills requires more than frequent exposure to online texts or growing up with technology (Leu et al. 2013). Extensive online experience does not automatically ensure proficient online reading skills (e.g., students can be proficient at using search engines but struggle to select relevant/reliable information).

Online reading skills must be carefully taught and practiced. It is important to make the complexity of the online environment manageable, e.g., by having students work with a few (simplified) texts or search results and gradually increasing complexity. Ultimately, students should be able to deal with the complexity of the unfiltered internet, but their practice environment can (initially) be less complex.

Finally, it is important that teachers realize that complex comprehension tasks are not limited to specific educational levels. To fully benefit from the richness of the online environment and successfully participate in a digital society, all students must develop these skills (e.g., Goldman 2015; Goldman et al. 2012; Leu et al. 2013). Teachers and other education stakeholders can play a vital role in supporting students in developing these skills (Buchholz et al. 2020; Journell 2019).

Take Action!

1. Include lessons on selecting appropriate search terms and relevant search results and help students recognize their own role in processing online information.
2. Include lessons on integrating information from various sources. Encourage students to make meaningful connections, practice integrating information from various types of sources, for example, by summarizing or making graphical overviews of texts and their interrelations.
3. Include lessons on assessing information relevance and reliability. Encourage students to investigate sources *before* using them and practice examining source reliability/credibility. Help them recognize the author's perspective and how it may impact how information is presented.

Conflicts of Interest

The authors declare no conflicts of interest.

Endnotes

[1] This can involve both factual information presented in the texts and conflicts related to differing worldviews or underlying values represented in the texts (List et al. 2023).

[2] Knowledge is not limited to factual knowledge, but readers use vast funds of knowledge, including cultural and linguistic resources as well as prior experiences, to evaluate the reliability of information.

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More to Explore

- Nash, B. L. 2021. "Constructing Meaning Online: Teaching Critical Reading in a Post-Truth Era." *The Reading Teacher* 74, no. 6: 713–722. https://doi.org/10.1002/trtr.1980.
- Video on CRAAP Test to evaluate sources: https://researchguides.ben.edu/source-evaluation.
- Book about Web Literacy—https://pressbooks.pub/webliteracy/.
- Lesson ideas for teaching the SIFT method: https://checkpleasecc.notion.site/checkpleasecc/Check-Please-Starter-Course-ae34d043575e42828dc2964437ea4eed.
- A video with classroom activities on selecting effective keywords: https://www.youtube.com/watch?v=pSfVKMl-Hj8&t=141s.