Adolescent Literacy: Development and Instruction

Susan R. Goldman

University of Illinois

Learning Sciences Research Institute

Sgoldman@uci.edu

Catherine E. Snow

Harvard Graduate School of Education

snowcat@gse.harvard.edu

Abstract

The demands of literacy tasks change appreciably after students have mastered the basics of reading words accurately and with reasonable automaticity. At about age 10 reading becomes a tool for acquiring information, understanding a variety of points of view, critiquing positions, and reasoning. The results of international and U.S. assessments show that many students who succeed at early reading tasks struggle with these new developmental challenges, focusing attention on the instructional needs of adolescent readers. Commonly used approaches to comprehension instruction in the post-primary grades, such as teaching reading comprehension strategies, do not adequately respond to the multiple challenges adolescent readers face. One such challenge is the need to acquire discipline-specific ways of reading, writing, and thinking, often from teachers who are themselves insufficiently aware of how reading literature differs from reading science or history. We argue that appropriate attention in instruction to discipline-specific literacy practices, to maintaining an authentic purpose for assigned literacy tasks, and to the role of focused discussion as a central element in teaching comprehension would improve reading outcomes and would revolutionize current theories about the nature of reading comprehension.

Keywords: adolescent literacy, comprehension, disciplinary literacy, comprehension interventions, history, science, literature, instructional conversations, development, instruction

The Challenge

With new technologies and the Web, 21st century citizens can now access unprecedented amounts of information on topics ranging from climate change to immigration policy to medical care and financial options. The price of unfettered availability is that information is no longer filtered by teachers, librarians, and traditional publishers. As a result, the burden of determining reliability and relevance falls on the reader, a process made more complex when information sources are inconsistent with, or even contradictory to, one another (Rouet & Britt, 2011; Stadtler & Bromme, 2007). Furthermore, the analysis, synthesis, and evaluation of information is increasingly expected in the workplace, even in jobs that do not require a college education (e.g. driving a truck, repairing ventilation systems). The definition of reading comprehension must include these new, 21st century literacy skills, and literacy instruction for 10-18 year olds should anticipate these realities.

Thus we adopt a conception of reading that aligns with national and international performance standards (National Assessment Governing Board, 2009; Organization for Economic Cooperation and Development (OECD), 2006). These standards define proficiency as reading to acquire content knowledge useful in addressing open-ended questions, solving problems, or making decisions. Conventional notions of comprehension involve locating and identifying facts, combining explicitly stated ideas, and making simple inferences from single text sources, whereas the new standards specify that students should analyze, interpret, integrate, critique and evaluate information within single and across multiple sources of information (National Assessment of Educational Progress (NAEP) 2009). Critical literacy processes require attention to text and context; to the use of rhetorical and symbolic devices to convey meaning; and to disciplinary conventions for argumentation, critique, and evaluation. Assessment data indicate that across the globe only about 10% of today's adolescents are mastering such advanced reading comprehension and critical literacy

skills (Carnegie Council on Advancing Adolescent Literacy (CCAAL), 2010; NAEP 2009; OECD, 2013). Thus the need arises for a serious consideration of how to improve adolescent literacy outcomes.

Reading instruction. Traditionally, most attention in reading research and instruction has been focused on early reading; in fact, only recently has the field called adolescent literacy even been recognized (CCAAL, 2010; Goldman, 2012; Lee & Sprately, 2010; Snow & Moje, 2010). But it is now clear that, although proficiency in word reading and basic fluency are crucial to long term outcomes (see Connor & Al Otaiba, this volume), these skills are insufficient to ensure success in the more challenging comprehension tasks facing adolescents (Wanzek et al., 2012). Furthermore, where once it was thought that the major change between early and later reading was the complexity of the texts involved, it is now clear that the tasks change even more radically than the texts. It is widely recognized that reading instruction needs to continue throughout schooling and that the focus of such instruction should be decreasingly the mechanics of reading and increasingly the language, discourse, and argumentation structures of the disciplines in which the reading is located.

The fact that such a high proportion of reading research has emanated from the English-speaking world has inflated attention to early reading instruction, because of the challenges posed by teaching students to read in the deep orthography of English. Students learning to read in more shallow orthographies, those in which phoneme-grapheme mapping is one-to-one rather than many-to-many, master the basic mechanics of word recognition and automaticity within the first year of schooling (Aro & Wimmer, 2003). Such students reveal much earlier the comprehension deficits associated with limited vocabulary, lack of relevant background knowledge, and unfamiliarity with how information is organized in literature vs. science vs. history. English-speaking readers start to reveal the consequences of such deficits later: U. S. assessments suggest that the percentage of poor readers

increases in the 10 – 12 year age range (National Center for Education Statistics, 2013). Poor

reading skills will no doubt become even more evident with the introduction of new assessments

aligned to the new, higher college and career-ready standards adopted by almost all the states in the

U.S. (Council of Chief State School Officers (CCSSO), 2010). Known as the *Common Core State*

Standards, they set grade-level expectations for reading, writing, speaking, and listening, specifying

that adequate literacy performance requires analysis, synthesis, and critiquing of text, and calling for

a much higher proportion of nonliterary and complex texts in instruction and in assessment. These

specifications are not just limited to performance in literature classes but extend to companion

standards for reading in history and in science and technical subjects. For perhaps the first time in

the history of educational policy and standard setting, a nation-wide educational policy calls

specifically for attention to the unique reading and writing practices of at least two disciplinary

contexts other than literature. These will have the most profound effects on adolescents, since their

schooling is typically discipline-based.

　　Challenges of post-primary reading. What are the issues unique to adolescent literacy that

require it be dealt with as a topic separate from initial literacy development or instruction? There are

several, at different levels of analysis – the learner, the task, the texts, the pedagogy, and the context.

　　The learners. Adolescent readers may need instructional attention for any of a number of

reasons. Some still struggle to read words accurately, fluently, and with automaticity; this becomes

an insuperable obstacle as they are expected to read longer, more complex texts containing more

unfamiliar words after grade 3, around age 8. But many adolescents with good basic reading skills

need targeted instruction as well, because comprehension of the texts they are asked to read requires

a larger vocabulary, more background knowledge, more stamina, and greater motivation than many

possess for school tasks. At the same time as school tasks are requiring more knowledge, skills, and

persistence, concerns about identity and increased interest in peer relationships compete with academic and cognitive demands, leading to an almost universal decline in intrinsic motivation for reading (Gottfried, 1985).

The tasks. Up to about the end of third grade, children are considered good readers if they can read grade level texts aloud without many errors, and answer low-inference comprehension questions such as 'What did the wolf want to do to Red Riding Hood?' In the primary grades, children read primarily to learn to read, from texts that use language structures within their oral language repertoires. In the higher grades, students must demonstrate that they can learn new information from reading texts on their own, that they can sift through large amounts of text to find relevant information, and that they can analyze literary texts (Chall, 1983). To reach higher levels of proficiency on tests like the Program for International Student Assessment (PISA; OECD, 2006) students must be able to analyze texts to find evidence for claims, compare texts to find disparities in information and in interpretation, learn word meanings from text, synthesize information from multiple texts, and so on (Goldman et al. 2011; Lee & Spratley, 2010; Shanahan & Shanahan, 2008). Instruction needs to improve and expand to help students succeed at these tasks.

The texts. Texts presented to older students are, of course, more complex in language structures and vocabulary than those in primary classrooms. In addition, a much higher proportion of them are expository texts, which organize the presentation of information in ways quite different from narrative or literary texts. The genre-specific organization of information is referred to as *discourse structure*. Furthermore, vocabulary and discourse structures are increasingly differentiated by content area so that reading history texts and science texts requires overlapping but not identical skills (Lee & Spratley, 2010; Moje, 2008).

The pedagogy. The pedagogical focus shifts in the post-primary grades from skills to content. Thus literature, history, science, and math teachers in middle and high schools do not think of themselves as responsible for teaching reading, nor are they for the most part prepared to provide instruction in how to read the texts they assign (Heller & Greenleaf, 2007). Two possible consequences ensue: either students who struggle with the texts have no chance to learn the content, or content is provided through lectures that supplant the texts and thus unwittingly undermine students' abilities to progress as content area readers.

The context. Because the unique needs of adolescent readers have only recently been widely recognized, most schools and teachers lack the resources to meet those needs (CCAAL, 2010). Teacher preparation programs and professional development efforts pay little attention to the skills required to provide discipline-specific literacy teaching or to incorporate open-ended questions and discussion into their classrooms, despite the strong evidence that these features support comprehension. Curricula are not in general designed to support such efforts, nor are schools always organized to promote them. In addition, schools serving students at risk of poor reading outcomes (those from low-income homes, from families that do not speak the school language, from primary programs that have not provided adequate instruction) are typically even less likely to have well-prepared teachers and engaging or challenging curriculum and pedagogy.

In light of these considerations, we will review what is currently known about literacy development and literacy instruction in the post-primary grades, focusing on a few themes: the inadequacy of just teaching comprehension strategies, which is currently the dominant instructional approach; the need to attend to the ways in which texts and tasks differ across content areas, which we refer to as *disciplinary literacies*; the interdependencies among writing, discussion, and reading in the adolescent years; and the value of attending to purpose and engagement in constructing

instructional activities. Note that our use of "text" in this chapter is intended to encompass static and dynamic visual representations of information and oral modes of communication, as well as traditional, printed verbal text.

Outside the scope of our discussion is a burgeoning focus on adolescents' engagement with reading and writing outside of school contexts. Numerous reports chart adolescents' increasing use of social media and participation in affinity groups, online games, and other internet-enabled hangouts (e.g., Lenhart, 2013; Madden, Lenhart, Duggan, Cortesi, & Gasser, 2013). To date, few positive relationships have been found between participation in these types of out-of-school activities and performance on school-based indices of achievement (e.g., grades, achievement tests) (Moje, Overby, Tysvaer & Morris, 2008; Purcell, Buchanan & Friedrich 2013). One educational challenge is to build on these interests and the knowledge they generate to leverage adolescents' participation in school-based activities.

Comprehension Strategy Instruction: A Little Patch on a Big Problem

Chall (1983) identified a major shift in the focus of reading instruction after the first several years of formal schooling from learning to read to reading to learn. By far the most common approach to enacting this shift has been to teach comprehension through the explicit teaching of comprehension strategies (see Oakhill, Berenhaus, & Cain, this volume). Experimental studies have indeed shown positive effects of strategy instruction (National Institute of Child Health and Human Development, 2000). However, there are many challenges in teaching comprehension that a simple strategy-based approach cannot resolve.

One challenge relates to the knowledge readers bring to texts. Comprehension instruction in grades 4-12 is typically applied to fictional narratives. Even young readers have a rich supply of knowledge about the kinds of events and motivations that are central to such stories – what we might

think of as background knowledge about human psychology. They can benefit from guiding

comprehension questions such as: *Who are the characters? What is the setting? What happened*

first? What happened next? Why was she sad/mad/happy? (Duke & Martin, 2008).

Questions like these do not apply to informational texts in science or social studies (nor, in fact,

to the full array of literary genres). Generic comprehension strategies (find the main idea, identify

the topic sentence, summarize, learn the bold-faced words) are often introduced for informational

texts (Alvermann & Wilson, 2011; McKeown, Beck, & Blake, 2009; Palincsar & Brown, 1984;

Pressley, 2002). Indeed, they can be helpful in reading textbooks and textbook-like materials in

which the conventions match these generic strategies. For example, key vocabulary items are

bolded; section headers mark new topics, and the first sentence under the header is often a good

summary of the section. Such strategies are very difficult to apply, however, to the full array of texts

we hope students are reading – newspaper articles, historical documents, journalistic reports of

research, editorials, political speeches. These texts vary in the way information is organized and the

conventions used to signal more versus less important information, most of which school-aged

readers have not been taught (Goldman & Bisanz, 2002; Goldman & Rakestraw, 2000). Lacking

these organizational cues to importance, students need the very information they are trying to learn if

they are to, for example, evaluate whether or not a summary captures the important ideas.

Importantly, it is possible to teach adolescents to use the structure of text to bootstrap comprehension

of new information (e.g., Meyer & Wijekumar, 2007).

The set of comprehension strategies that is widely taught was selected because of the empirical

evidence that good readers and better learners use them (Goldman & Saul, 1990; Pressley, 2002;

RAND, 2002). The assumption was that, if poor readers could be taught to do what good readers do,

their comprehension and learning would improve. But good readers use strategies like monitoring,

self-questioning, and rereading selectively – and they can be selective because they understand some of what they are reading. Good readers are also strategic in their choice of what to read deeply, what to skim, and what to skip. Strategic deployment of reading strategies depends on readers being metacognitively aware of whether, and how, particular efforts – strategic or otherwise – are leading to success in the task for which the reading is being done (cf. Goldman, Braasch, Wiley, Graesser, & Brodowinska, 2012; Goldman et al., 2012).

Guided by the findings from good readers, comprehension strategy training over the last 40 to 50 years progressed from single to multiple strategy interventions (cf. Pressley, 2002). As well, there has been a shift from autonomous student use of strategies to applying them in pairs or small-group settings, often with strategic roles (questioning, summarizing, monitoring) distributed over different group members. In small groups, students get feedback on their own thinking as well as exposure to alternative approaches to building understanding and to other interpretations of the text. Multiple-strategies interventions include attention to metacognitive strategies for monitoring understanding and for selecting what strategy to use when. Although multiple-strategies interventions have targeted informational text, there has been little attention to the differentiated conceptual skills and knowledge required in specific content areas (e.g., science, history, or literature), and few interventions have targeted multiple content areas simultaneously, so as to provide students with contrastive information about discipline-specific reading.

The limited success of generic reading strategies as a basis for comprehension instruction is also related to changes in the tasks posed and the behavior that is taken as indicative of comprehension. Whereas 10-year-olds might be asked only to summarize or to define a novel word after reading an expository text, by early adolescence students should be asked to make inferences, to identify the author's point of view, to evaluate the credibility of claims and conclusions, and to integrate

information derived from several sources (Alvermann & Wilson, 2011; Lee & Spratley, 2010; Shanahan & Shanahan 2008; Snow & Biancarosa, 2004). These skills are particularly important for reading the variety of text genres (articles, blogs, comments, posts, tweets) of varying credibility encountered on the Web (Stadtler & Bromme, 2007). These tasks require that adolescents reason with and about the information that they read, bringing to bear applicable inferential processes and requisite content knowledge that the texts do not provide. In so doing, students need to coordinate information in one text with information in other texts and with already known information. They also need knowledge of appropriate criteria for evaluating the information and the reasoning they do with it.

Thus, both the texts and reading-to-learn tasks adolescents encounter create high prior knowledge demands. It is therefore not surprising that researchers repeatedly find an effect of prior knowledge on new learning – those who start out knowing more about a topic typically perform better on memory and learning tasks than those who know less (Alexander & Jetton, 2002; Kintsch, 1994; McNamara & Kintsch, 1996). Evidence that a major obstacle to successful comprehension is lack of relevant background knowledge has led to approaches that downplay the role of generic reading skills (self-monitoring, drawing inferences) or improving readers' thinking processes. Rather, these approaches emphasize the match between reader knowledge and text demands – building on the familiar observation that even good readers flounder when asked to comprehend texts about unfamiliar topics (reports of cricket matches for Americans or of baseball games for South Africans). Although it would be desirable to have direct comparisons of the impact of exposure to background knowledge vs. strategy instruction, we are not aware of any studies of this sort. Rather, prior knowledge is frequently treated as an individual differences variable that is used

either to define contrastive groups, to predict performance, or as a covariate to "control for" differences among participants in prior knowledge.

The question remains however: How do readers make sense of texts for which they lack requisite prior knowledge? Some interventions address this question by framing reading as an inquiry process and externalizing the processes of making sense of the text; classroom talk focuses on *how* as well as *what* understanding is occurring (e.g., Schoenbach, Greenleaf, & Murphy, 2012). In interactions referred to as *metacognitive conversations* (Schoenbach et al., 2012), readers discuss with each other what they do and do not understand, how they figured out the meaning of an unfamiliar word, what parts of the text confused them and why, what questions they have, and so forth. Externalizing the processes of sense making exposes not only a range of strategies for building understanding but also what was difficult to understand and strategies for dealing with these difficulties. Externalizing reading processes in this way encourages deep engagement with the text even when comprehension difficulties are encountered. These types of interventions encourage readers to engage with rather than disengage from complex text by focusing on the questions the text raises.

In a review of studies conducted with 5th graders, McKeown et al. (2009) found that text-focused questions generated better comprehension and better recall than strategies instruction. The results of this rigorous study confirmed a wide array of findings showing the importance to successful comprehension of mastering procedures for figuring out precisely what the text says and what to do when you cannot.

Science, History, Math, and Literature: Learning content and literacy together

With few exceptions (cf. Greenleaf et al., 2010), most comprehension instruction approaches have been tested on generic, narrative texts. However, studies of experts in different disciplines make clear they read differently and that the comprehension demands of texts in different disciplines

are not the same. Literary experts reading poetry and prose relate what they are reading to other works by the same author and from the same period. They are sensitive to multiple interpretations and explore insights into human experience afforded by the literary work (Graves & Frederiksen, 1996; Langer, 2010; Lee, 2007). In both history and science, experts routinely engage in selection, analysis, and synthesis within and across multiple sources of evidence (Chinn & Malhotra, 2002; Shanahan & Shanahan, 2008; Wineburg, 1991). However, historians and scientists approach texts in their fields differently. For example, chemists use multiple representations to understand what they are reading. In other words, a hydrogen molecule can be represented symbolically (H_2O) or visually as a hydrogen atom connected to two oxygen atoms. When reading, chemists spend a lot of time relating elements of one representational form to another. On the other hand, historians first look at and spend time considering when, why, and by whom a text was created. For the most part, novices, including adolescents, do not engage in the disciplinary processes exhibited by experts (Britt & Aglinskas, 2002; Goldman, Braasch et al., 2012; Greene, 1994; Rouet, 2006; Rouet, Britt, Mason, & Perfetti, 1996; Seixas, 1994; Smith, 1991; Wineburg, 1991). Interestingly, experts reading outside their field of expertise do not display the same strategies they use when they read within their field of expertise (Bazerman, 1985, 1998), reinforcing the important role of topic knowledge and discipline-specific tasks in guiding reading behavior. This also makes clear that adolescents will need instruction in how to read for each of the content areas in which they are expected to use literacy skills as a route to knowledge.

That disciplinary literacies have been largely absent from middle and high school curricula is not surprising for several reasons. First, in most schools, content learning has been dominated by transmission of what is known rather than how it came to be known. That is, students are typically not engaged in the disciplinary inquiry practices that generate knowledge. Compendia-like textbooks

present what is known; students are expected to learn but not necessarily to understand the facts.

Criticisms of the transmission model of learning abound. As discussed earlier, contemporary

approaches point to the importance of active involvement in learning that engages students in

developmentally appropriate forms of disciplinary practices, including disciplinary reading practices

(e.g., Bransford et al., 2001; Donovan & Bransford, 2005; Duschl, Schweingruber, & Shouse, 2007;

Langer, 2010; Lee, 2007; Moje, 2008; Wineburg, 2001). Second, most disciplinary experts,

including teachers of adolescents, are typically unaware of how they themselves read in their

discipline, that reading within their discipline is different from how they read outside their discipline,

and that the way they read and interpret text in their discipline is not the same as the way a teacher

from a different discipline would (e.g., Grossman, Wineburg & Woolworth, 2001). In other words,

teachers' knowledge of their disciplinary literacy practices is tacit, so they are unaware of the need

to make these practices explicit to students. Finally, we lack information about the time courses and

trajectories for the development of disciplinary reading. For example, we know little about how and

when to introduce and then deepen disciplinary inquiry practices for building content knowledge

from text, either within a school year or across multiple years. We also know little about how to

support students' appreciation of the differences across disciplines in the nature of valid arguments

and how these are manifest in written (and spoken) discourse.

Authentic reading tasks in the various disciplines typically require reading multiple sources to

investigate a question or solve a problem. In literature the inquiry might be about comparative styles

and themes; in science about verifying claims and constructing explanations of phenomena in the

physical world; in history about contrasting perspectives and explanatory accounts of events. In

school, adolescents are only rarely asked to read multiple sources and synthesize what they read to

solve a problem or answer a puzzling question. In this era of unlimited digital access to vast

quantities of information, the capacity to sift, sort, and synthesize – achieving what Bråten and

Strømsø (2010) refer to as multiple documents literacy -- is crucially important (Bromme &

Goldman, 2014; Goldman & Scardamalia, 2013; Rouet, 2006). With the recognition of the

importance of reading multiple sources using reading practices specific to particular disciplines,

researchers have begun to research and develop instructional approaches through laboratory and

classroom-based studies. We describe examples of these in history, science, and literature.

Teaching history content and literacy practices of history.

Historians construct accounts of historical events by reading traces of the past found in

documents and other artifacts produced at the time of the event as well as other historical accounts

written subsequent to the event. They engage in critical analyses, syntheses, and evaluations across

these sources using three historical inquiry practices: sourcing, contextualization, and corroboration

(Wineburg, 1991). Sourcing asks who produced the source (document, artifact), for what purpose,

and when, in order to identify the perspective or point of view reflected in the information.

Contextualization considers the larger set of circumstances and events that were occurring at the

time a particular source was created. Corroboration examines whether and where multiple sources

about the same time period or event agree and disagree. Reading like a historian involves

employing these practices. For example, documents written by Hitler about the causes of World

War II would reflect his particular perspective and the context in which he lived. Churchill's

writings about the causes of World War II would likewise reflect his context and disagree in some

fundamental ways from Hitler's.

Several classroom-based interventions have attempted to teach adolescents to use the three

historical inquiry practices when reading historical documents (e.g., De La Paz, 2005; Nokes, Dole,

& Hacker, 2007; Reisman, 2012). Each prompted sourcing, contextualizing, and corroborating

through a series of questions students were to answer based on a set of historical documents. One of

these studies, conducted with 13- 14 year olds (De la Paz, 2005), also taught students to evaluate

what they had read in light of their answers to the sourcing and corroboration questions and how to

write an historical argument essay using the information from the documents. Students in the

treatment condition produced longer and more compelling essays than control group students;

interviews indicated that the treatment students showed greater understanding than control students

of how historians reason and why there might be different opinions about historical events.

Reisman (2012) took a similar approach to that of De La Paz in a study conducted with 16 -17

year olds and found similar positive effects. In addition to questions that promoted the three

historical inquiry practices, Reisman (2012) launched each topic in the U. S. history survey course

with an engaging question that required reconciling multiple accounts. Further, to assist students in

understanding the historical argument, Reisman provided students with questions intended to focus

them on the claims made and evidence the author was using, as well as the words and phrases that

led students to think the author was using the information appropriately. A six-month

implementation of this program in five high schools produced positive effects on knowledge of facts

taught, using historical thinking skills, sophistication in applying those strategies to current events,

and general reading comprehension (Reisman, 2012).

De La Paz (2005) and Reisman (2012) have demonstrated that developmentally appropriate

forms of "reading like a historian" have a positive effect on adolescents' literacy achievement and

content learning. In both cases, these approaches were implemented with substantial support from

the researchers. Project READI (Reading, Evidence, and Argument in Disciplinary Instruction;

Goldman et al. 2009) is exploring the kinds of experiences and supports that teachers need to adopt

this approach. Key issues are (1) building progressions in reading like a historian within and across

grade levels, starting at age 10 – 12 and extending through late adolescence; and (2) specifying the performances that would reflect mastery of, for example, sourcing, in a 12 year old as compared to an 18 year old. Particularly important for this work are teachers' analyses of the potential challenges posed by specific texts and tasks for their students (e.g., unfamiliar concepts, archaic language, contextual information) and the implications of these for the types of instructional supports they need to provide.

Teaching science and literacy practices of science together.

Recent efforts in the United States to foster greater achievement and better appreciation for science emphasize the practices of science that inform scientists' formulation of timely and interesting research questions, underlie data representations and that communicate science to other scientists and the general public (Achieve, 2013; Bromme & Goldman, 2014). Several instructional interventions exemplify ways in which the literacy practices of science can be integrated with hands-on experiences of doing observational and experimental science. For example, Magnusson and Palincsar (1995) fostered literacy and inquiry-based (hands-on) science to create an instructional approach they called *Scientists Notebook*. The main feature of the approach was the science notebook of Lesley, a fictitious physical scientist. In this notebook Lesley (really Magnusson) modeled experimentation: She recorded her questions about the physical world (e.g., about variables affecting motion), data collection plans, different displays of the data she had collected (graphs, tables), notes about patterns she noticed, and conclusions and revisions to her conclusions based on challenges from colleagues. Fourth and fifth grade students (9 – 11 years old) used these notebooks along with additional texts to conduct their own inquiries arising from their analyses and critiques of Lesley's information. Extensive documentation of instructional conversations around the notebook and related texts as well as students' work indicated increases in critical science literacy practices,

including coordination of information across different representations and multiple texts (Hapgood, Magnusson & Palincsar, 2004).

Romance and Vitale (2001) also reported increases in science understanding and reading achievement for 9 - 11 year olds who participated in their In-Depth Expanded Applications of Science (IDEAS) program. Instruction included hands-on inquiry experiences that tested predictions and observations students generated in response to "What would happen if…." questions. Students learned to carefully read science texts to inform their written explanations of findings from the hands-on inquiry. Students engaged in additional reading and writing activities to compare their current understanding to what they had originally understood and apply their knowledge to new contexts. When compared with students in regular programs that separated reading and science, IDEAS students performed significantly better on standardized measures of science achievement, reading achievement, and attitudes toward learning, with a one-year grade equivalent difference in science and a third of a year in reading. Romance and Vitale also showed that the gains persisted for three grade levels beyond students' last year of participation in IDEAS.

Cervetti, Barber, Pearson, and colleagues (2012) have expanded on the design features of both Scientists Notebook and IDEAS in *Seeds of Science/Roots of Reading,* a curriculum for 9 – 12 year olds. Students do their own investigations (observational as well as experimental) but also read to compare their own findings with those of other investigators who collected data under different conditions. They also read texts that explain the mechanisms that underlie causal relationships that are depicted in diagrams. For example, causal relationships are often depicted by directional arrows from cause to effect (e.g., the water cycle, photosynthesis); but the visual does not explain why, for example in the case of the water cycle, rain forms in clouds and falls to earth. Classroom discussion of data and students' efforts to make sense of discrepant data provide opportunities for students to

share their reasoning, experience challenges to data and interpretations, and create revised understandings based on the exchange of interpretations. Findings from a field trial across 16 school districts favored the treatment over business-as-usual groups for science learning, vocabulary, and science content in written measures (Cervetti et al., 2012).

Integrated science and literacy approaches have also proven effective with adolescents in the 14 – 16 year age range. In particular, Reading Apprenticeship (RA) focuses students on careful and thoughtful reading of science texts in support of their inquiry, including their explicit attention to what, how, and why they are reading and the understanding they are achieving (Schoenbach et al., 2012). In a large randomized field trial (approximately 5000 students), students in 10th grade biology with teachers who had received the RA professional development outperformed those in business-as-usual biology classes on standardized assessments of English language arts, reading comprehension and biology, with effect sizes indicating an advantage for the treatment group of about one year at the end of the study (Greenleaf et al., 2011). The fundamentals of the RA model have since been incorporated into Project READI's (Goldman et al., 2009) work in science. Students engage in text-based inquiry for purposes of constructing explanatory models of science phenomena that rely on cross-cutting concepts (e.g., patterns, cause and effect, structure and function) (Greenleaf, Brown, Goldman & Ko, 2013). For example, in one implementation students used texts to find out why drinking too much water is as dangerous as drinking too little, in the context of studying biological homeostasis.

Teaching literature and interpretive practices.

When reading literature, experts in literary analysis construct interpretations, i.e., connotations and thematic inferences about the human condition, whereas novices such as high school and college students do not (Graves & Frederiksen, 1996). These findings are consistent with results indicating

that few high school students are successful in going beyond the literal meaning of literary texts (NAEP, 2009). Indeed, research indicates that typical literature instruction emphasizes literal comprehension of the plot and some attention to characterization, with high dependence on teacher-directed instruction (Nystrand, Gamoran, Kachur, & Prendergast, 1997), perhaps because teachers find it difficult to help students move from literal to interpretive strategies for literary understanding (Marshall, Smagorinsky, & Smith, 1995). This situation contrasts with an inquiry approach to literature, i.e., one that emphasizes the tentative nature of literary interpretation and affords opportunities for adolescents to explore the ideas, possibilities, emotions, and perspectives of others on the human condition and to compare them with their own (Applebee, Burroughs, & Stevens, 2000; Langer, 2010; Lee, 2011; Olshavsky, 1976; Rosenblatt, 1978). Perspectives in literary texts are conveyed through many elements, including the events and sequences of events, the characters, the dilemmas, the solutions, the emotions conveyed in the narrative, and how language and structure are used to convey these elements (Hillocks & Ludlow, 1984; Rabinowitz, 1987; Scholes, 1985).

Instructional approaches that support an inquiry stance to literature emphasize close reading of text in conjunction with classroom discussion in which students do the intellectual work of constructing thematic and symbolic as well as literal meanings (Langer, 2010; Lee, 2006; Schoenbach et al., 2012). Doing so involves putting forth proposals or claims that go beyond the literal actions or events in the story e.g., the tragic flaw in the main character of *Hunger Games* is her loyalty to her family. Support for claims of this type draws on both the text in question and on knowledge of other texts, personal beliefs, belief systems (social, political, philosophical, or religious), or literary theories (Appleman, 2000; Lee, 2014; Schoenbach et al., 2012). Literary analysis requires combining knowledge of human nature with knowledge about literary and rhetorical communication practices, for example, that authors make intentional choices about plot

structure (e.g., story events are told in chronological order or are relayed through flashbacks),

character types (e.g., anti-hero, trickster), and rhetorical devices (e.g., irony, dialogue, first-person

narration) in order to convey their messages (Applebee et al., 2000; Lee, 2011, 2014; Olshavsky,

1976; Rabinowitz, 1987; Smith & Hillocks, 1988). Thus, fundamental to teaching literary analysis is

making students aware of these conventions and providing opportunities for students to argue with

one another as well as with the author about the message, using evidence from the text and reasoning

that connects the evidence to the claim.

There are a number of descriptive accounts of efforts to create inquiry-focused literature

classrooms, including Langer (2010), Lee (2001; 2007) and Smith and Hillocks (1988). Recently,

the Project READI literature design team designed and implemented an approach to instruction that

involves closely reading literary texts multiple times, carefully analyzing language use (e.g.,

repetition of particular words or phrases), and applying criteria for specific themes and motifs (e.g.,

what counts as evidence of heroism? Of cowardice?) as well as for literary conventions and

rhetorical devices (e.g., Why do we think this is a symbol? What is it a symbol of?) (Lee et al., 2014;

Sosa, Hall, Goldman & Lee, in review). The design includes Lee's Cultural Modeling approach as a

means of providing adolescents entry points to literary analysis (Lee, 2007): Teachers select texts

from popular culture (cultural data sets) that manifest the rhetorical device(s) students will encounter

in a school-assigned story or novel. Students discuss interpretations of the cultural data sets, making

explicit how they know that, for example, particular song lyrics are not meant literally (e.g., the song

lyrics to the Academy Award winning song "Let It Go".[i]) Having gone "meta" on the cultural data

sets makes students aware of the interpretive practices they already use and they can then apply them

to "school" texts.

Summary

In each of the disciplines discussed here, emphasis in the pedagogical approach has been on all forms of representation typical of the discipline and modes of language – listening, speaking, reading, and writing. Although we emphasized discipline-specific features in this section, these efforts also reveal some features of effective instruction that apply across disciplines and that we will expand upon below: the need for engaging texts and task and the important role of discussion in building adolescents' knowledge of disciplinary literacy practices as well as content. Through discussion, students can try out ideas, hear alternative interpretations or counterarguments, expand their knowledge, and revise their thinking in socially supportive contexts.

Literacy is more than Reading: The role of discussion

Although the classic portrait of the successful reader shows a solitary person curled up with a book, much reading comprehension and most effective reading instruction integrate and depend on discussion. Discussion is not a frequent feature of U.S. classrooms (Nystrand & Gamoran, 1991), but considerable evidence suggests it is likely to be present in classrooms where students acquire high-level literacy skills (Lawrence & Snow, 2010). Furthermore, discussion skills themselves are identified as a component of being college and career ready (CCSSO, 2010), increasing the likelihood that they will receive focused instructional attention. Classroom discussion is hypothesized to promote students' literacy skills via several routes: increasing engagement, building content knowledge presupposed by the text, revealing to students teachers' and classmates' alternative perspectives and interpretations, and providing opportunities for students to practice orally the language and thinking skills they need to apply in reading and writing.

A recent meta-analysis of interventions focused on classroom discussions by students in K – 5th grade examined effects of a wide range of discussion-based interventions on comprehension and learning from text (Murphy, Wilkinson, Soter, Hennessey, & Alexander, 2009). The approaches

reviewed shared an emphasis on classroom discussion that valued the exploration of ideas and development of understanding through discussion, often referred to as a dialogic rather than monologic orientation (Nystrand et al., 1997). The Murphy et al. (2009) meta-analysis showed that in classrooms where these particular approaches were used the ratio of student to teacher talk increased and students were more engaged. The meta-analysis reveals the feasibility and utility of discussion even for pre-adolescents.

With a relatively large sample of low- and high-achieving middle and high school adolescents (across approximately 80 schools), Applebee, Langer, Nystrand and Gamoran (2003) found that dialogic classroom discussion was significantly related to performance on tasks requiring students to adopt interpretive as opposed to literal stances in literature. Langer (2010) stressed that this type of discussion needs to move students from looking for "the point" of a story to "exploring the possible" through literary works. In other words, literature can be a vehicle for exploring what might be rather than what is. Engaging adolescents in these conversations requires that teachers invite students to develop their ideas, listen carefully to the ideas of others, and use multiple perspectives to enrich interpretation of literary works. Prompts for discussion are designed to move students through a series of orientations, or stances, toward text: initial understanding (e.g., What images catch your attention as you read?), developing ideas and multiple perspectives (e.g., What are you noticing about the ideas?), learning from the text (e.g., What does this story do to help you understand about the character's culture? How does it help you understand your world?), taking a critical stance (e.g., What are you noticing about the style of the text?), and going beyond (e.g., How does this story help you understand what is and what might be?). It should be evident that these types of discussions require literary works that are sufficiently complex, challenging, and interesting to the students.

Classroom discussion is the primary means of implementing Lee's (2007) Cultural Modeling approach. As discussed earlier, Cultural Modeling is designed to make students explicitly aware of the processing they are doing to understand text.; its goal is to have students externalize how they know that some object or phrase is to be interpreted beyond the literal meaning. Making this process explicit allows students to apply it to their comprehension and interpretation of school texts. Classroom discussion is initially led by teachers but gradually gets taken over by students (Lee, 2001).

Classroom discussion has also significantly increased conceptual skills and knowledge in mathematics and science. In mathematics, O'Connor and colleagues examined the impact of introducing a conceptually based mathematics program along with the type of dialogic discourse that Langer and Lee used in their interventions. Of course, the prompts were appropriate to mathematics thinking and to the curricular content being taught to the participants (10-14 year olds) (Chapin & O'Connor, 2012; O'Connor, Michaels & Chapin, in press). For example, students are encouraged to provide multiple answers to a problem along with an explanation of how they got the answer and why that method is reasonable. If answers agree but were arrived at using different methods, students are asked to think about why the methods agreed. If answers conflict, teachers elicit comments from students about the mathematical reasonableness of the answers. Teachers deepen the mathematics of conversations by revoicing students' contributions, sometimes introducing math-appropriate language (e.g., associative and distributive principles). Over the course of instruction, students take up these forms of mathematical reasoning and speaking. O'Connor and colleagues found that student gains on standardized achievement tests exceeded those in comparison classrooms, as well as those in one of the highest scoring districts in the state (Chapin & O'Connor, 2012; O'Connor & Michaels, 2011).

Similar characteristics of classroom talk are found in efforts to promote inquiry-oriented science in elementary and middle school classrooms. When these norms for interacting and conversational routines are established, there is visible development of student generated scientific argumentation (Osborn, Erduran, & Simon, 2004; Ryu & Sandoval, 2012).

A program designed specifically to improve students' argumentation skills across the content areas is *Word Generation.* Word Generation introduces engaging topics and supports small- and large-group discussion about those topics as a stimulus to more purposeful reading and writing for authentic audiences. Texts provided to start Word Generation discussions provide models of the academic language forms (precise word choice, compact sentence structure, use of nominalizations, avoidance of evaluation, etc.; see Snow, 2010) that students will be expected to use in their own writing. In addition, Word Generation incorporates activities requiring students to analyze texts to understand speakers' or characters' perspectives. The program is effective in supporting vocabulary learning (Snow, Lawrence, & White, 2009), with larger-than-expected effects for low-scoring students in low-scoring schools on reading comprehension as well as vocabulary (Lawrence, Snow, Francis, under review). Most saliently, the effects of the program are significantly mediated by the quality of the discussion in which the class engages (Lawrence, Paré-Blagoev, Crosson, & Snow, in press), supporting the claim that discussion is the 'active ingredient' accounting for outcomes.

It is worth noting that the instructional approaches highlighted above in our discussion of disciplinary literacy rely heavily on text-focused discussion. For example, classroom discussion plays a key role in the Reading Apprenticeship model of integrating biology and literacy for 14-18 year olds (Greenleaf et al., 2011; Schoenbach et al., 2012), Project READI's designs of instruction, Scientists Notebook, and in the approaches to history highlighted there.

Efficacy data on classroom discussions is often difficult to obtain because discussions are typically part of more complex interventions that involve multiple pedagogical strategies, a variety of tasks, and texts. Discussions are, however, important in their own right because they make thinking visible, thereby creating opportunities for students to juxtapose their own understanding to that of their classmates, and for teachers to assess student understanding.

Purpose and Engagement

The approaches to integrating literacy instruction with disciplinary subject matter instruction discussed thus far incorporate design elements that are intended to actively engage students in the learning process, consistent with the contemporary views of effective learning environments (e.g., Bransford et al., 2000). As we have discussed, successful comprehenders actively engage with text, relying on multiple types of knowledge (e.g., of words, concepts, sentence structures, text structures, genres) as they try to interpret print. They monitor their comprehension, and use a range of strategies in response to failures to understand what they are reading (Goldman & Saul, 1990; Palincsar & Brown, 1984; Pressley, 2002; RAND, 2002). They connect ideas within a text with each other and with relevant prior knowledge, ask questions, and explain the ideas and connections (Coté, Goldman, & Saul, 1998; Magliano & Millis, 2003).

The active engagement in making meaning described in the previous paragraph contrasts sharply with the default reading activity in many classrooms, where the recurrent student questions are "Why do we have to learn this?" and "Will this be on the test?" These questions reflect the often purpose-less nature of many school tasks and learning experiences, along with the disengagement on the part of all but the most dedicated students. Students view history and science as lists of facts to be memorized, static bodies of information that have little bearing on the present and that are encapsulated in thick text books with questions at the end of each chapter. Although the movement

to introduce "hands-on" science into K – 12 classrooms reflects efforts to reform textbook-based science instruction, these efforts have been criticized for encouraging "minds-off" science: Students carry out sequences of procedures to get "the right answer" with little understanding of why. The situation is similar for other areas of the curriculum. Thus, it is little wonder that learning school subject matter commands little interest on the part of youngsters in the 21st century.

A wide array of approaches has been designed to counter the demotivating practices typical of American classrooms, and many of these approaches are starting to show promising results. The specifics of the approaches vary, and one of the research tasks of the next decade should be to explore their relative merits.

One set of approaches focuses on ensuring students are interested in a topic before starting to teach about it. Content-oriented Reading Instruction, for example, has shown positive effects on reading and on science content learning of ensuring engagement by building interest with introductory videos, using direct observation prior to reading, and offering students a choice of texts (Guthrie et al., 1999; Guthrie et al., 2004). The CREATE team developed a similar approach to science as well as to social studies instruction specifically for 12-14 year olds from homes where the school language is not spoken (August, Branum-Martin, Cardenal-Hagan, & Francis, 2009). Lessons, designed to cover district-defined topics, were launched with videos, incorporated collaborative learning, and explicitly taught second language structures in the context of the content instruction. Students showed significantly better performance on assessments of language outcomes and content knowledge than those participating in typical science (August et al., 2009) or social studies instruction (Vaughn et al., 2013).

A second set of approaches capitalizes on students' interest in intriguing questions and effective self-expression to place discussion at the center of the instruction. Discussion-based approaches are

designed to address the default in classrooms that teachers talk a lot and students rather little. In addition, comprehension-oriented discussion-based approaches such as Word Generation reflect the theory that students' interest in defending their point of view about a topic or dilemma will provoke information-seeking through reading (Snow, Lawrence, & White, 2009). Word Generation has been effective in promoting high engagement and supporting vocabulary learning among middle grades students, especially when the discussion element is well implemented (Lawrence, Paré-Blagoev, Crosson & Snow, in press). Effects on reading comprehension have not yet been confirmed for this particular program, but other discussion-based programs show significant effects on comprehension (cf. Murphy et al., 2009).

A third set of approaches starts from the assumption that authentic, discipline-specific inquiry tasks that also make contact with the concerns and interests of adolescents will pique the curiosity of students and draw them into rigorous, challenging, adult-like tasks. As illustrated in the section on integrating literacy and content, in these approaches, reading to learn is embedded in inquiry - a "need to know" situation; learning is directed toward solving some problem or answering some question appropriate to the content area but formulated so that students are genuinely interested in addressing it. Reading thus becomes a tool for knowing, and motivation derives from engagement with authentic disciplinary tasks. Such practices assume that challenge and rigor motivate rather than discourage.

These various approaches embed principles learned from research on strategy instruction and text processing, as well as from small-scale classroom-based research studies. It is clear that adolescent readers benefit from instruction that exposes them to accessible topics, engaging questions, and authentic tasks. Those authentic tasks should incorporate processes akin to those in which disciplinary experts engage in the process of doing their work (Gee, 1992; Lave & Wenger,

1991), albeit in developmentally appropriate forms. Effective instruction intertwines content and communication (Moje, 2008). For example, when adolescent students are given tasks requiring the construction of historical narratives from information found in multiple documents, they learn to think more critically about what they read and engage in deeper processing of text sources (Hartman & Hartman, 1993; VanSledright, 2002; Wolfe & Goldman, 2005). When 4th-8th graders are given social-science or science dilemmas, and a variety of texts that offer evidence supporting different resolutions, they read purposefully to find the evidence that will support their own position in debates and in writing (Snow et al., 2009). In science inquiry environments where adolescent students (12 – 15 years of age) learn to create arguments that support claims with evidence from multiple sources of information, they show improvements in their reasoning and science content knowledge (Geier et al., 2008; Greenleaf et al. 2013; Linn, Clark, & Slotta, 2003). In literature, when adolescents are made aware of interpretive processes they already use to understand texts from their everyday worlds (e.g., rap songs) and are shown how these processes are relevant to particular literary problems (e.g., symbolism), many experience success at interpreting complex literary works (Lee, 2001, 2007; Levine & Horton, 2013; Sosa et al., in review).

Conclusions

In this chapter we have sketched a rationale for treating adolescent literacy as a separate topic, both because of the developmental challenges that are unique to adolescents in academic settings and because of the new tasks and texts that modern schooling presents to adolescents. We have certainly not covered the entire landscape of work in the field of adolescent literacy; we have chosen instead to focus on four specific points:

1. Comprehension strategy instruction is widely used, often forming the primary (or sole) focus of reading instruction after third grade. Although it can be useful, strategy instruction falls far short of being a solution to the challenges of adolescent literacy.

2. A major new challenge in adolescence is learning to navigate the distinctive literacy demands of different content areas, often with insufficient guidance from content area teachers about how to do that. Nonetheless, instructional programs that embed literacy instruction deeply into disciplinary inquiry have been shown to be effective both for content area learning and for literacy development.

3. Literacy develops not just through reading, but also through discussion. Well-structured and well-focused classroom discussion helps prepare students for many of the demands of literacy, by confronting them with different perspectives on a topic and by providing opportunities to practice academic language and reasoning. Discussion also helps teachers by making their students' thinking public and accessible.

4. As the intrinsic motivation to read declines during adolescence, it becomes vitally important to attend to student engagement and to provide an explicit purpose for reading in the design of instructional activities. Students learn more, read more widely, and write better when they are engaged in the content and understand how the school tasks set for them relate to their lives.

Proper attention to these four points would revolutionize our theories of literacy development and of reading comprehension processes. Full attention to the challenges of disciplinary literacy would shift our theories of literacy development from assuming a single pathway from word reading to successful text comprehension, and substitute instead an image of a branching in middle childhood, with later growth varying across topic, discipline, and task. Recognizing the role of

discussion in promoting comprehension and learning would undermine our view of literacy as a

purely cognitive, inside-the-head skill, adding the sociocultural and affective dimension. By

studying adolescent readers and how they learn, we discover how closely aligned reading is to

thinking and to knowing, and the degree to which success at comprehension requires understanding

the purposes behind the cultural and disciplinary practices that are being taught.

References

Achieve (2013). *The Next Generation Science Standards.* Washington, DC: Achieve.

Alexander, P. A. & Jetton, T. L. (2002). Learning from text: A multidimensional and developmental perspective. In M. L. Kamil, P. Mosenthal, P. D. Pearson, & R. Barr (Eds.) *Handbook of reading research*, *Volume III* (pp. 285-310). Mahwah, NJ: Erlbaum.

Alverman, D. & Wilson, A. (2011). Comprehension strategy instruction for multimodal texts in science. *Theory into Practice, 50*, 116-124.

Aro, M. & Wimmer, H. (2003). Learning to read: English in comparison to six more regular orthographies. *Applied Psycholinguistics, 24,* 621-635.

Applebee, A. N., Burroughs, R. & Stevens, A. S. (2000). Creating continuity and coherence in high school literature curricula. *Research in the Teaching of English, 34,* 396-429.

Applebee, A. N., Langer, J.A., Nystrand, M. & Gamoran, A. (2003). Discussion-based approaches to developing understanding: Classroom instruction and student performance in middle and high school English. *American Educational Research Journal, 40,* 685–730.

Appleman, D. (2000). *Critical encounters in high school English: Teaching literacy theory to adolescents.* NY: Teachers College Press and National Council of Teachers of English.

August, D., Branum-Martin, L., Cardenas-Hagan, E. & Francis, D. (2009). The impact of an instructional intervention on the science and language learning of middle grade English language learners. *Journal of Research on Educational Effectiveness, 2,* 345–376.

Bazerman, Charles. (1998) Emerging perspectives on the many dimensions of scientific discourse. In E. J. Martin & R. Veel (Eds.), *Reading Science* (pp. 15-30). NY: Routledge.

Bazerman, C. (1985). Physicists reading physics: Schema-laden purposes and purpose-laden schema. *Written Communication, 2,* 3-23.

Bransford, J. D., Brown, A. L. & Cocking, R. R. (2000). *How people learn.* Washington, DC: National Academy Press.

Bråten, I. & Strømsø, H.I. (2010). When law students read multiple documents about global warming: Examining the role of topic-specific beliefs about the nature of knowledge and knowing. *Instructional Science, 38*, 635-657.

Britt, M.A. & Aglinskas, C. (2002). Improving students' ability to use source information. *Cognition and Instruction, 20,* 485-522.

Bromme, R. & Goldman, S. R. (2014). The public's bounded understanding of science. *Educational Psychologist, 49,* 59-69.

Carnegie Council on Advancing Adolescent Literacy. (2010). *Time to act: An agenda for advancing adolescent literacy for college and career success*. NY: Carnegie Corporation of New York.

Cervetti, G., Barber, J., Dorph, R., Pearson, P. D., & Goldschmidt, P. (2012). The impact of an integrated approach to science and literacy in elementary school classrooms. *Journal of Research in Science Teaching, 49,* 631-658.

Chall, J. (1983). *Stages of reading development.* NY: McGraw-Hill.

Chapin, S. & O'Connor, C. (2012). Project Challenge: Using challenging curriculum and mathematical discourse to help all students learn. In C. Dudley-Marling & S. Michaels, (Eds.) *Places where all children learn* (pp. 113-127). New York, NY: Teachers College Press.

Chinn, C. A. & Malhotra, B. A. (2002). Epistemologically authentic reasoning in schools: A theoretical framework for evaluating inquiry tasks. *Science Education*, *86*, 175–218.

Connor, C. & Al Otaiba, S. (in press). Reading Instruction in the Primary Grades. To appear in A. Pollatsek & R. Treiman (Eds.), *The Oxford Handbook of Reading*. New York, NY: Oxford University Press.

Coté, N., Goldman, S. R. & Saul, E. U. (1998). Students making sense of informational text: Relations between processing and representation. *Discourse Processes, 25,* 1-53.

Council of Chief State School Officers (CCSSO). (2010). *Common Core State Standards.* National Governors Association Center for Best Practices, Council of Chief State School Officers, Washington D.C.

De La Paz, S. (2005). Effects of historical reasoning instruction and writing strategy mastery in culturally and academically diverse middle school classrooms. *Journal of Educational Psychology, 97*, 39 – 156.

Donovan, S. M. & Bransford, J. D. (Eds.) (2005). *How students learn: History, mathematics and science in the classroom.* Washington, D. C.: National Academies Press.

Duschl, R. A., Schweingruber, H. A. & Shouse, A. W. (Eds.). (2007). *Taking science to school: Learning and teaching science in grades K-8*. Washington, DC: National Academies Press.

Duke, N. K. & Martin, N. M. (2008). Comprehension instruction in action: The elementary classroom. In C. C. Block & S. Paris (Eds.), *Comprehension instruction: Research-based best practices* (pp. 241-257). New York, NY: Guilford.

Gee, J. P., (1992). *The social mind: Language, ideology, and social practice.* New York, NY: Bergin and Garvey.

Geier, R., Blumenfeld, P. C., Marx, R. W., Krajcik, J. S., Fishman, B., Soloway, E., & Clay-Chambers, J. (2008). Standardized test outcomes for students engaged in inquiry-based science curricula in the context of urban reform. *Journal of Research in Science Teaching, 45,* 922 - 939.

Goldman, S. R. (2012). Adolescent literacy: Learning and understanding content. *Future of Children, 22*, 89 – 116.

Goldman, S. R. & Bisanz, G. (2002). Toward a functional analysis of scientific genres: Implications

for understanding and learning processes. In J. Otero, J. A. León, & A. C. Graesser (Eds.), *The*

psychology of science text comprehension (pp. 19-50). Mahwah, NJ: Erlbaum.

Goldman, S.R. & Rakestraw, Jr., J.A. (2000). Structural aspects of constructing meaning from text.

In M.L. Kamil, P. Mosenthal, P.D. Pearson & R. Barr (Eds.), *Handbook of reading research*

(Vol. 3, pp. 311-335). Mahwah, NJ: Erlbaum.

Goldman, S. R. & Saul, E. U. (1990). Flexibility in text processing: A strategy competition model.

Learning and Individual Differences, 2, 181–219.

Goldman, S. R. et al. (2009). *Reading for understanding across grades 6 through 12: Evidence-*

based argumentation for disciplinary learning. Funded July, 2010 by the Institute of Education

Sciences, U.S. Department of Education, Grant # R305F100007.

Goldman, S. R., Braasch, J. L. G., Wiley, J., Graesser, A. C., & Brodowinska, K. (2012).

Comprehending and learning from internet sources: Processing patterns of better and poorer

learners. *Reading Research Quarterly, 47*, 356–381.

Goldman, S. R., Lawless, K. A., Pellegrino, J. W., Braasch, J. L.G., Manning, F. H., & Gomez, K.

(2012). A technology for assessing multiple source comprehension: An essential skill of the 21st

century. In M. Mayrath, J. Clarke-Midura, & D. H. Robinson (Eds.). *Technology-Based*

assessments for 21st century skills: Theoretical and practical implications from modern

research (pp. 171 - 207). Charlotte, NC: Information Age Publishing.

Goldman, S. R., Ozuru, Y., Braasch, J., Manning, F., Lawless, K. Gomez, K., & Slanovits, M.

(2011). Literacies for learning: A multiple source comprehension illustration. In N. L. Stein &

S. W. Raudenbush (Eds.), *Developmental science goes to school: Implications for policy and*

practice (pp. 30-44). New York, NY: Routledge.

Gottfried, A.E. (1985). Academic intrinsic motivation in elementary and junior high school

students. *Journal of Educational Psychology, 77*, 631-645.

Graves, B. & Frederiksen, C. H. (1996). A cognitive study of literary expertise. In R. J. Kruez & M.

S. MacNealy (Eds.), *Empirical Approaches to Literature and Aesthetics* (pp. 397-418).

Norwood, NJ: Ablex.

Greene, S. (1994). The problems of learning to think like a historian: Writing history in the culture

of the classroom. *Educational Psychologist, 29,* 89-96.

Greenleaf, C. L., Brown, W., Goldman, S. R. & Ko, M. L. (2013, December). *READI for science:*

Promoting scientific literacy practices through text-based investigations for middle and high

school science teachers and students. Presented at Workshop on Literacy for Science.

Washington, DC: National Research Council.

Greenleaf, C. L., Litman, C., Hanson, T. L., Rosen, R., Boscardin, C. K., Herman, J., Schneider, S.

A. (2011). Integrating literacy and science in biology: Teaching and learning impacts of

Reading Apprenticeship Professional Development. *American Educational Research Journal,*

48, 647-717.

Grossman, P., Wineburg, S. & Woolworth, S. (2001). Toward a theory of teacher community.

Teachers College Record, 103, 942-1012.

Guthrie, J. T., Anderson, E., Alao, S., & Rinehart, J. (1999). Influences of Concept-Oriented

Reading Instruction on strategy use and conceptual learning from text. *Elementary School*

Journal, 99, 343-366.

Guthrie, J. T., Wigfield, A., Barbosa, P., Perencevich, K. C., Taboada, A., Davis, M. H., Scafiddi, N.

T., & Tonks, S. (2004). Increasing reading comprehension and engagement through Concept-

Oriented Reading Instruction. *Journal of Educational Psychology, 96*, 403–423.

Hartman, D. K. & Hartman, J. M. (1993). Reading across texts: Expanding the role of the reader. *The Reading Teacher, 47,* 202-211.

Hapgood, S., Magnusson, S. J. & Palincsar, A. S. (2004). Teacher, text, and experience mediating children's learning of scientific inquiry. *Journal of the Learning Sciences*, *13*, 455-506.

Heller, R. & Greenleaf, C. (2007). *Literacy instruction in the content areas: Getting to the core of middle and high school improvement*. Washington, DC: Alliance for Excellent Education.

Hillocks, G. & Ludlow, L. H. (1984). A taxonomy of skills in reading and interpreting fiction. *American Educational Research Journal, 21*, 7-24.

Kintsch, W. (1994). Text comprehension, memory, and learning. *American Psychologist*, *49*, 294-303.

Langer, J. A. (2010). *Literature: Literary understanding and literature instruction, 2nd edition.* NY: Teachers College Press.

Lave, J. & Wenger, E. (1991). *Situated learning: Legitimate peripheral participation.* NY: Cambridge University Press.

Lawrence, J. & Snow, C. (2010). Oral discourse and reading. In M. Kamil, P. D. Pearson, E. Moje & P. Afflerbach (Eds.), *Handbook of Reading Research Volume IV* (pp. 320-338). New York, NY: Routledge.

Lawrence, J., Paré-Blagoev, J., Crosson, A. & Snow, C. (in press). Word Generation randomized trial: Discussion mediates the impact of program treatment on academic word learning. *American Educational Research Journal.*

Lee, C. D. (2001). Is October Brown Chinese? A cultural modeling activity system for underachieving students. *American Educational Research Journal, 38*, 97-141.

Lee, C. D. (2006). 'Every good-bye ain't gone': Analyzing the cultural underpinnings of classroom talk. *International Journal of Qualitative Studies in Education, 19*, 305-327.

Lee, C. D. (2007). *Culture, literacy, and learning: Taking bloom in the midst of the whirlwind.* NY: Teachers College Press.

Lee, C. D. (2011). Education and the study of literature. *Scientific Study of Literature*, *1*, 49-58.

Lee, C. D., Goldman, S. R., Levine, S., Sosa, T., George, M. A., Magliano, J., Briner, S. W., Coppola, R., McCarthy, K. S., & Burkett, C,   (2014, April). *Literary reasoning and argumentation: Reconceptualizing pedagogical implications of the domain.* Presented in the Symposium *Expanding pedagogical understandings of literary reasoning and argumentation in middle and high schools: Project READI.* American Educational Research Association, Philadelphia, PA.

Lee, C. D. & Spratley, A. (2010). *Reading in the disciplines: The challenges of adolescent literacy.* NY: Carnegie Corporation of New York.

Lenhart, A. (2013). *Teens, smartphones & texting.* Washington, D.C.: Pew Research Center. Downloaded January 10, 2014. http://pewinternet.org/Reports/2012/Teens-and-smartphones.aspx.

Levine, S. & Horton, W. S. (2013). Using affective appraisal to help readers construct literary interpretations. *Scientific Study of Literature, 3,* 105-136.

Linn, M. C., Clark, D. & Slotta, J. D. (2003). WISE design for knowledge integration, *Science Education, 87*, 517 – 538.

Madden, M., Lenhart, A., Duggan, M., Cortesi, S. & Gasser, U. (2013). *Teens and technology 2013.* Washington, D.C.: Pew Research Center. Downloaded: January 10, 2014.
   http://www.pewinternet.org/Reports/2013/Teens-and-Tech.aspx.

Magliano, J. P. & Millis, K. K. (2003). Assessing reading skill with a think-aloud procedure and

latent semantic analysis. *Cognition and Instruction, 21*, 251–283.

Magnusson, S. & Palincsar, A.S. (1995). Learning environments as a site of science education

reform: An illustration using interdisciplinary guided inquiry. *Theory into Practice, 34*, 43-50.

Marshall, J., Smagorinsky, P., & Smith, M. W. (1995). *The language of interpretation.* Urbana, IL:

National Council of Teachers of English.

McKeown, M., Beck, I. & Blake, R. (2009). Rethinking reading comprehension instruction: A

comparison of instruction for strategies and content approaches. *Reading Research Quarterly,*

44, 218-253.

McNamara, D. S. & Kintsch, W. (1996). Learning from texts: Effects of prior knowledge and text

coherence. *Discourse Processes, 22*, 247-288.

Meyer, B.J.F. & Wijekumar, K. (2007). A web-based tutoring system for the structure strategy:

Theoretical background, design, and findings. In D.S. McNamara (Ed.), *Reading*

comprehension strategies: Theories, interventions, and technologies (pp. 347–375). Mahwah,

NJ: Erlbaum.

Moje, E. B. (2008). Foregrounding the disciplines in secondary literacy teaching and learning: A

call for change. *Journal of Adolescent & Adult Literacy, 52*, 96-107.

Moje, E. B., Overby, M., Tysvaer, N. & Morris, K. (2008). The complex world of adolescent

literacy: Myths, motivations, and mysteries. *Harvard Educational Review, 78,* 107 –154.

Murphy, P. K., Wilkinson, I. A. G., Soter, A. O., Hennessey, M. N. & Alexander, J. F. (2009).

Examining the effects of classroom discussion on students' high-level comprehension of text: A

meta-analysis. *Journal of Educational Psychology, 101*, 740-764.

National Assessment of Educational Progress (2009). *NAEP 2008 Trends in Academic Progress*

(NCES 2009–479). Prepared by Rampey, B.D., Dion, G.S., & Donahue, P.L. for the National

Center for Education Statistics, Institute of Education Sciences, U.S. Department of Education, Washington, D.C.

National Center for Education Statistics (2013). *The Nation's Report Card: A First Look: 2013 Mathematics and Reading* (NCES 2014-451). Washington, DC: Institute for Education Sciences.

National Institute of Child Health and Human Development. (2000). *Report of the National Reading Panel. Teaching children to read: An evidence-based assessment of the scientific research literature on reading and its implications for reading instruction* (NIH Publication No. 00-4769). Washington, DC: U.S. Government Printing Office.

Nokes, J. D., Dole, J. A. & Hacker, D. (2007). Teaching high school students to use heuristics while reading historical texts. *Journal of Educational Psychology* 99, 492–504.

Nystrand, M. & Gamoran, A. (1991). Instructional discourse, student engagement, and literature achievement. *Research on the Teaching of English, 25*, 261-290.

Nystrand, M., Gamoran, A., Kachur, R., & Prendergast, C. (1997). *Opening dialogue: Understanding the dynamics of language and learning in the English classroom.* NY: Teachers College Press.

Olshavsky, J. E. (1976). Reading as problem solving: An investigation of strategies. *Reading Research Quarterly, 12,* 654-674.

Organization for Economic Co-operation and Development (OECD) (2006). *Assessing scientific, reading and mathematical literacy: A framework for PISA 2006.* Paris: OECD.

Organization of Economic and Cultural Development (2013). *PISA 2012: Results in focus.* Paris: OECD.

Palincsar, A.S. & Brown, A.L. (1984). Reciprocal teaching of comprehension- fostering and

monitoring activities. *Cognition and Instruction, 1,* 117-175.

O'Connor, C., Michaels, S. & Chapin, S. (in press). "Scaling down" to explore the role of talk in

learning: From district intervention to controlled classroom study. In Resnick, L.B., Asterhan,

C., & Clarke, S.N. *Socializing intelligence through talk and dialogue.* Washington DC:

American Educational Research Association.

Osborne, J., Erduran, S., & Simon, S. (2004). Enhancing the quality of argument in school science.

Journal of Research in Science Teaching, 41, 994-1020.

Pressley, M. (2002). Comprehension strategies instruction. In C. Collins Block & M. Pressley

(Eds.), *Comprehension instruction: Research based practices* (pp. 11-27). NY: Guilford.

Purcell, K., Buchanan, J., & Friedrich, L. (2013, July). *The impact of digital tools on student writing

and how writing is taught in schools.* Washington, D.C.: Pew Research Center.

http://www.pewinternet.org/2013/07/16/.

Rabinowitz, P. J. (1987). *Before reading: Narrative conventions and the politics of interpretation.*

Ithaca: Cornell University Press.

RAND Reading Study Group (Snow, C., Chair). (2002). *Reading for understanding, Toward an

R&D program in reading comprehension.* Santa Monica, CA: RAND.

Reisman, A. (2012). Reading like a historian: A document-based history curriculum intervention in

urban high schools. *Cognition & Instruction, 30*, 86-112.

Romance, N. R. & Vitale, M. R. (2001). Implementing an in-depth expanded science model in

elementary schools: Multi-year findings, research issues, and policy implications. *International

Journal of Science Education, 23,* 373–404.

Rosenblatt, L. (1978). *The reader, the text, the poem: The transactional theory of the literary work.* Carbondale, IL: Southern Illinois University Press.

Rouet, J. F. (2006). *The skills of document use: From text comprehension to web-based learning.* Mahwah, NJ: Erlbaum.

Rouet, J-F. & Britt, M.A. (2011). Relevance processes in multiple document comprehension. In M.T. McCrudden, J. P. Magliano, & G. Schraw (Eds.), *Relevance instructions and goal-focusing in text learning* (pp. 19 - 52). Greenwich, CT: Information Age Publishing.

Rouet, J. F., Britt, M. A., Mason, R. A. & Perfetti, C. A. (1996). Using multiple sources of evidence to reason about history. *Journal of Educational Psychology, 88*, 478-493.

Ryu, S. & Sandoval, W. A. (2012). Improvements to elementary children's epistemic understanding from sustained argumentation. *Science Education, 96,* 488-526.

Schoenbach, R., Greenleaf, C. L., & Murphy, L. (2012). *Reading for understanding: How Reading Apprenticeship improves disciplinary learning in secondary and college classrooms.* New York, NY: Jossey-Bass.

Scholes, R. (1985). *Textual power, literary theory and the teaching of English*. New Haven, CT: Yale University Press.

Seixas, P. (1994). Students' understanding of historical significance. *Theory and Research in Social Education, 22*, 281-304.

Shanahan, T. & Shanahan, C. (2008). Teaching disciplinary literacy to adolescents: Rethinking content-area literacy. *Harvard Educational Review, 78*, 40-59.

Smith, M. (1991). *Understanding unreliable narrators: Reading between the lines in the literature classroom*. Urbana, IL: National Council of Teachers of English.

Smith, M. W. & Hillocks, G. (1988). Sensible sequencing: Developing knowledge about literature text by text. *The English Journal*, *77*(6), 44-49.

Snow, C.E. (2010). Academic language and the challenge of reading for learning. *Science, 328*, 450-452.

Snow, C. E. & Biancarosa, G. (2004). *Reading next: A vision for action and research in middle and high school literacy.* A report to the Carnegie Corporation of New York. Washington, DC: Alliance for Excellent Education.

Snow, C., Lawrence, J. & White, C. (2009). Generating knowledge of academic language among urban middle school students. *Journal of Research on Educational Effectiveness*, 2, 325-344.

Snow, C.E. & Moje, E.M. (2010). What is adolescent literacy? Why is everyone talking about it now? *Phi Delta Kappan, 91,* 66-69.

Sosa, T., Hall, A, Goldman, S, R. & Lee, C. D. (in review). Developing symbolic interpretation through literary argumentation. *Journal of the Learning Sciences.*

Stadtler, M. & Bromme, R. (2007). Dealing with multiple documents on the WWW: The role of metacognition in the formation of documents models. *International Journal of Computer-Supported Collaborative Learning, 2*, 191-210.

VanSledright, B. A. (2002). Confronting history's interpretive paradox while teaching fifth graders to investigate the past. *American Educational Research Journal*, *39*, 1089-1115.

Vaughn, S., Swanson, E. A., Roberts, G., Wanzek, J., Stillman-Spisak, S. J., Solis, M., & Simmons, D. (2013). Improving reading comprehension and social studies knowledge in middle school. *Reading Research Quarterly, 48*, 77–93.

Wanzek, J., Vaughn, S., Scammacca, N. K., Metz, N., Murray, C. S., Roberts, G., & Danielson, L.

(2012). Extensive reading interventions for students with reading difficulties after grade 3.

Review of Educational Research, 83, 163-195.

Wineburg, S. (1991). Historical problem solving: A study of the cognitive processes used in the

evaluation of documentary and pictorial evidence. *Journal of Educational Psychology, 83*, 73-

87.

Wineburg, S. (2001). *Historical thinking and other unnatural acts: Charting the future of teaching

the past*. Philadelphia, PA: Temple University Press.

Wolfe, M. B. & Goldman, S. R. (2005). Relationships between adolescents' text processing and

reasoning. *Cognition & Instruction, 23,* 467-502.

---

[i] My power flurries through the air into the ground; My soul is spiraling in frozen fractals all around; And one thought crystallizes like an icy blast; I'm never going back, the past is in the past (Lopez & Lopez, 2013). http://www.metrolyrics.com/let-it-go-lyrics-idina-menzel.html