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LITERACY

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Literacy: Reading and Writing

In this theoretical contribution, we aim to offer an integrated review and discussion of the major advances in theory and practice in the area of literacy, with particular focus on the work since 2014 onward. For the purposes of this review, we approach Literacy as *the ability to read and write*. Thus, we synthesize the relevant literature more broadly in the areas of reading and writing as well as emerging work integrating the two. For reading, we highlight (a) theoretical advances that expand our view of reading and its relation to prior knowledge and digital context and (b) practical advances on the impact of language and content-area instruction, assessment, as well as technological innovations. For writing, we highlight (a) theoretical advances that expand our view of writing and its socio-cultural context, and (b) practical advances on the impact of self-regulated strategy instruction and technological innovations. We also highlight that despite the reciprocal relation between reading and writing, these two areas of work have largely evolved independently of one another, with only recent work directly integrating the two theoretically and practically.

While in this review we focus on recent advances in literacy research, it is important to acknowledge the current context in which this effort has been undertaken. National (NAEP, 2022 Reading Assessment) and international assessments (e.g., PISA) continue to underscore the prevalence of inadequate reading and writing performance in students of all ages. There are also wide and persistent opportunity gaps for students living in poverty, as well as for students from marginalized racial and ethnic groups and multilingual students, raising concerns about systemic inequities in both assessment and instruction (Patton-Terry, 2021). Addressing these opportunity gaps is an educational imperative that should be central in ongoing literacy research efforts (Burns et al., 2023).

Reading

Reading comprehension is one of the most complex activities of human cognition. This complexity has led scholars to develop theoretical models and frameworks that attempt to account for the cognitive and linguistic processes involved (Kendeou et al., 2016). This theory building naturally evolved from a "simple view" aiming to identify core components to more

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comprehensive views aiming to embrace the inherent complexity of reading and its processes (Kendeou & O'Brien, 2014; Perfetti & Stafura, 2014). Recent theoretical frameworks and models open new possibilities in the future research agenda that can significantly advance the field of reading comprehension. The theoretical advances reviewed here also influence practice. Practical advances include instructional approaches and interventions as well as new web-based tools and assessments.

Theoretical Advances

Complicating and Expanding the Simple View of Reading

Initial simple conceptualizations of reading in the 1990s continue to be influential and guide much of the work in reading comprehension, particularly in K-12 settings. For example, the Simple View of Reading (SVR; Hoover & Gough, 1990) conceptualizes reading comprehension as the product of listening comprehension and decoding, thus identifying the two core components of reading comprehension. Our understanding of the decoding component has remained relatively stable across time. Decoding is known to depend heavily on phonological awareness, orthographic knowledge and awareness, morphological awareness, and fluency (e.g., Petscher et al., 2019). Recent research has enhanced our understanding of the listening or language comprehension component (Kim, 2015, 2017; LARRC, 2015, 2017), which depends heavily on vocabulary (i.e., knowledge about the meaning of words), grammatical knowledge (i.e., knowledge of how words combine to convey meaning), inference making (iLC framework; Kendeou et al., 2020; van den Broek et al., 2022), comprehension monitoring (LARRC et al., 2019), and theory of mind or perspective taking (Diazgranados et al., 2015; Foorman et al., 2015a,b; McNamara, 2021a,b). Drawing on this evidence, new frameworks expanded the SVR, articulating further nuance in the core components and their interrelations. for example, Duke and Cartwright (2021) proposed the Active View of Reading model, which not only emphasizes the importance of decoding and language comprehension, but also shared processes that serve to bridge the two across development: vocabulary, reading fluency, and morphological awareness (Burns et al., 2023). The model also acknowledges the important role of additional components such as executive function (Butterfuss & Kendeou, 2018; Follmer, 2018), motivation and engagement (McBreen & Savage, 2021), and strategy use (Okkinga et al., 2018).

From Single to Multiple Text Comprehension

Within a cognitive psychology perspective or a *cognitive view* (Kendeou et al., 2014; McMaster et al., 2015), reading comprehension is often defined as the process of deciphering written code into meaningful language units that are combined to build a coherent representation of the text (Kintsch & Van Dijk, 1978). This mental representation includes textual information and associated background knowledge connected via semantic relations (e.g., causal relations). Semantic relations are identified by the reader through inferential processes (Kintsch, 1988; van den Broek et al., 2005). This view, driven primarily by Kintsch's Construction-Integration (CI) model, remains the best approximation to a theory of reading comprehension (Kendeou & O'Brien, 2018). The notion of the situation model proposed in the context of the CI model is central in the literature because it is considered the integration of the reader's understanding of the information in the text (i.e., textbase) and prior knowledge about the world and text domain and topic. The construction of the mental representation involves an iterative integration of the words, sentences, textbase, and prior knowledge. The construction

of a coherent deep understanding of new material additionally involves the integration of information across multiple dimensions, including rhetorical and pragmatic levels of understanding (Graesser, 2015; McNamara et al., 2014), thus going beyond the situation model.

The current information age naturally posed a challenge to traditional models of reading comprehension that accounted primarily for a single reader engaging with a single text. As a result, a more generalized theory of multiple-text processing was further refined (Britt et al., 2018; List & Alexander, 2017), the Documents Model Framework (DMF; Perfetti et al., 1999). The DMF posits that when readers engage with multiple texts, the result is a Documents Model. The Documents Model consists of two connected components. The *Intertext Model,* which captures readers' representations of what each information source says and how each source relates to the others; and the *Situations Model* or integrated mental model, which represents the relations among semantic content found within the documents. When connections are established between the Situations Model and the Intertext Model, the result is a rich *Documents Model* that coherently integrates multiple sources and the content.

Recent advances in this area of work enhanced our understanding with respect to the processes of attending to, evaluating, and using available information about the sources of documents, termed *sourcing*. Sourcing is especially important and challenging when learning about controversial socio-scientific issues in which there is much disagreement (Barzilai et al., 2015). One of the key features of a source is its credibility, namely the extent to which readers perceive a source to be believable and trustworthy (Lombardi et al., 2014). Source credibility is among the most important source information readers attend to and use as they engage in sourcing (Van Boekel et al., 2017). Indeed, readers who attend to such source information demonstrate better comprehension of texts than those who do not attend to source (Strømsø et al., 2010). However, readers may not spontaneously or routinely attend to or use source information when evaluating texts (Kobayashi, 2014). Accounting for the importance of sourcing in the context of multiple text comprehension led to the development of several theoretical frameworks, including the Content-Source Integration Model (Stadtler & Bromme, 2014), the Discrepancy-Induced Sourcing Model (D-ISC; Braasch & Bråten, 2017), and a two-step validation model (Richter & Maier, 2017).

Perhaps the most recent theoretical advancement that also expanded our conceptual understanding of reading comprehension with multiple documents is the RESOLV Model (Reading as Problem Solving; Rouet et al., 2017). RESOLV draws attention to two aspects of multiple text comprehension not specified enough in previous accounts: reading context and readers' goals. According to the model, readers construct two mental models at the outset of any reading activity. The first is the *context model* or a mental model of the physical and/or social context in which the reading task is situated. Based on the context model, a reader constructs the *task model,* which represents the goal for engaging in a reading activity and the means by which a reader may achieve that goal. The reading activity consists of processes, decisions, and actions that result from a cost-benefit analysis regarding a reader's goal. The addition of context and task models to the intertext and situations model initially articulated by the DMF provides a more complete picture of the complexities of multiple text comprehension.

Expanding the Sociocultural Model in Digital Reading

Analogous to the path from the simple view of reading to more comprehensive views and from single to multiple text comprehension, our understanding of digital reading evolved in recent years from digital reading as reading text on a screen to digital reading experiences that are multifaceted and multimodal (Leu et al., 2013; Sheldon & Castek, 2024; Singer &

Alexander, 2017). Research comparing reading in print and in digital environments provided evidence for core processes that overlap (e.g., attending to information, encoding and connecting, monitoring comprehension, and evaluating content) as well as processes that are unique to online reading (e.g., navigating hyperlinks and multimodal information) (Cho, 2013; Coiro et al., 2015; McGrew et al., 2018).

Recently, Coiro (2021) proposed a multifaceted heuristic grounded in the reading community's collective understanding of comprehension as the complex interaction between texts, activities, and readers in the broader sociocultural context or the sociocultural model of reading comprehension (Snow, 2002). This new heuristic highlights the areas of overlap between traditional and digital reading, with many factors remaining the same but with expanded unique dimensions to digital reading. For example, the notion of text is expanded to include hybrid text, multimedia, multimodal text, hypertext, and internet text. The notion of context is expanded to include the medium platform (e.g., augmented reality, virtual world, software applications, and digital devices) as well as contextual features of the community (e.g., school-based, after-school, home-based, or community-based). Activities or tasks are also expanded to include online search as well as engaging with multiple texts and/or platforms. This new heuristic promises to expand our current understanding by identifying the complex interactions between reader, task, and activity in digital environments that have only recently begun to be systematically examined.

Reading and Prior Knowledge

Prior knowledge has always presented a challenge for reading comprehension theory. Even though most models and frameworks do acknowledge and account for some influence of prior knowledge, articulating with precision this inherent and rather complex relation has often resulted in research efforts to eliminate or control rather than integrate prior knowledge (Kendeou, 2020). This approach is less than optimal because prior knowledge is one of the factors that carries the largest variability in reading comprehension (Goldman et al., 2016, 2019; Kendeou et al., 2016; Murphy et al., 2018). Prior knowledge is an integral component because at various points during reading, the reader draws on different sources of knowledge (Perfetti & Stafura, 2014). These sources include topic knowledge (knowledge closely related to the topic of the text), domain knowledge (knowledge related to a disciplinary area), world knowledge (general academic knowledge not related to the text), and cultural knowledge (knowledge based on sociocultural experiences of the reader) (Cervetti & Wright, 2020). Not only the type of knowledge but also its dimensions influence comprehension. The Multidimensional Knowledge in Text Comprehension framework (McCarthy & McNamara, 2021) identifies four intersecting dimensions: amount, accuracy, specificity, and coherence. For example, high amount and accuracy can facilitate reading comprehension, whereas low amount and accuracy can severely disrupt it, but only if the knowledge is of high specificity or relevant to the text topic (Kendeou & O'Brien, 2015).

Perceiving prior knowledge and its dimensions as integral to reading comprehension raises questions not only about how knowledge influences reading (Hattan et al., 2023), but also how reading influences knowledge. This reciprocal relation of reading and knowledge has only recently begun to be fully realized (Cabell & Hwang, 2020; Cervetti & Hiebert, 2015; Pearson & Billman, 2016). Readers use their knowledge to understand texts, and successful comprehension of text also results in enhanced knowledge, which further strengthens reading comprehension (Hwang et al., 2023). The latter relation has given rise to the Knowledge

Revision Components framework or KReC (Kendeou & O'Brien, 2014), a discourse model that articulates the conditions that facilitate revision of knowledge during reading. Specifically, the framework proposes that knowledge revision can be facilitated under three conditions: (a) co-activation of correct and previously acquired incorrect information, subsequent (b) integration into a single mental network with a supporting, highly interconnected explanation of the correct information, which in turn can (c) compete and "win" the activation while simultaneously reducing the activation of and interference from incorrect information. From a theory construction perspective, the framework expands our understanding of what we know about how readers respond when they are confronted with discrepant information, and the conditions under which these responses may facilitate knowledge revision (Kendeou et al., 2019).

Practical Advances

Advances in instructional practice over the last decade are in line with the theoretical advances noted above. Specifically, the expansion of the SVR and further specification of language comprehension gave rise to the development and testing of several language-focused interventions. Similarly, the expansion of the sociocultural model to digital reading in conjunction with advances in technology gave rise to the development of personalized learning systems and intelligent tutors (D'Mello & Graesser, 2024) that provide opportunities for deliberate training on core skills and strategies, as well as the development and refinement of Natural Language Processing tools (Crossley et al., 2019) and assessments. Finally, the realization of the reciprocal relation of knowledge and reading gave rise to the development and testing of content-rich focused interventions.

Effective Instruction and Interventions

LANGUAGE-FOCUSED INTERVENTIONS

Advances in instructional practice over the last decade have been driven, in part by the products of one of the biggest investments in reading comprehension research, the Reading for Understanding Research (RfU) initiative (Institute of Education Sciences, 2010), which was launched with the aim to improve *reading for understanding* across all readers in U.S. schools (Douglas & Albro, 2014). In 2020, the National Academy of Education (NAEd) commissioned a report to synthesize the findings of this ambitious investment (Pearson et al., 2020). Importantly, the fully-powered randomized control trials (RCTs) undertaken in the context of the initiative demonstrated how difficult it is to improve reading comprehension achievement and raised questions about whether expecting medium-to-large effect sizes is even realistic for a construct so complex and multidimensional (Biancarosa et al., 2020).

Nevertheless, a number of instructional approaches in the primary grades that focused on children's language skills have shown efficacy. Among those, Let's Know! (LK), a multicomponent, supplemental curriculum for pre-K through grade 3 (LARRC et al., 2019) designed to improve children's language skills (i.e., vocabulary, comprehension monitoring, and text-structure knowledge) demonstrated robust significant effects on vocabulary and monitoring comprehension measures (Jiang & Davis, 2017; Pratt & Logan, 2014). The Assessment to Instruction (A2i) web-based program that adapts student instruction on code- and meaning-based skills has also shown promise for improving student reading outcomes (Connor, 2019). A2i uses formative assessments to provide data to teachers regarding current skill level,

suggested amount of instructional time for language and reading categories, class groupings for targeted instruction, and appropriate lesson plans and materials (Connor et al., 2013, 2014, 2022). Finally, the Early Language Comprehension Individualized Instruction (ELCII, Kendeou et al., 2019; McMaster et al., 2019) was designed to improve reading comprehension by fostering inference making, a core language comprehension skill. ELCII *does not* rely on decoding skills and includes an interactive, cloud-based software application designed to engage students to learn key vocabulary words, respond to inferential questions, and receive individualized scaffolding and feedback. Studies showed a large pretest to posttest effect for proximal measures and small effects for distal measures of language comprehension (Butterfuss et al., 2022). Taken together, although the effects of language-focused interventions are relatively small, they are likely to be important because they give students the advantage they need to benefit fully from possible sustained effects of comprehension instruction that have been observed to continue over time (e.g., Silverman et al., 2020; Kim et al., 2016).

CONTENT AND DISCIPLINARY-READING INTERVENTIONS

Whereas language has been the focus of instruction in the early years, content and disciplinary knowledge and strategies typically have been the focus in later years. Several instructional approaches that focus on reading as a discipline-specific task (Shanahan & Shanahan, 2008) have been developed and tested for efficacy in RCTs in middle and high school students (Goldman et al., 2016). Specifically, the READI project (Goldman et al., 2019; Lee & Goldman, 2015) focused on teaching evidence-based argumentation in science in a semester-long intervention. A RCT demonstrated that the READI intervention had small-to-medium effects on evidence-based argumentation proximal measures and reading comprehension. STARI, a small-group supplemental intervention targeting word reading, fluency, vocabulary, and comprehension also showed significant small effects on word recognition and reading comprehension when compared to a BAU control (Kim et al., 2016). Finally, the PACT intervention, which focuses on training content knowledge and reading comprehension skills, also showed significant small-to-medium effects on reading comprehension and knowledge measures when compared to BAU controls (Vaughn et al., 2013, 2015, 2017).

Emerging work has focused on examining the efficacy of content-rich curriculum in the early years, also showing promising results for the effects of knowledge building on reading comprehension (Hwang et al., 2021). For example, Connor et al. (2017) developed and tested the content-area literacy instruction (CALI) in K-4 to build science and social studies knowledge, showing significant effects on proximal measures of knowledge. Kim et al. (2020) developed and tested the Model of Reading Engagement (MORE), a content literacy intervention on science domain knowledge, showing significant effects on proximal measures of vocabulary and language comprehension, as well as on standardized reading comprehension. Finally, Neuman and Kaefer (2018) developed and tested the efficacy of a shared book intervention (World of Words) in PreK-K designed to improve oral language vocabulary and content knowledge in science, showing significant effects on proximal vocabulary and knowledge measures. In a recent meta-analysis, Cabell and Hwang (2020) showed that students who received integrated instruction in literacy and content areas (i.e., treatment) in elementary school performed significantly higher on comprehension outcomes than those students who received traditional literacy and content area instruction separately (i.e., control or comparison group). Although the number of studies conducted in this area is relatively small, the findings show promise in building content knowledge and reading comprehension when using integrated curriculum as early as elementary school.

Technological Innovations

INDIVIDUALIZED, COMPUTER-BASED INSTRUCTION

Developing into a skilled reader requires extended deliberate practice (McNamara & Kendeou, 2022), and in-time scaffolding and feedback that is individualized to the learners' needs. However, given classroom constraints, teachers have limited time to provide individualized instruction, practice, and feedback (Goldman et al., 2016). Intelligent tutoring systems (ITSs) can provide fully automated adaptive responses with the use of natural language processing (NLP) (Crossley et al., 2019; Roscoe et al., 2018), and thus create opportunities for individualized instruction and practice that would not otherwise be possible in the classroom (D'Mello & Graesser, 2024; Graesser et al., 2014; McCarthy et al., 2020b). Such ITSs can *supplement* classroom reading instruction, allowing students to practice the application of reading strategies in the classroom, in after-school programs, or at home.

As an example, the Intelligent Tutoring of the Structure Strategy (ITSS) system teaches readers to examine the author's organization of the text to help organize their own understanding (Meyer & Wijekumar, 2016; Wijekumar et al., 2012). In the structure strategy, signaling words (e.g., in contrast, bring about, subsequently) can be used to identify the type of structure (e.g., comparison, cause-and-effect, sequence), which can help the reader to build a mental representation of the information in the text. Structure strategy instruction has been shown to improve reading outcomes with students as young as second grade (Meyer et al., 2010; Williams et al., 2009).

Similarly, iSTART (Interactive Strategy Training for Active Reading and Thinking; McCarthy et al., 2018; McNamara et al., 2006) combines self-explanation with comprehension strategy instruction. Students explain challenging texts with instruction on how to use strategies such as paraphrasing, making bridging inferences, and elaborating using prior knowledge (McCarthy et al., 2020a; Snow et al., 2016). iSTART is an ITS that provides automated, adaptive instruction and game-based practice on comprehension strategies within the context of self-explanation. Feedback is provided using an NLP algorithm that assesses the quality of students' responses. iSTART has demonstrated effectiveness in improving comprehension strategies and comprehension of challenging science text across a wide spectrum of learner ages and abilities (e.g., Johnson et al., 2017; McCarthy et al., 2018, 2020a; McNamara, 2017, 2021a,b; Snow et al., 2016).

NATURAL LANGUAGE PROCESSING TOOLS

Another technological advancement has been the development and further refinement of theory-driven Natural Language Processing (NLP) tools (McNamara et al., 2018). For example, the construction integration model, as the best approximation of a current theory of reading comprehension, has informed the development of Coh-Metrix (McNamara & Graesser, 2012; McNamara et al., 2014). Coh-Metrix affords researchers a tool that provides automated measures of text difficulty, including cohesion, syntax, and lexical information. Cohesion refers to the amount and quality of overlap between ideas in terms of explicit words, semantically related words and ideas, and connectives. Cohesion is particularly important in relation to readers' knowledge, because cohesion gaps require the reader to make inferences to connect the words and ideas in the text.

Since the development of Coh-Metrix, several other tools have been developed. For example, TERA (Text Easability and Readability Assessor) provides researchers and educators with a profile analysis of text ease based on the Coh-Metrix component scores. The Tool for the Automatic Analysis of Text Cohesion (TAACO; Crossley et al., 2016) provides indices related to

text cohesion, including indices related to lexical and semantic overlap, connectives, and lexical diversity, at both local and global levels. Such tools provide the means to explore the effects of cohesion and many other facets of text across multiple contexts (Dascalu et al., 2018, 2020).

Reading Assessments

Advances in assessment have been long overdue in the field of reading comprehension. The Reading for Understanding (RfU) initiative delivered on this need with the development of three new assessments—RISE, GISA, and FRA—that can be characterized as a new generation of reading assessments (Kendeou, 2020). RISE (Sabatini et al., 2015, 2019a) and FRA (Foorman et al., 2015; a, 2015b) evaluate core components of reading comprehension with attention to identifying students' strengths and weaknesses. These components include decoding, fluency, vocabulary, morphology, syntactic processing, and sentence processing. GISA (Sabatini et al., 2019b) evaluates global reading literacy, defined as the deployment of cognitive, language, knowledge, and strategies directed towards achieving specific reading purposes (Sabatini et al., 2013). These new assessments have a strong theoretical basis, reflect a broader and more authentic conceptualization of reading comprehension, are developmentally sensitive, emphasize instructional sensitivity and value, and have defensible psychometric properties.

Broader research efforts have also contributed to the literature additional measures of reading-related constructs. A few examples are: an Inference Task (LARRC & Muijselaar, 2018) that evaluates local and global inference processes; the Minnesota Inference Assessment (MIA; Kendeou et al., 2021), a fully-automated inference measure that does not rely on decoding; a measure of Social Perspective-taking (ASPP; Kim et al., 2018); MOCCA (Biancarosa et al., 2019; Davison et al., 2018), an innovative and fully automated screening and diagnostic assessment of reading comprehension; CALS-I, a new measure of academic language proficiency (CALS-I; Phillips Galloway & Uccelli, 2019); a measure of evidence-based argumentation in science (Goldman et al., 2019); and a measure of students' reading strategy use (CReSS; Denton et al., 2015). Even though the list of these assessments is not meant to be exhaustive, it illustrates significant progress in the field with regards to measuring various aspects of reading comprehension. These advancements in assessment enrich the range of possibilities available to researchers in the field of reading comprehension by enabling measurement of aspects of reading comprehension that are more nuanced and contemporary.

Writing

Like reading, writing is a complex and multidimensional activity involving the coordination of multiple cognitive and linguistic processes. As with reading, scholars have proposed "simple" and "not-so-simple" theoretical frameworks to describe the core components of writing and how they interact. Recent theoretical advances have helped researchers and practitioners to understand better the processes that underlie these core components in ways that are useful for developing and improving instructional practices.

Theoretical Advances

Complicating and Expanding the Simple View of Writing

The Simple View of Writing (SVW; Berninger et al., 2002; Juel, 1988) posits that writing is the product of transcription (e.g., handwriting and spelling) and ideation (e.g., generating ideas and the words, sentences, and longer pieces of discourse to express those ideas). Researchers

have elaborated upon this view, and proposed the Not-So-Simple View of Writing, to include self-regulatory processes (such as goal setting, planning, organizing, and reviewing/revising; e.g., Berninger & Amtmann, 2003; Berninger & Winn, 2006) and cognitive processes (such as attention and working memory), with the notion that, when a developing writer experiences difficulty in one area (e.g., transcription), they must devote significant cognitive resources to that component, leaving fewer cognitive resources to devote to other components (e.g., ideation). Thus, building automaticity in basic writing skills, such as handwriting/typing and spelling, should free up attention and memory needed to generate text and engage in self-regulatory processes involved in writing (Ritchey et al., 2016).

Like the Simple View of Reading, the Simple View of Writing is useful for understanding key component skills, but lacks specificity as to what comprises those component skills. Thus, researchers have attempted to expand this general model to elucidate which aspects of key component skills contribute to overall writing quality. Much of the research recently has been conducted with young writers in the early to mid-elementary grades to shed light on writing development and inform early assessment and intervention practices (Kim et al., 2014, 2015, 2018; Kent et al., 2014). The Direct and Indirect Effects Model of writing (DIEW; Kim, 2020; Kim & Park, 2019; Kim & Schatschneider, 2017) grew out of this empirical work as a more comprehensive (and complex) model of early writing. DIEW built on the simple view of writing by identifying its two core skills, transcription and ideation, as proximal skills as well as specifying additional components, such as higher order cognitive skills (e.g., working memory, attention, and self-regulation) and knowledge (e.g., content knowledge, discourse knowledge). Furthermore, the proximal skills (also identified in the SVW) capture the cognitive skills (largely identified in the not-so-simple view of writing).

As an additional complication to the cognitive, language, and literacy dimensions that contribute to writing, researchers have also identified gender differences in young children's writing skills, particularly with respect to compositional fluency and productivity (McMaster et al., 2017). Such differences have been shown to be related, at least in part, to overall differences in cognitive and language skills, as well as to differences in motivation and attitudes (Kim et al., 2015). Gender gaps might also vary in the context of students' responsiveness to instruction; for example, Truckenmiller et al. (2014) found a gender gap in third-graders' initial writing fluency, but not for progress made during writing intervention.

Sociocultural Approaches and Writing in the Community

Whereas the theoretical and empirical literature described thus far provides important insights into some of the cognitive, linguistic, and motivational dimensions of writing, it does not attend to the sociocultural dimensions of writing. Graham (2018) argued that merging multiple perspectives lends a more comprehensive account of the writing process and how it develops, and proposed the Writers Within Communities (WWC) model, which positions writing as an inherently communicative activity that occurs within social, historical, cultural, institutional, and political contexts. This model follows from combining cognitive perspectives on writing (e.g., Portanova, 2017) with sociocultural frameworks, which assume that literacy is inseparable from the writer's context and the social and cultural purposes for writing (e.g., Dyson, 2016). Graham defines a writing community as "a group of people who share a basic set of goals and assumptions and use writing to achieve their purposes" (Graham, 2018, p. 259). The members of that community include the writers (those who produce the work); collaborators, teachers, and mentors (those who support the production in some way); and readers (the audience who consumes the work). The WWC model articulates four underlying tenets that

describe the interaction between the writing community and the cognitive characteristics of the members who contribute to it. These tenets include that writing is shaped simultaneously by (1) the writing community and the cognitive capabilities of its members, (2) the affordances and constraints of the writing community and its members, (3) variability within the writing community and individual differences in cognitive capabilities and resources among its members, and (4) participation in writing communities and complex interactions with individual and environmental factors.

The WWC model and its tenets provide a useful framework for further study of writing, both in terms of individual differences among community members (e.g., students) as well as the communities themselves (e.g., classrooms). Graham (2018) proposed that each of the four tenets can be used to make testable predictions about writing and writing development at individual and community levels. Further research should reveal the utility of the WWC model in generating and testing such predictions.

Practical Advances

Effective Instruction and Interventions

Fewer researchers have examined the efficacy of instruction and intervention approaches to improve writing outcomes than to improve reading outcomes. Those who have done so have demonstrated that instruction that explicitly targets the cognitive, language and literacy, motivational, and community aspects of writing identified in the theoretical literature can lead to improved quantity and quality of writing in written compositions (Datchuk et al., 2020; Graham et al., 2015; Koster et al., 2015; McMaster et al., 2018).

ADDRESSING MULTIPLE COMPONENTS OF WRITING

In a comprehensive meta-analysis of writing instruction in grades K-8, Graham et al. (2015) aimed to identify research-based practices for successfully meeting writing objectives in the Common Core State Standards (CCSS; National Governors Association Center for Best Practices & Council of Chief State School Officers, 2010). Their findings led to the following recommendations: (a) teach writing in a positive and supportive environment, (b) establish routines that facilitate motivation for writing, (c) implement a process approach to teaching writing (e.g., focusing on the purpose, audience, goals, planning/drafting/revising and evaluation components of the writing process), (d) create routines that promote frequent writing, (e) design routines in which students write together, (f) establish writing goals, (g) use 21st century writing tools, (h) provide formative feedback, (i) ensure students have knowledge, skills, and strategies needed for writing, including teaching foundational writing skills and knowledge about text structures, and (k) use writing as a tool to support learning. These recommendations align well with theoretical and empirical understandings of the cognitive, language and literacy, motivational, and community-focused dimensions of writing.

Other syntheses have corroborated these recommendations. Gillespie and Graham (2014) conducted a meta-analysis to examine the effects of writing instruction on the writing quality of students with learning disabilities (LD) in Grades 1-12. Findings revealed that, overall, writing interventions had a significant positive impact, with an effect size of 0.74. Specific instructional approaches with the strongest effects included strategy instruction (in which students learned specific strategies for planning, writing, revising, and editing texts), dictation (in which students dictated their compositions into a tape recorder or to a scribe to alleviate the cognitive burden imposed by transcription), goal setting (in which teachers provided specific

goals for writing, such as to revise a text), and process writing (in which students learned the components of the writing process). A later systematic review conducted by Rouse and Sandoval (2018) with students with LD in Grades K-12 yielded similar findings.

Koster et al. (2015) conducted a meta-analysis of writing instruction focused on middle-grade students (4-6) in general education classrooms. Consistent with Graham et al.'s (2015) findings, their review revealed that instruction with the strongest effects included goal setting, strategy instruction (in which students were given specific goals for the writing process or product before engaging in writing tasks), text structure instruction (in which students were explicitly taught about the structure of texts), peer-assisted instruction (in which students supported each other during parts of the writing process), and feedback (in which students receive comments from others on their writing), with effect sizes ranging from 0.59 to 2.03.

SELF-REGULATED STRATEGY DEVELOPMENT (SRSD)

Self-Regulated Strategy Development (SRSD; Harris & Graham, 2017) involves teaching students to use strategies to remember important components of text generation processes, as well as to self-regulate their use of these processes. SRSD entails six basic steps: (1) the teacher supports students' development of background knowledge needed for using a strategy (e.g., how to revise a text), (2) the teacher and students discuss the benefits of the strategy and when and how to use it, (3) the teacher models using the strategy, (4) students use mnemonics to memorize the strategy, (5) the teacher supports students' use of the strategy through collaborative writing and guided practice, and (6) students engage in independent practice, applying the strategy to various writing tasks and self-evaluate their performance with teacher support. Throughout these steps, students learn self-regulation procedures such as goal setting, self-monitoring, and self-reinforcement. Consistent with previous systematic reviews of SRSD, this approach has continued to show particularly strong effects for a broad range of typically developing students (Graham et al., 2013; Harris & Graham, 2017; Harris et al., 2012) with high teacher fidelity (McKeown et al., 2019).

Positive findings of SRSD have also been reported for younger students. In a best-evidence synthesis, McMaster et al. (2018) summarized writing intervention research focusing on children in grades 1-3. They identified "exemplary studies" that met standards for methodological quality and provided clear evidence of intervention effects on at least one measure of writing composition. "Exemplary" transcription interventions focused on handwriting or spelling skills, with handwriting including using visual cues, memory retrieval, and copying; and spelling instruction including various combinations of letter-sound, onset-rime, and whole-word methods. Transcription studies revealed that explicit teaching with modeling, guided and independent practice, and fluency-building activities yielded moderate to strong effects on measures of writing quantity. Most exemplary text generation plus self-regulation interventions involved SRSD, which consistently revealed moderate to strong effect sizes on measures of writing quantity and quality (McMaster et al., 2018).

Finally, Datchuk et al. (2020) conducted a meta-analysis of writing interventions implemented specifically for students with difficulties and disabilities related to writing. They also found that interventions that used direct and explicit instruction focused on transcription and text generation skills and SRSD yielded positive intervention effects, with older students performing at higher levels of performance as a result of intervention, and younger students showing steeper growth during intervention. Students' writing fluency was higher on sentence-writing tasks than on discourse-writing tasks, indicating a need for further research to improve students' (at least those with writing difficulties or disabilities) discourse-level writing.

Technological Advances

AUTOMATED WRITING EVALUATION AND INSTRUCTION

The use of technology is increasingly integrated in writing instruction. This advancement is due in part to the fact that writing requires a large amount of extended, deliberate practice on multiple writing genres with meaningful feedback (Allen et al., 2016; Graham et al., 2015). Such practice can require an extensive amount of time and resources from teachers who they simply do not have, and thus too little writing instruction and practice occur in many curricula (e.g., Brindle et al., 2016). Automated writing evaluation and instruction tools have strong potential to relieve some of the burden on teachers by providing automated scoring and formative feedback for students' writing assignments. Automated writing evaluation (AWE) leverages natural language processing to provide automated assessment and formative feedback on multiple aspects of writing quality (Crossley & McNamara, 2016; Roscoe et al., 2015).

The use of AWE and automated writing instructional tools in classrooms is increasing due to greater need and greater evidence for their reliability, validity, and effectiveness in helping students to improve writing. Specifically, an increasing number of AWE tools are available that can provide feedback that is reliably aligned to writing assessments and writing quality rubrics for a wide range of developing writers, including multilingual learners, young writers in elementary grades, and adolescents (e.g., Allen et al., 2016; Rupp et al., 2020; Wilson, 2018; Wilson et al., 2019). For example, Palermo and Thomson (2018) assessed the benefits of combining classroom instruction using SRSD with AWE on middle-school students' writing quality. They found that AWE combined with either traditional instruction or SRSD both led to higher-quality essays compared to a comparison condition, but AWE+SRSD was also associated with longer essays that contained more essential elements characteristic of strong essays. Wijekumar et al. (2017) developed an intelligent tutor that assists the teacher in assessment and genre-based writing instruction also using SRSD, with initial evidence for efficacy in improving student outcomes (Wijekumar et al., 2022).

It is important to note that the majority of AWE systems and tools have been developed for students who are in the secondary grades with only a few systems currently available for younger students (Wijekumar et al., 2017). One example is MI-Write (MI-Write, also known as PEG; Wilson, 2017, 2018; Wilson et al., 2021). MI-Write increases students' revision attempts, and the quality of their essays across revisions, as well as attitudes toward writing (Wilson & Andrada, 2016; Wilson & Czik, 2016; Wilson & Roscoe, 2020). A challenge for future research will be to find the ideal blends of AWE within classrooms, adapting to the unique needs of the students as well as the instructional approaches adopted by the teacher (Graham, 2019).

Integrating Reading and Writing

Reading and writing both draw on the same knowledge and cognitive systems (Shanahan, 2016). These knowledge and cognitive systems include general background knowledge needed for both comprehending and generating text, meta-knowledge about written language systems (such as genre and text structure), procedural knowledge about how to interact with text, and pragmatic knowledge about text attributes (such as alphabetic knowledge needed to both decode and encode text; knowledge about words, syntax, and so on). Empirical evidence supports this strong relation between reading and writing. For example, several meta-analyses indicate that writing instruction supports reading achievement (Graham & Hebert, 2011; Graham & Santangelo, 2014) and vice versa (Graham et al., 2018), and that instructional programs that include a balance of reading and writing instruction (Graham et al., 2018) or integrate

reading and writing instruction (Harris & Graham, 2014; Harris et al., 2019; Mason, 2017; Wijekumar et al., 2019) lead to strong reading and writing outcomes. Empirical evidence has also accumulated to support an asymmetry in the bidirectional relation of reading and writing. Specifically, evidence suggests that reading exerts a larger influence on writing than writing on reading (Ahmed & Wagner, 2020; Ahmed et al., 2014). Further, many children identified with reading difficulties also experience writing difficulties (Graham et al., 2021).

Even though the relations between reading and writing have been well-documented, the sciences of reading and writing have yet to become fully integrated (Graham, 2020). However, there are emerging efforts to propose new models and frameworks that facilitate this integration. Kim (2020) proposed the Interactive Dynamic Literacy Model, which posits that reading and writing are interactive systems that influence and reinforce the development of each other by drawing on shared language and cognitive skills. The model has a rather complex hierarchical structure and four hypotheses: (1) a set of component skills with direct and indirect relations; (2) interactive relations between component skills, and between reading and writing; (3) co-morbidity of reading and writing difficulties; and (4) dynamic relations as a function of development, learner characteristics, and measurement. McNamara and Kendeou (2022) recently proposed the early automated writing evaluation framework (eAWE), which incorporates cutting-edge technologies to interlace reading and writing instructional activities combined with feedback to use reading and writing strategies for young children (K-5). Continued research is needed to provide evidences to support such models and frameworks.

Future Directions

As we argued above, research over the last decade has offered theoretical and practical advances in the areas of reading and writing as well as their integration. This work has also highlighted areas where more work is needed. In closing, we discuss a few future directions.

Scaling up and Integrating Effective Interventions

Expanding the reach of evidence-based instruction and interventions in both reading and writing, as well as integrating them to optimize learning outcomes, remains a challenge. Such expansion and integration necessitate further focus on the processes of implementation in authentic school settings (Solari et al., 2020) as well as the use of SMART designs (Ghosh et al., 2020). In this context, future research needs to address not only what works, but also for whom and under what conditions so we can ensure equity, sustainability, and scalability (Schneider, 2018).

Educational technologies might be leveraged more effectively to begin both reading and writing instruction as early as Kindergarten and integrate opportunities for practice (e.g., ITSs) and evaluation (e.g., using AWE, NLP) across K-12. While these technical capabilities exist, they have not been implemented yet in systems that combine reading and writing intentionally, and moreover, they have not been tested for feasibility and efficacy. Nonetheless, the future holds strong promise in developing intelligent, adaptive systems to meet the diverse needs of students and teachers.

Sociocultural Factors

Reading and writing are inherently a cultural activity that cannot be decontextualized (Pearson et al., 2020). A critical dimension of reading research is the impact of students' social

and cultural experiences as well as the larger sociocultural context in which reading and writing take place. A large and rich body of work in this area exists (see, for example, Moje et al., 2020) that is beyond the scope of this chapter to summarize, but should not be ignored and should continue to be an integral dimension in reading research. Future research is needed to achieve a deeper understanding of sociocultural factors and their impact on student development, teacher practices, and assessment (Goodrich et al., 2021; Piazza et al., 2015).

Conclusion

In this chapter, we presented an integrated review of major advances in literacy research—focusing on reading and writing—over the last decade. We situated our review in the context of current cultural and educational imperatives—including the urgent need to address systemic inequities in students' learning opportunities and to prepare young learners to succeed in a world that requires increasingly sophisticated digital literacy skills as they deal with multiple texts and sources of information. We provided an overview of how theoretical advances have expanded and complicated the "simple views" of reading and writing, and how these advances have informed the development of literacy assessment, instruction, and intervention. Finally, we highlighted how the strong relation between reading and writing—given their shared knowledge and cognitive systems—should be considered to support instructional innovations going forward and emphasized the importance of ongoing research that advances our understanding of how best to scale up effective literacy instruction, leverage technology, and situate literacy learning in sociocultural contexts. We imagine that literacy researchers will continue to break important ground over the next decade and continue to advance the sciences of reading and writing, leading to improved outcomes for all students.

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