Learning from Multiple Texts

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Abstract

Multiple texts refers to different text-based sources about the same topic. Learning from multiple texts involves selecting, comprehending, evaluating, and integrating information from two or more textual sources to meet a reading goal. This article provides an overview of learning from multiple texts. We overview models that describe learning from multiple texts and review research on the role of individual differences in learning from multiple texts. Then, we describe measurement of multiple text comprehension and the representation of information about sources. Next, we discuss approaches to teaching students to integrate content information across texts and to evaluate source information critically. Later, we discuss reading on the Internet (including social media) and the use of multimedia documents and sources. We conclude with general comments about learning from multiple texts.

Keywords: learning; comprehension; multiple texts; multiple documents; multiple sources

Learning from Multiple Texts

Individuals read for many purposes. When individuals have questions, are attempting to solve problems, or seek to improve their understanding, they commonly access text. These purposes can be self-generated or assigned by others (e.g., teachers) and can be part of informal contexts (e.g., reading to understand the nutritional value of different foods) and formal contexts (e.g., reading as part of a class to complete an assessment task). For this article, we define *multiple texts* (or multiple textual sources) as different text-based sources about the same topic. *Learning from multiple texts* can involve selecting, comprehending, evaluating, and integrating information from two or more textual sources to carry out an assigned task or a self-selected reading goal (Braasch, Bråten, & McCrudden, 2018).

To illustrate, primary school students may be asked to read to determine whether a dolphin is a fish or a mammal. The students could be provided different texts about fish, mammals, and dolphins. They could identify the defining characteristics of fish and mammals, compare the characteristics of dolphins with the defining characteristics of fish and mammals, and subsequently infer that a dolphin is a mammal. Each text relates to a larger whole that is not specified by any single text. In this example, the teacher may provide students with texts that are deemed credible and provide information consistent with biologists' accepted understandings of fish and mammals. However, in other cases, readers many need to consider characteristics of the sources. An information source can be defined as the person or entity to whom the information is attributed (Macedo-Rouet et al., 2013). Suppose students are asked to evaluate the impact of progressive tax rates on different segments of the economy (e.g., job creation, capital investment, wage rates, foreign investment). This example differs from the previous example (dolphins) not only in the number and complexity of the concepts, but some of the texts may provide

conflicting views. Thus, readers need to consider not only the content of a text, but also the source to whom the content is attributed.

The purpose of this article is to provide an overview of learning from multiple texts. The article consists of seven main sections. In the first section, we provide an overview of models that describe learning from multiple texts. In the second section, we review research on the role of individual differences in learning from multiple texts. In the third section, we describe how researchers measure readers' comprehension of multiple texts and their representation of information about sources. In the fourth section, we discuss approaches to teaching students to integrate content information across texts and to critically evaluate source information. In the fifth section, we discuss reading on the Internet (including social media) and the use of multimedia documents and sources. Finally, we end with general comments about learning from multiple texts.

Models of Learning from Multiple Texts

Models are useful for trying to describe the processes and products of learning from multiple texts. Processes refer to the moment-by-moment activities that occur before, during, and after a reading experience. Products refer to the mental representations and external artifacts (e.g., notes, essays) that readers generate from a reading experience. In this section, we review seven models. The first model, the Construction-Integration model (Kintsch, 1988, 1998) was developed to describe how readers construct meaning from text, implicitly a single text. However, this model is foundational to subsequent models developed to describe learning from multiple texts. In particular, the Construction-Integration model introduces different levels of mental representation that inform subsequent models. These later models build upon and/or

complement each other by specifying additional processes, variables, or contexts for describing how readers learn from multiple texts.

Construction-Integration (C-I) model. According to the Construction-Integration (C-I) model (Kintsch, 1988, 1998), two main processes facilitate comprehension. The first is *construction*, which begins when text information and prior knowledge are active in the reader's focus of attention. The text information can be the sentence currently being read or sentences read earlier. Sentences from the text can be fused with each other and with prior knowledge, forming a propositional network. The second is *integration*, which involves the continuous spread of activation throughout this network until activation settles on the overlapping nodes in the network, which decreases activation of isolated nodes or nodes that have less overlap.

Over the course of reading, the reader constructs a mental model of the text. The reader's mental model can be represented at three levels: surface code, textbase, and situation model (Kintsch, 1998). The *surface code* represents the exact wording and syntax of sentences. Readers typically only retain the surface code of the most recent clause. The *textbase* represents the gist meaning of the propositions stated explicitly in the text, rather than the exact wording and syntax. The *situation model* represents the reader's overall understanding of the information in the text. The situation model is the fusion of information in the text with the reader's prior knowledge. Thus, skilled readers generally create similar textbases, which reflect the content and organization as provided by the author. However, situation models may vary as a function of readers' goals, interests, and background knowledge.

Document Models Framework (DMF). The C-I model (Kintsch, 1988, 1998) was conceived of as a framework for describing learning from a single text. Building upon the C-I model, Perfetti et al. (1999) introduced the Documents Model Framework (DMF) to describe the

mental representations that are created when learning from multiple texts. According to the DMF, readers generate a documents model that includes a situations model and an intertext model. The *situations model* (or integrated mental model) reflects the individual situation model for each text, but also the inter-connections between/among the individual situation models. Thus, the situations model is a composite of the situation models for each text and represents the reader's overall understanding of the topic or phenomenon described in the texts. The *intertext model* contains information about the individual texts themselves and how they are related, such as each text's style (e.g., informational vs. narrative) and intent (e.g., to persuade or inform), the author's status, perceptions of text quality, and whether the authors of the different texts agree or disagree.

Multiple-Document Task-based Relevance Assessment and Content Extraction (MD-TRACE) model. The MD-TRACE model describes the resources and processes readers use when learning from multiple texts (Rouet & Britt, 2011). As with the Documents Model Framework, the reader generates a documents model (situations model/integrated mental model and intertext model) based on the texts. However, the MD-TRACE model extends learning from multiple texts to include a task model. A *task model* is the reader's understanding of the task requirements, which contributes to goal formation and suggests the means necessary to achieve that goal. Thus, when reading multiple texts, the reader not only constructs a documents model (situations model and intertext model), but also generates a task model that directs the reading activity.

The MD-TRACE model includes five core processes that occur *iteratively* over the course of learning from multiple texts. For simplicity, we will describe the processes as steps, but it is important to recognize that the process is iterative. The first step involves constructing a task

model. It includes the goals readers create and actions that should be taken to reach the goals. The second step involves assessing information needs. These needs are clarity about the task to be done (e.g., write an essay vs. prepare for a multiple-choice test), familiarity with the task (e.g., knowing how to write an argument essay), prior knowledge about the content of the text, and what resources are needed (e.g., books, journal articles) and where to find them. The third step involves selecting, processing, and integrating document information. *Selection* involves determining the relevance of information in relation to the goal for reading. Information that more effectively contribute to a reader's goals is more relevant than information that less effectively contributes to a reader's goals (McCrudden & Schraw, 2007). Processing involves attempts to create meaning. It involves cognitive activities to make sense of ideas, connecting ideas from the text with each other, and connecting ideas from the text with prior knowledge. It can also include evaluations of the author/source as well as the texts themselves. The fourth step is the construction of a task product. The reader engages with multiple texts to reach some goal, which is generally reflected in the task model. The task product involves the utilization of the documents model and the external resources, such as the texts themselves, to create some output. This can be simple, such as an oral response, or complex, such as a paper that synthesizes information from several sources. The last step involves assessing product quality. The reader assesses whether the product meets the task goals, and whether improvements are needed. All five of these steps draw heavily on readers' use of self-regulation.

Reading as problem solving (RESOLV) model. The MD-TRACE model (Rouet & Britt, 2011) highlights the decision-based nature of reading. The RESOLV model (REading as problem SOLVing; Britt et al., 2018; Rouet et al., 2017), extends this focus further. It includes three additional assumptions. First, dimensions of the reading context other than the task

instructions influence reader goals. Second, readers' interpretations of contextual cues influence their goals. Third, motivation, interest, and value influence reading decisions, such as whether to read and what to read.

Readers generate goals for reading in context. As such, according to the RESOLV model readers generate a context model. A *context model* can include information about the request (what is the task statement), the requester (who is making the request), the audience (who will receive the completed request), supports or obstacles (what external resources are available and how can they support or impede request completion), and the self (the readers' assessment of their own skill, knowledge, and interest related to the request and their assessment of the perceived costs and benefits of the activity). Thus, readers who receive the same task instructions may generate different interpretations of the task context and/or have different levels of motivation for initiating, sustaining, and completing activities needed to achieve the task.

In both the MD-TRACE and RESOLV models, the reader creates a task model. In both, the task model includes the goal (goal state for the final product, subgoals, constraints) and how to accomplish it (plans, strategies). However, the RESOLV model also includes the values associated with subgoals (importance of desired states and methods). In other words, readers assess the value of engaging in effortful behaviors and strategies when deciding what to do while reading. Thus, the task model complements the context model.

Like previous models, RESOLV assumes that the mental product of a reading activity is a documents model (situations model/integrated mental model and intertext model). Rouet et al. (2017) further specify the nature of the intertext model. The *intertext model* represents source information (e.g., who wrote the document and in what context) and connections between content and sources. Source-to-content connections are links between a source and specific

information or ideas from a particular document (e.g., who said what). Source-to-source connections are links between sources that represent readers' interpretations about whether information and ideas from different documents corroborate or conflict with each other.

Discrepancy-Induced Source Comprehension (D-ISC) model. The discrepancy-induced source comprehension (D-ISC) model, which stems from the DMF, describes the cognitive processes readers use when reading to understand controversial messages (Braasch et al., 2012; Braasch & Bråten, 2017; Braasch & Kessler, 2021). The DMF is relevant to situations in which information from multiple sources is consistent, complementary, or conflicting. The D-ISC model is particularly relevant to situations in which multiple sources present conflicting information about the same issue (e.g., sun exposure is harmful vs. healthy). In these situations, readers need to understand the conflict and attempt to reconcile the different perspectives so they can build an integrated model of the situation or issue. One way to do this is to shift attention strategically toward the sources of conflicting information in order to resolve the conflict in light of the sources (e.g., by acknowledging that different authors may have different expertise or motives).

Content-Source Integration (CSI) model. The Content-Source Integration (CSI) model (Stadtler & Bromme, 2014) also describes how readers may use a document's source to draw conclusions about conflicting information. The CSI model consists of three stages. The first stage is *conflict detection*, which occurs when a reader perceives a contradiction between information from different sources. In this stage, readers notice when information they are currently reading conflict with information they have read previously. This introduces a coherence break. To restore coherence, readers engage in the second step, which is *conflict regulation*. There are three common ways that readers can restore coherence: (a) ignore the conflict (decide not to attempt to do anything to interpret the conflict), (b) reconcile the conflict using

text (e.g., the text provides a satisfactory explanation for the conflict) or prior knowledge (e.g., use prior knowledge to explain the conflict), or (c) accept the conflict as due to different sources or points of view (i.e., interpret the disruption of coherence as due to different perspectives rather than a genuine conflict). The third stage is *conflict resolution*. In this stage, the reader needs to develop a personal stance on the conflict. They need to evaluate the truthfulness of conflicting claims, which entails making a first-hand or second-hand evaluation (Bromme & Goldman, 2014). When readers make first-hand evaluations, they use their understanding of the subject to assess the validity of the competing claims. The question to be addressed is: What is true? However, when readers have limited understanding of the subject, they may need to make a second-hand evaluation, which entails evaluating the sources themselves. The question then becomes: Whom to believe? Thus, when a topic is more familiar, readers may rely to a greater extent on first-hand evaluation, but when a topic is less familiar, readers may rely to a greater extent on second-hand evaluation (McCrudden et al., 2016).

Integrated Framework of Multiple Texts (IF-MT). The integrated framework of multiple texts (IF-MT; List & Alexander, 2019) describes the process of learning from multiple texts as a three-stage process. The first stage is *preparation*, in which the reader evaluates the reading task and develops a stance for how to complete it. Two dimensions characterize the reader's stance: affective engagement and behavioral dispositions towards the evaluation of sources and verification of information the sources provide (List & Alexander, 2017). *Affective engagement* refers to the degree to which students are motivated to complete a task. Motivational variables include topic interest, attitudes towards the topic, self-efficacy for the reading task, and value placed on doing the task. *Behavioral dispositions* refer to the extent to which readers have mastered the skills needed to evaluate sources and the content provided by sources, and their ability to integrate texts. Further, this dimension includes the extent to which the reader commonly uses these skills.

The second stage is *execution*, which describes the behaviors and strategies readers use while engaging with multiple texts. There are three core strategies. *Behavioral strategies* refer to the observable actions that readers take when they engage with the texts, including information search, text selection, and note taking activities. *Cognitive strategies* refer to the mental processes that readers use when they engage with the texts including strategies used to comprehend individual texts and strategies used to integrate ideas between/across texts. *Metacognitive strategies* refer to the regulatory actions that readers use when they engage with the texts, such as comprehension monitoring (i.e., self-evaluations of understanding).

The third stage is *production*, which involves the generation of an external product, such as an essay, to address the reading task. This usually reflects selective elements of the reader's mental representation of the texts, based on the specific task expectations. For instance, when writing a summary, the learner might include main ideas, but exclude some details that are retained in memory.

The Role of Individual Differences

Working with multiple texts may result in a more complex and deeper understanding of a topic, issue, or phenomenon than working with one single text (Wolfe & Goldman, 2005). Further, working with multiple texts may lead to greater flexibility because the acquired knowledge is less tied to one specific text and therefore more accessible across different contexts (Spiro et al., 2015). However, there is no reason to believe that all learners will profit equally from working with multiple sources. Among the individual differences likely to play a role are learners' comprehension skills, prior knowledge, beliefs, motivation and engagement, and strategic processing.

Comprehension skills. Several recent studies have linked learners' single text comprehension skills to aspects of multiple text comprehension (e.g., Florit et al., 2019; Mahlow

et al., 2020; Mason et al., 2020; Salmerón, Sampietro, & Delgado, 2020). For example, Florit et al. (2019), in a study of Italian fourth-grade students, found that comprehension skills measured with a single informational text uniquely predicted multiple text comprehension measured with post-reading essay tasks. Likewise, Mahlow et al. (2020), in a study of German university students, found that comprehension skills measured with a single text predicted multiple text comprehension when controlling for other relevant variables. Such findings are consistent with the idea that comprehension of each single text indeed matters when learners try to build integrated understanding across multiple texts.

Prior knowledge. There is evidence that learners' prior knowledge about the topic discussed across multiple texts contributes to the comprehension of those texts (e.g., Bråten et al., 2014; Gil et al., 2010; Stang Lund et al., 2019). For example, Stang Lund et al. (2019) found that Norwegian upper-secondary students' prior knowledge both directly and indirectly predicted their ability to integrate source and content information when reading about the issue of sun exposure and health. Presumably, prior knowledge contributes to multiple source comprehension because it facilitates bridging inferences that create interconnection and coherence in complex, divergent textual materials (Bråten et al., 2020).

Results are mixed regarding the relationship between prior knowledge and attention to source information, such as the authors, when working with multiple texts. Notably, quite a few studies have found no relationship between prior knowledge and sourcing (for review, see Anmarkrud et al., 2021). This inconsistency seems to reflect theoretical divergence. For instance, some models (List & Alexander, 2017, 2019) imply that more prior knowledge will increase attention to source information through adoption of a critical analytic stance. However, others

(Stadtler & Bromme, 2014) imply that less prior knowledge will increase attention to source information because learners do not feel competent in validating knowledge claims themselves.

Beliefs. Two kinds of beliefs have been studied in relation to multiple text comprehension. The first type of beliefs, called topic beliefs, concerns positions people take about the truth value of statements about some aspect of reality (Wolfe & Griffin, 2018). The second type, called epistemic beliefs, concerns positions people take about the truth value of statements about knowledge and knowing (Bråten & Strømsø, 2020).

Research has indicated that learners' prior topic beliefs may influence the comprehension of multiple texts, especially when those beliefs are inconsistent with information presented in the texts (for reviews, see Bråten & Strømsø, 2020; Richter & Maier, 2017). In such instances, learners tend to be biased toward their own prior beliefs when evaluating arguments and drawing conclusions, which does not bode well for creating a balanced mental representation of controversial issues discussed across multiple sources (Richter & Maier, 2017). However, learners may sometimes decouple their beliefs from the meaning making process and consider information independently of their prior beliefs, which increases the likelihood of belief revision and construction of a more balanced mental representation of the issue in question (McCrudden, 2020).

Much research has also been directed toward understanding the role of learners' beliefs about the nature of knowledge and the process of knowing when working with multiple texts (for reviews, see Bråten et al., 2016; Bråten & Strømsø, 2020). This research has indicated that believing that knowledge is tentative and complex and that the process of knowing involves justifying claims by corroborating and integrating information across sources may promote multiple text processing and comprehension (e.g., Barzilai & Eshet-Alkalai, 2015; Bråten et al.,

2014; Wiley et al., 2020). Presumably, this is because such beliefs about knowledge and knowing are well aligned with the requirements of multiple text learning contexts, which involve open, complex problem spaces characterized by claims and arguments distributed across diverse, often conflicting textual sources (Bråten et al., 2020).

Motivation and engagement. Because comprehending multiple texts may be considered more challenging than comprehending a single text on a topic, it is reasonable to assume that comprehending multiple texts requires higher levels of learner motivation and engagement. Thus far, the motivation construct most researched in relation to multiple text comprehension is topic interest (e.g., Bråten et al., 2014; List, 2020; List, Stephens, & Alexander, 2019; Salmerón, Gil, & Bråten, 2018; Stang Lund et al., 2019), although this research provides little support for a direct relationship between topic interest and multiple text comprehension. However, some research (Bråten et al., 2014; List, 2020) has suggested that topic interest may indirectly affect multiple text comprehension through behavioral engagement, that is, learners' active, observable involvement in tasks as typified by time, effort, persistence, and productivity (Eccles & Wang, 2012).

In a range of studies, behavioral engagement has been shown to be a proximal contributor to multiple source comprehension. In some of these studies (Bråten, Brante, & Strømsø, 2018; Bråten et al., 2014; Du & List, 2020; List, 2020; List, Stephens, & Alexander, 2019), the time learners invest in reading and comprehension tasks has uniquely predicted their comprehension performance. In other studies (Bråten, Brante, & Strømsø, 2018; Kammerer et al., 2021; Latini et al., 2019), learners' productivity (length of written responses) when working on post-reading essay tasks used to measure multiple text comprehension has been shown to be positively related to comprehension performance.

Strategic performance. At the same time, it is important to ensure that learners' engagement is channeled into adaptive strategic processing of the text materials. In particular, learners' use of cross-text elaboration strategies has been linked to multiple text comprehension (e.g., Bråten et al., 2014; Cho et al., 2017; List, 2020; List & Alexander, 2020; List, Du, et al., 2019; McCrudden et al., 2021). These strategies involve intentional intertextual processing, such as connecting, comparing, and contrasting information across texts, to build an integrated understanding of the topic in question. Conversely, strategic processing that involves an accumulation of piecemeal information from single texts does not seem to promote integrated understanding of multiple texts (Bråten & Strømsø, 2011).

Strategic attention to source information, such as authors, publications, and date and purpose of creation, to evaluate information in light of its source, has been given special status within this area of research (Scharrer & Salmerón, 2016). Accordingly, a range of studies have indicated that learners' critical evaluation of source information is related to adaptive meaning making in multiple text contexts (e.g., Bråten et al. 2009; Cho et al., 2017; Florit et al., 2019; Salmerón, Gil, & Bråten, 2018). Presumably, this is because it allows learners to prioritize information from competent, credible, and less biased sources, as well as to understand reasons for conflicting views on the same issue (e.g., because authors have different competencies or motives).

Measurement of Multiple Source Comprehension

In reviewing the literature on multiple source comprehension, Primor and Katzir (2018) found that researchers had either used expressive tasks in the form of essays and open-ended questions or receptive tasks in the form of verification tasks to measure content integration across multiple texts. Essay tasks have sometimes been scored holistically (e.g., Anmarkrud et

al., 2014; List, Stephens, & Alexander, 2019) and sometimes by segmenting them into idea units and identifying the types of inferences made (i.e., intratext vs. intertext inferences; Gil et al., 2010; Salmerón, Gil, & Bråten, 2018). When open-ended questions have been used, they have directly or indirectly required learners to integrate different views across sources, capturing how well learners are able to reason about the issue in terms of the claims, reasons, and evidence provided across texts (Barzilai & Ka'adan, 2017; Bråten et al., 2014). In some instances (Le Bigot & Rouet, 2007; Latini et al., 2019), content integration has also been measured by taking learners' use of connective words into account. For example, Latini et al. (2019) scored undergraduates' written responses to open-ended questions by coding their use of causal (e.g., because, therefore) and adversative (e.g., however, whereas) connectives in combining, comparing, and contrasting information across sources.

Regarding verification tasks, Strømsø et al. (2008) introduced the intertextual inference verification task. This task requires learners to verify (yes or no) whether presented statements can be reasonably inferred by combining information across two or more texts recently read. Importantly, the statements included in an intertextual inference verification task should not just be combinations of statements included in the texts, but statements requiring the use of bridging inferences between information from those texts.

These different ways of measuring integration across multiple texts have different strengths and weaknesses. For example, whereas essays and open-ended questions seem well suited to assess deeper level, integrated understanding of multiple texts, such tasks involve additional writing skills. Ideally, writing skills should therefore be measured independently and their effects partialled out when researchers use essays and open-ended question tasks in correlational or experimental designs. Correspondingly, when learners respond orally instead of

in writing to open-ended questions (e.g., Andresen et al., 2019), expressive oral language skills come into play and should preferably be accounted for. Whereas intertextual inference verification tasks do not require writing or expressive oral language skills, such tasks often have lower reliabilities unless they include a large number of items, and they involve a 50% chance of guessing correctly. Further, intertextual inference verification tasks typically include quite complex items (i.e., statements) that may be difficult to understand. As such, these tasks may require comprehension skills in and of themselves.

With respect to learners' representation of source information, an important distinction is between measurement of spontaneous (i.e., unprompted) and prompted representation of sources. For example, spontaneous representation of sources is measured through learners' references to source information or inclusion of source-content links when trying to explain conflicting positions on the same issue in an essay task, that is, without being given any specific instructions to refer to sources (e.g., Anmarkrud et al., 2014; Salmerón, Gil, & Bråten, 2018). On the other hand, prompted representation of sources may be measured by probing learners' memory for source features after reading (e.g., Kammerer, Meier, & Stahl, 2016; Salmerón, Gil, & Bråten, 2018), by asking them to rank or rate sources according to credibility (e.g., Barzilai, Thomm, & Shlomi-Elooz, 2020; Bråten et al., 2009), and by asking them to justify their ranking or rating of the sources (e.g., Braasch et al., 2014; Mason et al., 2018). As highlighted by Anmarkrud et al. (2021), learners generally have been found to perform rather poorly on measures of spontaneous source representation. On measures of prompted source representation, more variation among learners are typically found, which also makes it easier to discover relationships between learners' representation of source information and other variables, such as individual differences (Anmarkrud et al., 2021).

Noteworthy is also the development of scenario-based digital assessment tools within multiple source comprehension, such as the Online Research and Comprehension Assessment (ORCA; Leu et al., 2015) and the Global Integrated Scenario-based Assessment (GISA; Sabatini et al., 2018). In essence, scenario-based assessments involve purposeful reading of multiple thematically related sources, with built-in guidance provided throughout task completion and with both content integration and critical source evaluation targeted by the assessment (Sabatini et al., 2018). Wang et al. (2021) showed that a scenario-based assessment may be more difficult than a traditional single text comprehension assessment, with learners' prior topic knowledge also contributing more to performance on the former than on the latter. However, the scenario-based assessment that Wang et al. (2021) evaluated was based on only multiple-choice questions and did not seem to include guidance or assess critical evaluation of source information.

Teaching Integration and Sourcing Skills in Multiple Text Contexts

Given the great challenges that multiple text comprehension represents across educational levels, direct instruction and guidance seem necessary. This means that making multiple texts available to students, or even providing them with a selection of relevant sources, is hardly sufficient. In such situations, students may still perceive the task as one of gathering and reproducing as much information as possible from different texts, without constructing a coherent representation of the topic by integrating information across texts and without critically evaluating the credibility of the content in light of the source information. Students must therefore learn *how* diverse and complex text materials should be handled. In the following, we discuss approaches to teaching integration of content information across texts and critical evaluation of source information, respectively.

Teaching content integration. In a review of interventions targeting integration of information across multiple texts, Barzilai et al. (2018) showed that many of these interventions have emphasized collaboration and discussion among students. In such interventions, students have typically worked in pairs or small groups in which they have discussed texts and engaged in various text-based writing activities. As an example, Lundstrom et al. (2015) had students work with multiple texts individually before they shared what they had learned with their group. Students then organized information from the texts collaboratively and created an outline for writing a synthesis based on the texts.

Other interventions targeting content integration have emphasized various forms of strategy instruction, that is, guidance in using strategies to integrate content across texts (Barzilai et al., 2018). These interventions include guidance in how to annotate or summarize single texts (e.g., Britt & Sommer, 2004; Hagerman, 2017), as well as guidance in how to create and use graphic representations (e.g., tables or maps) that explicate how information from different texts hang together (e.g., Barzilai & Ka'adan, 2017).

In an 8-hour intervention where Israeli 9th-graders worked with multiple texts on a historical topic that included both complementary and contradictory information, Barzilai, Mor-Hagani, et al. (2020) combined student discussions and graphic representations. Students learned to represent relationships between the contents of multiple texts graphically by means of a map, in which they also mapped connections between content and source information and between sources of information. Students used this graphic representation when they produced their own texts on the topic. They worked in pairs both when they mapped the connections between the texts and when they produced their own texts, and they also discussed their experiences with writing with support from the map in class. The results of this intervention showed that students

who created and used the graphic representation collaboratively clearly outperformed students in a control group with respect to integrating information across texts on an essay task.

Teaching source evaluation. A number of interventions targeting sourcing skills have been implemented and evaluated during the last decades (for review, see Brante & Strømsø, 2018). However, many of these interventions have been quite brief, implemented by researchers rather than teachers, and failed to provide evidence for long-term effects (Brante & Strømsø, 2019).

As an example of an extensive intervention implemented by teachers as part of regular classroom activities and demonstrating not only immediate but also long-term effects, Bråten et al. (2019) conducted a study in which high school students were taught to consider relevant source features (i.e., author, author competence, author affiliation, type of document, publisher, publication date) when selecting texts, interpreting and evaluating content information, and writing from multiple texts. This six-week intervention was integrated into regular classroom activities in language arts and implemented by regular teachers who participated in professional development seminars led by the research team. The intervention built on a contrasting cases approach (Schwartz & Bransford, 1998) in which students were presented with two fictitious students who varied with respect to source evaluation skills, and they were tasked to compare and contrast these students' strategic attention to source information when working on authentic multiple text tasks framed by the curriculum. In this way, students were presented with a model of how they could approach multiple text tasks effectively, that is, by trying to emulate the sourcing skills illustrated by the "adaptive sourcer" case.

Results showed that students who participated in the intervention put more emphasis on source information when selecting texts, processed the selected texts more thoroughly, and more

frequently attributed textual ideas to their respective sources during text-based writing than did students in the control group. Importantly, these effects were observed on far transfer tasks and were maintained over a 5.5-week period (Bråten et al., 2019).

Another example of a successful approach to teaching source evaluation is an extensive Finnish intervention study in which 6th-graders were taught to evaluate the credibility of multiple Web pages (Hämäläinen et al., 2020). This intervention, which also was implemented by the students' regular teachers, shared some important features with the Bråten et al. (2019) study. Thus, the younger Finnish students also were presented with and asked to compare contrasting cases that varied with respect to source evaluation, discussed source evaluation with each other and with the teacher, and practiced source evaluation when working with authentic multiple text tasks integrated in subject matter teaching. The results of this intervention showed that students who had participated in the intervention, as compared with a control group, to a larger extent based their evaluation of the credibility of Web pages on relevant source features, such as author expertise. However, no follow-up data were provided in this study.

Further research directed toward the design, implementation, and evaluation of long-term, classroom-based interventions is highly needed in this area. Preferably, teachers and researchers should collaborate to conduct such intervention research. Further, it should take place within the framework of regular subject teaching, where the taught sourcing skills can be practiced while working with authentic tasks that involve the evaluation of students' academic performance. Finally, although the teaching of source evaluation and the teaching of content integration have been discussed in two separate sections, it seems essential that these aspects of multiple text comprehension, in line with theoretical accounts, are integrated in educational

interventions. The effects of such interventions also need to be evaluated on different tasks and on delayed post-tests to investigate the transferability and sustainability of those effects.

Reading on the Internet

Understanding how students read on the Internet requires an understanding of Internet sources. First, all Internet sources are linked to other sources by means of hyperlinks. Reading a printed book involves collecting a book from a library or book store, whereas reading from the Internet often involves inspecting a search engine results page (SERP) to click and access a particular web page. Accordingly, reading on the Internet demands specific navigation competences, or the ability to select texts to read and the sequence in which to read those texts (Cho & Afflerbach, 2017).

Second, the Internet was created with an open editorial philosophy, which means that anybody with Internet access can share content with the rest of the World. The quality of printed books is often maintained by editorial gatekeepers (editors, librarians), whereas content on the Internet is not subject to the same editorial standards and can range from high-quality content written by authors with content-area expertise to low-quality content provided by novice or biased sources, such as bots spreading fake news (Braasch & Graesser, 2019). In a survey conducted in 2018, approximately two thirds of EU citizens reported that they encountered fake news at least once a week (European Commission, 2018). Accordingly, reading on the Internet requires that readers regularly use active sourcing processes to filter, select, and interpret multiple texts (Bråten et al., 2020).

Third, the open nature of the Internet enables easy access to vast amounts of texts on virtually any topic. Thus, Internet readers have easy access to complementary information, alternative (or opposing) perspectives, or information in different formats (e.g., text, animated

pictures, videos). But as Internet sources are created as single entities, and not as part of a coherent document, chances are high that documents referring to the same topic are not easily comparable. For example, they may lack contextual information, use different terminology, or use different types of arguments (e.g., scientific claims vs. personal accounts). Thus, reading multiple texts via the Internet may require continuous effort to integrate multiple sources across different formats.

Empirical evidence for the existence of the three major competencies that can be assumed to constitute the core of Internet reading (i.e., navigation, evaluation and integration), comes from a study by Kiili et al. (2018), who modelled the factor structure of scores on an Internet reading assessment in a large sample of 6th grade students (ages 12 and 13). They identified six factors that could be further categorized within the three major competencies: Navigation (1 factor: locating information with a search engine), Evaluation (3 factors: questioning credibility of information, confirming credibility of information, and communicating a justified, source-based position), and Integration (2 factors: identifying main ideas from a single online source, and synthesizing information across multiple online sources). Yet, empirical studies consistently show that young adolescents frequently display limited Internet reading competencies. For example, young readers frequently struggle to navigate, evaluate, and integrate digital information (e.g., Keil & Kominsky, 2013), and they often have difficulty evaluating the credibility of the sources they encounter (e.g., on YouTube or Twitter; e.g., Breakstone et al., 2019). Because such difficulties create particular challenges for younger or less-skilled readers, it is important to understand how Internet reading competences develop during school. Although some cross-sectional studies have investigated how navigation and evaluation competencies develop during school (Breakstone et al., 2019; Keil & Kominsky, 2013; Potocki et al., 2020;

Rouet et al., 2011; Salmerón, García, & Vidal-Abarca, 2018), less is known about how the ability to integrate Internet sources develops. A widely used indicator of navigation efficiency is the percentage of relevant pages visited (e.g., OECD, 2009). This index takes into consideration that some Internet pages include relevant information for completing learning tasks, whereas other pages include irrelevant or distracting information. Navigation is positively related to students' reading comprehension abilities (Salmerón, García, & Vidal-Abarca, 2018). The challenge is that readers must use a few words in a hyperlink to infer the extent to which it contains semantically relevant information.

Like reading comprehension, navigation competencies increase with grade level across adolescence. Salmerón, García, and Vidal-Abarca (2018) analyzed navigation (log-files) from a sample of adolescents that completed a digital reading assessment constructed on the basis of the PISA framework (OECD, 2009). Results revealed that navigation efficiency tended to be rather high, with average percentages of navigation efficiency between 80-85%, meaning that for every 10 pages visited, 8-8.5 contained relevant information for the students' goal. In terms of development, 7th and 8th graders showed similar navigation efficiency, but were less efficient than 9th and 10th graders, who also showed comparable navigation efficiency. Such development resembles the pattern obtained by Keil and Kominsky (2013), who asked participants to rate the relevance of pages from a list of four pages, where only two were semantically relevant to the learning goal. Participants' ability to detect relevant links substantially improved between the 6-7th grade and 9-10th grade samples. Interestingly, scores did not improve beyond 10th grade (11-12th grade and undergraduates). In a similar study, Rouet et al. (2011) found that young adolescents (5th grade) were highly influenced by superficial cues, such as using uppercase

keywords in the hyperlink, regardless of their topic relevance. The influence of superficial cues on navigation gradually decreased and eventually disappeared across 7th to 11th grade students.

The assessment of evaluation competence usually includes the ability to identify sources, interpret source expertise and intentions, and to use such knowledge to judge the quality of information (Bråten, Stadtler, & Salmerón, 2018). Potocki et al. (2020) used an inventory to investigate the development of evaluation competence in a sample of 5th-, 7th-, 9th-graders and undergraduates. Overall, students across all age groups were proficient at identifying source elements (e.g., author) when requested to do so. Regarding source interpretation, the ability to discriminate competent from less competent authors increased gradually across the grade levels assessed, but the ability to discriminate benevolent from biased sources was more challenging and did not progress across grades. Finally, the ability to justify the selection of pages from a SERP based on source characteristics was challenging for 5th graders, with less than 10% citing source features to justify their selections, but increased across grades (approx. 45% in 7th grade, and approx. 65% in undergraduates).

Breakstone et al. (2019) assessed evaluation competence, specifically the ability to use source features to judge the quality of information. A representative sample of US high school students from grades 9th to 12th were presented with a set of Internet documents (Facebook posts, social media posts, or webpages), and they were asked to judge their credibility (e.g., Evaluate whether a video posted on Facebook is good evidence of voter fraud). Responses were coded using a rubric with three levels: beginning (incorrect responses), emerging (in the right direction but without proper reasoning), and mastery (effective evaluation by investigating sources and evidence). Overall, task performance was rather low, with participants obtaining emerging or mastery levels ranging across different tasks from 1% (min) to 39% (max). Regarding the

development of evaluation competence, a small but continuous progression was observed across high school grades. Nevertheless, even 12th grade students scored well below mastery performance.

In sum, Internet reading competencies should be explicitly taught and practiced throughout the high school years. Several programs have been implemented to improve students' navigation, evaluation, and integration of Internet documents (for reviews see Barzilai et al., 2018; Brante & Strømsø, 2018; Salmerón & Llorens, 2019). In general, such programs have successfully increased high school students' specific competences. Still, current instructional programs do not fully consider the interrelated nature of Internet reading competencies. The three competencies are closely related and, potentially, students' engagement in any one of them may support or trigger the other two (Salmerón, García, & Vidal-Abarca, 2018). Recent research efforts have identified possible types of adaptive coordination between the competencies (e.g., Delgado et al., 2020; Kammerer, Kalbfell, & Gerjets, 2016; Kohen et al., 2020; Salmerón, Delgado, & Mason 2020; Sampietro & Salmerón, 2021), and there is a clear need to move from instruction addressing each competence in isolation towards instruction teaching students to self-regulate their knowledge construction during Internet reading by coordinating the required competencies.

Conclusion

As the nature of reading contexts in the 21st century changes, models of learning from multiple texts will need to be developed to provide a basis for representing and understanding how readers create meaning. Several individual difference variables play a key role in understanding how readers learn from multiple texts. The variables include (but are not limited to) comprehension skills, prior knowledge, beliefs, motivation and engagement, and strategic

processing. Measurement of reading processes and the products of reading play a key role in understanding how readers learn from multiple texts and how individual differences impact learning. Similarly, by understanding how readers learn from multiple texts, interventions and instruction can be developed to promote engagement and learning. Importantly, readers not only need to be able to locate, comprehend, evaluate, and integrate texts, they need to be able to critique sources to whom texts are attributed (sourcing). Readers in the 21st century are consumers of information in an age dominated by rapid access to vast amounts of information. Thus, the challenge moving forward is to consider how readers can complement their roles as consumers of information to builders of knowledge.

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