Goldman, S.R. (2012). Adolescent literacy: Learning and understanding content. Future of Children, 22(2), Literacy Challenges for the Twenty-First Century, 89-116.

Adolescent Literacy: Learning and Understanding Content

Susan R. Goldman

Summary

Learning to read—amazing as it is to small children and their parents—is one thing. Reading to learn, explains Susan Goldman of the University of Illinois at Chicago, is quite another. Are today's students able to use reading and writing to acquire knowledge, solve problems, and make decisions in academic, personal, and professional arenas? Do they have the literacy skills necessary to meet the demands of the twenty-first century? To answer these questions, Goldman describes the increasingly complex comprehension, reasoning skills, and knowledge that students need as they progress through school and surveys what researchers and educators know about how to teach those skills.

Successfully reading to learn requires the ability to analyze, synthesize, and evaluate information from multiple sources, Goldman writes. Effective readers must be able to apply different knowledge, reading, and reasoning processes to different types of content, from fiction to history and science, to news accounts and user manuals. They must assess sources of information for relevance, reliability, impartiality, and completeness. And they must connect information across multiple sources. In short, successful readers must not only use general reading skills but also pay close attention to discipline-specific processes.

Goldman reviews the evidence on three different instructional approaches to reading to learn: general comprehension strategies, classroom discussion, and disciplinary content instruction. She argues that building the literacy skills necessary for U.S. students to read comprehensively and critically and to learn content in a variety of disciplines should be a primary responsibility for all of the nation's teachers. But outside of English, few subject-area teachers are aware of the need to teach subject-area reading comprehension skills, nor have they had opportunities to learn them themselves. Building the capacity of all teachers to meet the literacy needs of today's students requires long-term investment and commitment from the education community as well as society as a whole.

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The nation's educational system is turning out readers who are ill-prepared for the literacy demands of the twenty-first century. The most recent National Assessment of Educational Progress report indicates that almost one-third of U.S. students do not achieve basic levels of reading competency by fourth grade.[1] Equally alarming, high school students' reading performance shows no improvement from 1971, with only 38 percent of high school seniors scoring at or above proficient.[2] Indeed, estimates are that 90 million U.S. adults lack adequate literacy, with many unable to take care of their health needs, let alone participate in the contemporary workforce.[3] And the literacy skills needed for the twenty-first century have themselves increased. To be literate today means being able to use reading and writing to acquire knowledge, solve problems, and make decisions in academic, personal, and professional arenas.

Twenty-first-century literacy poses four major challenges for students and their teachers. First, successful readers must learn how to move beyond what text says to what text means. Successful learning, problem solving, and decision making at school, at work, and in personal situations rely on analysis, synthesis, and evaluation of information from multiple sources of traditional text as well as expanded conceptions of text that include multimodal information sources.[4] Second, effective readers must be able to apply reading and interpretation skills differently depending on subject matter, using different knowledge, reading, and reasoning processes to interpret *Macbeth*, analyze the causes of the Vietnam War, or explain the advantages of compact fluorescent bulbs over incandescent ones.[5] Third, ongoing advances in information technology make it necessary for readers to be able to navigate vastly increased amounts of information, both traditional print-based texts and multimodal forms including complex visuals and animations.[6] Moreover, because the World Wide Web lacks traditional controls on the quality of that information, readers and users must know how to evaluate sites and sources for relevance, reliability, level of complexity, impartiality, and completeness.[7] Some argue that the web has introduced "new" literacies.[8] In fact, by spotlighting the centrality of inquiry and problem solving to twenty-first-century literacy, the web has raised the bar on what it means to be literate.[9] Fourth, to analyze, synthesize, and integrate disparate material, readers must be able to connect information across multiple sources and evaluate whether the different sources are consistent. Successful readers must adopt an active, critical, questioning stance while reading.[10] In so doing they not only use general reading skills but also pay close attention to discipline-specific content, reasoning, and knowledge-production processes.

As yet, only a meager body of research-based evidence speaks directly to the teaching and learning challenges posed by these literacy demands. Much of what researchers and educators know about successful reading comprehension comes from small-scale laboratory- or classroom-based research (ranging from one or two teachers to twenty or thirty for each instructional intervention) on comprehension instruction, including vocabulary development. Research related to disciplinary literacies and the use of online resources is just emerging. As might be expected for an emerging research area, more of this work is descriptive than experimental, but it is nevertheless instructive. In this article I focus on what is known about reading to learn content,

the core educational task from fourth grade through high school. I describe what reading to learn content entails, the kinds of knowledge and conceptual skills it requires, and three broad types of instructional approaches aimed at helping students acquire and gain proficiency at reading to learn. I also discuss what teachers need to know to support students in reading to learn.

Beyond Learning to Read

Jeanne Chall pointed out thirty years ago the sharp distinction between learning to read and reading to learn.[11] Learning to read involves mastering basic procedural reading skills that enable readers to recognize written words, pronounce them correctly, and read with reasonable fluency (see the articles in this issue by Nell Duke and Meghan Block and by Nonie Lesaux).[12] Reading to learn involves moving beyond these procedural reading skills to acquire information from text.[13] Chall emphasized that many students do not automatically make the transition from learning to read to reading to learn. Such students need specific instruction as they move through school to master more complex texts and new comprehension tasks. Until students reach fourth grade, teachers focus most of their effort on helping them learn to read. Thereafter, if students are to understand how to read to learn history, math, science, and literature, much of reading instruction must take place in content-area classes.

That the different disciplines have differentiated literacy practices has been recognized explicitly by the Common Core State Standards for English Language Arts and Literacy in History/Social Studies, Science, and Technical Subjects, developed in 2010 by the Council of Chief State School Officers and the National Governors Association and adopted voluntarily by nearly all the states.[14] The reading and writing standards, specifically Standards 7, 8, and 9 for each of these disciplines, include integration of knowledge and ideas from multiple texts, along with considerations of the quality of the claims and evidence in them. Table 1 provides descriptions of Standards 7, 8, and 9 for the Common Core standards at each of three grade bands. Two aspects of these descriptors are especially notable. First, within a content area, the complexity of the task increases. For example, in literature, seventh graders compare and contrast a literary piece in its traditional print form with an audio or video version; in grades nine and ten, students analyze the impact of the medium on interpretation; finally in grades eleven and twelve, students analyze multiple interpretations of the same work across several media forms. Second, the descriptions of the standards differ depending on whether the content area is literature, history and social studies, or science and technical subjects. For example, Standard 8—evaluate the argument in a text—is not applicable to literature; in history and science the descriptors are similar until grades eleven and twelve. For Standard 9, the descriptors reflect the differences in the nature of reasoning and evidence across the disciplines. Furthermore, although the table does not show this point, students are expected to apply these skills to texts of increasing complexity and more varied genres as they progress from grade four through grade twelve (Standard 10).

Impressive though they are in raising the literacy bar, the standards will not by themselves change the practices of content-area teachers, whose teacher preparation has, for the most part, focused on content rather than on the literacy practices of the content area. At the same time, many adolescents have not adequately mastered the procedural literacy

Table 1. Standards 7, 8, and 9 from the Common Core State Standards for English Language Arts and Literacy in History/Social Studies, Science, and Technical Subjects

Reading standards for literature	Reading standards for literacy in history and social studies	Reading standards for literacy in science and technical subjects
Standard 7: Integrate and evaluate content presented in diverse formats and media, including visually and quantitatively, as well as in words.		
Grade 7*: Compare and contrast a written story, drama, or poem to its audio, filmed, staged, or multimedia version, analyzing the effects of techniques unique to each medium (for example, lighting, sound, color, or camera focus and angles in a film).	Grades 6–8: Integrate visual information (for example, in charts, graphs, photographs, videos, or maps) with other information in print and digital texts.	Grades 6–8: Integrate quantitative or technical information expressed in words in a text with a version of that information expressed visually (for example, in flowchart, diagram, model, graph, or table).
Grades 9–10: Analyze the representation of a subject or a key scene in two different artistic mediums, including what is emphasized or absent in each treatment (for example, Auden's "Musée des Beaux Arts" and Bruegel's *Landscape with the Fall of Icarus*).	Grades 9–10: Integrate quantitative or technical analysis (for example, charts, research data) with qualitative analysis in print or digital text.	Grades 9–10: Translate quantitative or technical information expressed in words in a text into visual form (for example, a table or chart) and translate information expressed visually or mathematically (for example, in an equation) into words.
Grades 11–12: Analyze multiple interpretations of a story, drama, or poem (for example, recorded or live production of a play or recorded novel or poetry), evaluating how each version interprets the source text. (Include at least one play by Shakespeare and one play by an American dramatist.)	Grades 11–12: Integrate and evaluate multiple sources of information presented in diverse formats and media (for example, visually, quantitatively, as well as in words) in order to address a question or solve a problem.	Grades 11–12: Integrate and evaluate multiple sources of information presented in diverse formats and media (for example, quantitative data, video, multimedia) in order to address a question or solve a problem.
Standard 8: Delineate and evaluate the argument and specific claims in a text, including the validity of the reasoning as well as the relevance and sufficiency of the evidence.		
Grades 6–8: Not applicable to literature	Grades 6–8: Distinguish among fact, opinion and reasoned judgment in a text.	Grades 6–8: Distinguish among facts, reasoned judgment based on research findings, and speculation in a text.
Grades 9–10: Not applicable to literature	Grade 9–10: Assess the extent to which the reasoning and evidence in a text support the author's claims.	Grade 9–10: Assess the extent to which the reasoning and evidence in a text support the author's claims or a recommendation for solving a scientific or technical problem.
Grades 11–12: Not applicable to literature	Grade 11–12: Evaluate an author's premises, claims, and evidence by corroborating or challenging them with other information.	Grades 11–12: Evaluate the hypotheses, data, analysis, and conclusions in a science or technical text, verifying the data when possible and corroborating or challenging conclusions with other sources of information.
Standard 9: Analyze how two or more texts address similar themes or topics in order to build knowledge or to compare the approaches the authors take.		
Grade 7: Compare and contrast a fictional portrayal of a time, place, or character and a historical account of the same period as a means of understanding how authors of fiction use or alter history.	Grade 6–8: Analyze the relationship between a primary and a secondary source on the same topic.	Grades 6–8: Compare and contrast the information gained from experiments, simulations, video, or multimedia sources with that gained from reading a text on the same topic.
Grades 9–10: Analyze how an author draws on and transforms source material in a specific work (for example, how Shakespeare treats a theme or topic from Ovid or the Bible or how a later author draws on a play by Shakespeare).	Grades 9–10: Compare and contrast treatments of the same topic in several primary and secondary sources.	Grades 9–10: Compare and contrast findings presented in a text to those from other sources (including their own experiments), noting when the findings support or contradict previous explanations or accounts.
Grades 11–12: Demonstrate knowledge of 18th-, 19th-, and early 20th-century foundational works of American literature, including how two or more texts from the same period treat similar themes or topics.	Grades 11–12: Integrate information from diverse sources, both primary and secondary, into a coherent understanding of an idea or event, noting discrepancies among sources.	Grades 11–12: Synthesize information from a range of sources (for example, texts, experiments, simulations into a coherent understanding of a process, phenomenon, or concept, resolving conflicting information when possible.

Source: Council of Chief State School Officers. "The Common Core Standards for English Language Arts and Literacy in History/Social Studies and Science and Technical Subjects" (2010) (www.corestandards.org), pp. 36–38; 61–62.
*Literature Standard 7 is separately described for each of grades 6, 7, and 8. I reproduced grade 7 here.

skills of the early grades, and even those who have mastered them are often ill-equipped to confront the comprehension challenges of content-area texts.[15] Middle grades and high school teachers' primary responsibility has been to teach the content, de-emphasizing the literacy practices central to comprehending the content and thereby increasing the struggles of students who may not have learned to read adequately in the lower grades.[16] The tension inherent in this situation is exacerbated by the meager resources (curricular supports or assessments) available to guide content-area teachers with what should be their dual emphasis—teaching disciplinary content and disciplinary literacy.

Because U.S. adolescents have few opportunities to be taught advanced reading comprehension, their lack of progress on national assessments should not be surprising.[17] Nevertheless, some students do successfully read to learn. In the next section I briefly review research characterizing the reading skills of successful students in order to identify the conceptual skills and knowledge that all readers need.

Successful Comprehension and Reading to Learn

Much research on comprehension has focused on students who are reading to learn from single texts.[18] The research identifies five characteristics of successful readers; all five involve active engagement. First, those who are successfully reading to learn monitor their comprehension and use a range of strategies when they realize they do not understand what they are reading.[19] Second, successful readers are able to explain concepts in the text and relate different concepts within a text to each other and to relevant knowledge they have already acquired.[20] Third, they often generate self-explanations during reading,[21] ask questions that probe the connections among parts of the text, or seek explanations.[22] Fourth, they use cues to the logical organization of a text to guide their comprehension.[23] And, finally, they rely on multiple types of knowledge (for example, knowledge of words, concepts, sentence structures, text structures, genres) as they try to interpret print. By contrast, students who are weak at comprehension tend to restate or paraphrase texts, substituting synonyms or reordering the words, rather than explaining. Any connections these readers make or questions they ask tend to be superficial.[24]

Researchers have learned about successful multiple-source comprehension from investigating how specialists read in specific academic disciplines. 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.[25] In history and science, experts routinely engage in selection, analysis, and synthesis within and across multiple sources of evidence, yet they enact these processes differently.[26] Chemists, for example, spend a lot of time mapping back and forth across different representations of the same information, for example, structural notations like H_2O, molecular models, words, and equations. Historians, by contrast, first look at and consider when, why, and by whom a text was created.[27] Interestingly, specialists reading outside their field of expertise do not display the same complex processing strategies they use within their field of expertise,[28] demonstrating the important role that content knowledge plays in guiding reading behavior.[29]

Not surprisingly, adolescent students rarely engage in the disciplinary processing strategies used by experts.[30] For most high school students—excepting only the few who enroll in Advanced Placement (AP) courses in history—participating in a research study may be the first time they are asked to read more than one source to address a question. In some high schools, students write "term papers" that require them to read multiple sources, but too often the results are annotated bibliographies rather than syntheses across the sources.

Promising Instructional Approaches to Comprehension

Researchers have developed a variety of promising instructional approaches to reading to learn and have subjected them to empirical evaluation, mostly with small samples of teachers and classrooms (fewer than twenty per comparison). In some cases, the positive effects observed in these studies have been replicated across several other small-scale studies, increasing confidence in the impact of the approach. Only a few of these approaches have yielded experimental evidence of effectiveness, however.[31] One reason for the paucity of evidence is that effective reading-to-learn instruction has many moving parts: teaching several different instructional strategies; teaching how to use those strategies flexibly depending on task, text, and learning goals; ensuring engagement; and introducing opportunities for interacting with peers and teachers about the text.[32]

In the following sections I review research on three different approaches to teaching comprehension. The first is strategy-based instruction of single or multiple strategies. The second is discussion-based instruction. The third is disciplinary content-based instruction. In reality, all three approaches are likely to be needed in a successful reading-to-learn instructional program.

Strategy-Based Instruction

By far the most common approach to teaching comprehension is to focus explicitly on teaching strategies to aid comprehension. The strategy-based approach has had positive effects in experimental studies and was the only approach sanctioned in the report issued by the National Reading Panel, a group of experts in reading that was convened by the National Institutes of Health.[33]

The bulk of research on strategy-based instruction has focused on text-processing strategies and on making students more aware of the text per se, including vocabulary, cues to logical organization (for example, paragraphing, connector words such as *therefore, because, as a result*), as well as their own monitoring of points in need of clarification, and questions about the text. Initially strategy-based training focused on teaching individual strategies, but research revealed that the effects of single-strategy training tended to be limited to the particular strategy itself with little impact on reading comprehension more generally.[34] That discovery contributed to a shift toward interventions that focused on multiple strategies and their coordination. One of the earliest multiple-strategy interventions, Reciprocal Teaching, teaches four strategies for processing text, both narrative and expository: clarification, questioning, summarization, and predicting.[35] Reciprocal Teaching is a small-group intervention designed to be managed by students after it is introduced through teacher modeling. Students monitor their reading to make sure they understand the meaning of the text (clarification), ask any questions they have about the content, summarize the content, and predict what will be next in

the text. In an extensive review of research on the effectiveness of Reciprocal Teaching with elementary and middle school students, Barak Rosenshine and Carla Meister concluded that the intervention had positive and robust effects on reading comprehension performance on standardized tests.[36] Another multiple-strategy intervention, Students Achieving Independent Learning (SAIL), has also been found effective.[37] SAIL focuses on the coordinated use of strategies that are characteristic of successful readers and includes many of the same strategies used in Reciprocal Teaching. It adds an emphasis on understanding when and why particular strategies are useful.

Summarization, one of the strategies in Reciprocal Teaching and SAIL, actually involves using multiple strategies, especially when applied to lengthy texts and text sets. A good summary demonstrates understanding of the gist or main ideas of the text, selects only content that is important and relevant to the purpose or task for which the reading is being done, and is sufficiently detailed to preserve the flow of ideas. The challenge for readers with limited knowledge of the content of the text is that everything is unfamiliar and seems important, making it difficult to selectively include information in the summary. Summary Street is a web-based intervention that targets students' summarization skills by providing guided practice in writing summaries for passages.[38] Summary Street gives students feedback on the content of their summaries and asks them to decide how to adjust the summaries. The feedback uses a back-end computational process that determines similarity between the student's summary and the text being summarized. The heuristics used to evaluate the written summaries favor those that use the reader's own words, contain few redundancies, include the important main ideas, and are appropriate in length.[39] The feedback provides suggestions for improving the summary (for example, include more from paragraph two, less from paragraph one). Students then decide how to improve their summaries, resubmit them, and receive feedback on the new summary. Revision continues until the summary reaches predetermined coverage and length constraints. Summary Street's feedback practices are consistent with those recommended by studies of tutors and tutoring, which suggest that feedback is most useful when it gives the user some responsibility for determining what to do next.[40]

A group of researchers including Donna Caccamise, Walter and Eileen Kintsch, and colleagues tested Summary Street with sixth- through ninth-grade students from a variety of socioeconomic backgrounds across the state of Colorado. They found that students' summaries of history and science texts showed significant improvement in content coverage (more relevance, less redundancy, more parts of the text included) compared with summaries written by students who did not use the program, with the size of the effect varying depending on how frequently students used the intervention.[41]

Structure Strategy Training, another multiple-strategy approach, teaches readers how to use paragraphing and signaling cues, such as *In summary, First, Finally, On the other hand*, and *The problem is*, to figure out the overall organization of the information they are reading (for example, whether the text is presenting a problem and solution or is comparing and contrasting ideas). Interventions designed to guide the attention of elementary school students to these features of text improved their reading comprehension performance.[42] Using a technology-based

tutor, Bonnie Meyer and several colleagues were able to adapt future lessons for students based on their performance on past lessons; the adaptive version improved reading comprehension performance on a standardized reading comprehension test more than a nonadaptive version.[43]

Laboratory-based studies have found that successful readers engage in explanation-based processing while those who are less successful tend to process on a superficial level, with a predominance of paraphrases and less developed explanations.[44] Based on these findings, Danielle McNamara and several colleagues developed an intervention, Self-Explanation Reading Training (SERT), to help students improve comprehension. SERT teaches students to engage in five different strategies, each targeting a critical aspect of the comprehension process.[45] The first strategy, paraphrasing, involves understanding the basic structure and meaning of the words and sentences in the text—what the text says. The second, putting it into one's own words, makes the content more familiar. The third, elaborating and predicting, asks readers to make inferences that connect what the text says to what they already know or expect based on common sense and general reasoning heuristics. The fourth, bridging, engages readers in understanding how different concepts and ideas in the text fit together. It also helps readers achieve more sentence-to-sentence connections as well as a more coherent understanding of the overall text. Finally, comprehension monitoring orients readers to thinking about what they do and do not understand and to using the other strategies to repair problems they detect. SERT uses explicit, direct instruction to tell students the purpose and function of the different kinds of processing strategies. In tests with high school students reading science texts, SERT training produced promising results.[46] The intervention has now been extended into a computer-based automated intelligent tutoring system, iSTART (Interactive Strategy Trainer for Active Reading and Thinking) and is undergoing testing (see the article in this issue by Gina Biancarosa and Gina Griffiths for more information).[47]

Strategy-Based Instruction: Lessons Learned and Limitations

The research evidence on strategy training supports three conclusions. First, effective strategy-based instruction involves teaching multiple strategies and ways to coordinate them. Some strategies involve explicit attention to features of texts as cues to important content and its organization. Other strategies connect pieces of information within the text. Yet other strategies build connections to readers' pre-existing content knowledge and expectations regarding additional content. Second, coordinating multiple strategies requires students to assess their successes and failures using particular strategies, whether they have achieved sufficient understanding, and what to do if they have not. Third, explicit teaching of strategies and their coordinated use is necessary for most students, especially when they are reading to learn. Students need opportunities to practice explicitly taught strategies and get feedback on their performance. Gradually, as students acquire greater skill in using and coordinating strategies, externally provided feedback becomes less necessary.

However, strategy-based instruction has clear limitations in meeting the many complex challenges in teaching reading comprehension in content areas. For one, coordinating multiple strategies is hard work. It requires that students engage with the texts, often for

sustained periods of time and multiple readings—something that many students either do not do at all or do only in cursory ways. A second challenge relates to the knowledge, or lack of knowledge, that readers bring to texts. Strategy-based comprehension instruction in grades four through twelve typically takes place in English language arts and is applied to fictional narratives. Even young readers typically have a rich supply of knowledge about many of the events and motivations that are central to fiction. They can benefit from strategies that use guided comprehension questions such as: Who are the characters? What is the setting? What happened first? What happened next? Why was she sad/mad/happy?[48]

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Questions like these, however, do not apply to informational texts in science or social studies (nor, in fact, to all literary genres). Alternative comprehension strategies that are more generic in nature (find the main idea, identify the topic sentence, summarize, learn the words in boldface type) are often introduced for such texts.[49] These strategies can be helpful in reading textbooks because textbooks often follow conventions that match these generic strategies. For example, key vocabulary items are presented in boldface type; section headers mark new topics; and the first sentence under the header is often a good summary of the section. Generic strategies are difficult to apply, however, to the authentic texts educators hope students are reading—newspaper articles, historical documents, research reports, editorials. These texts vary in the way information is organized and in the conventions used to signal more and less important information, and school-aged readers are not routinely taught how to process that information.[50] Lacking these organizational cues to importance, students do not have the tools they need to be able to evaluate whether their summary of an authentic text captures the important ideas. Generic comprehension strategies are particularly limited in helping students read the multiple text forms of variable credibility they encounter on the web.

Comprehension instruction that focuses only on generic reading strategies also falls short because comprehension itself becomes more complex and expansive as students mature and progress from grade to grade. Whereas fourth graders might be asked only to summarize or to define a new word after reading a science text, eighth graders and high school students are likely to 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.[51] Furthermore, eighth graders are implicitly expected to engage in different comprehension practices when reading literature, math, science, and social studies—often without explicit instruction in these disciplinary practices.[52] For example, the role of the unexpected is quite different in literature, history, and science. In literature when unexpected events occur, they are often the point or message of the story, as in Aesop's fable *The Lion and the Mouse*.[53] History, by contrast, is sometimes compared

with a jigsaw puzzle with pieces missing. When new "pieces" come to light, they may not fit in expected ways. The poor fit occasions close reading and re-examination of the texts using historical reasoning strategies (who produced the piece? when? for what purpose?).[54] In science, when experiments or observations run counter to expectations, new experiments are conducted to replicate the findings. The result may be new models and explanatory accounts; sometimes, the unexpected results are discredited.

Furthermore, curricula in later grades assume that students have been acquiring content-area knowledge through reading, as well as other means, in the earlier grades. As students progress through school, the reading challenges become greater as the gap widens between the conceptual skills and knowledge students are assumed to bring to reading to learn and what most students actually bring to reading-to-learn tasks. As a result, some students may disengage from reading, learning, and school. To teachers in later grades, it often appears that past teachers simply failed to teach students what they needed to know. In fact, teachers in earlier grades may well have taught strategies such as summarization, but not in ways that enable students to use them in other contexts and for other types of content learning.

Discussion-Based Instruction: Building Content Knowledge and Literacy Practices

The second form of reading-to-learn instruction is based on student discussion. A recent meta-analysis examined nine discussion-based interventions aimed at improving student comprehension and learning from text.[55] The interventions focused on varied types of text (narratives, history, science) but all shared a dialogic orientation—that is, all used discussion to explore ideas and develop understanding.[56] The nine interventions are Book Club,[57] Collaborative Reasoning,[58] Instructional Conversation,[59] Grand Conversation,[60] Junior Great Books,[61] Literature Circles,[62] Paideia Seminar,[63] Philosophy for Children,[64] and Questioning the Author.[65]

The meta-analysis found, not surprisingly, that most of the interventions increased student talk and decreased teacher talk. Although many "were highly effective at promoting students' literal and inferential comprehension," relatively few were equally so "at promoting students' critical thinking, reasoning, and argumentation about and around text."[66] Effects were generally stronger in the smaller-scale, nonexperimental interventions, perhaps reflecting the difficulty of establishing good classroom discussion at larger scale. The meta-analysis was limited in several ways. Some of the instructional approaches had been evaluated in only one study, and for them it was not possible to look for effects on content knowledge. What the dialogic orientation did accomplish was to involve students more actively in articulating meaning in and around text and to enhance basic comprehension of the meaning of the text and inferences based on the text.

Classroom discussion is a key feature of another approach to teaching literature that was developed and tested by Judith Langer, Arthur Applebee, and colleagues with a relatively large sample (approximately eighty schools) of low- and high-achieving middle and high school students in English language arts classes. Langer and colleagues found that dialogic classroom discussion was significantly related to performance on tasks requiring students to adopt interpretive stances in literature.[67] They stressed that

discussion moves students from looking for "the point" of a story to "exploring the possible" through complex and challenging literary works.[68] Engaging adolescent students in these conversations requires that teachers set up classroom norms that 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 "stances" toward text: initial understanding (for example, what images catch your attention as you read?), developing ideas and multiple perspectives (what are you noticing about the ideas?), learning from the text (what does this story help you understand about the character's culture?), taking a critical stance (what are you noticing about the style of the text?), and going beyond (write your own story in the style of this one).

Cultural Modeling, an approach complementary to Langer's, was developed by Carol Lee.[69] Its goal is to make students explicitly aware of how they are processing text. Cultural Modeling posits that many of the literary devices that students need to know to engage critically with literature are already part of their everyday repertoire. Students use satire, irony, symbolism, and other rhetorical devices all the time—but need to see how these same techniques are used by writers and thus how they are key to interpreting literature. If symbolism is central to a particular text, the designer or teacher would present a more familiar form—song lyrics, logos, advertisements—whose symbolism students already understand and have the students discuss both what the symbol means and *how they know* that it is a symbol and what it means. Consider several stanzas of a popular song by Katy Perry, "Firework."[70]

Do you ever feel like a plastic bag
Drifting through the wind, wanting to start again?
Do you ever feel, feel so paper thin
Like a house of cards, one blow from caving in?
Do you ever feel already buried deep?
Six feet under screams, but no one seems to hear a thing
Do you know that there's still a chance for you
'Cause there's a spark in you?
You just gotta ignite the light and let it shine
Just own the night like the 4th of July
'Cause baby, you're a firework
Come on, show 'em what you're worth
Make 'em go, oh, oh, oh
As you shoot across the sky.

The teacher might ask students what they make of the song and specifically what they think is the meaning of "you're a firework." Undoubtedly recognizing that Perry does not literally mean that a person is a firecracker, students would provide a range of symbolic interpretations. Discussing the song enables them to give voice to the reasoning behind their interpretations, and making their reasoning explicit allows them to apply the same thinking as they approach canonical texts. The work is enacted through classroom discussion that is initially led by teachers and then taken over by students.[71]

Students in mathematics and science classes have also experienced discussion-oriented interventions. Catherine O'Connor and her colleagues examined the impact of introducing a conceptually based mathematics program paired with the dialogic discourse that Langer and Lee used in their interventions. Discussion prompts were appropriate to mathematics thinking and to the upper elementary and middle school (grades four through seven) participants.[72] For example,

teachers encouraged students to provide multiple answers to a problem, to explain how they got the answer, and why their method worked. If different students arrived at the same answers using different methods, teachers asked why both methods worked. If students arrived at different answers, teachers asked which answers were most reasonable in terms of the mathematics. Teachers deepened the mathematics of conversations by revoicing students' contributions introducing math-appropriate language (for example, revoicing "I added four and four and four and four and four" as "So you multiplied four times five by adding four five times."). Over the course of instruction, students gradually took up these forms of mathematical reasoning. Such classroom talk—dubbed "accountable talk"—stresses that students are accountable to the subject matter and to their classmates for their thinking.[73] O'Connor and her colleagues found that students participating in accountable talk scored higher on standardized achievement tests of reading as well as math than students who did not engage in classroom discussions.[74]

Similar classroom talk has found its way into science instruction in elementary and middle school classrooms. Science-specific discourse norms emphasize practices of science argumentation: recording, measuring, and repeating trials of data collection; noticing patterns in data; reasoning about data; accepting disagreements about claims but backing up claims with data-based evidence; basing disagreements on data, not on personal opinion; accepting that the validity of an answer depends on the evidence used to support it.[75] Discussion-based science instruction also uses different forms of data representation, especially in middle school, as well as aids for representing arguments and clearly indicating claims, data, and the reasoning that connects data to claims (that is, why *that* data set is evidence for *that* claim). Once these norms and routines are established, student-generated scientific argumentation advances noticeably.[76]

At the high school level, classroom discussion plays a key role in the Reading Apprenticeship program that integrates biology and literacy.[77] Students learn to annotate text (for example, by underlining key words or writing the main idea in the margin) and then to talk to each other about the text using their annotations. By making their thinking visible in the annotations, they share not only their interpretations but also the processes by which they come to these interpretations. Putting into words both interpretations and interpretive processes contributes to students' awareness of the strategies they are using and the characteristics of texts to which they are responding.

Efficacy data on discussion-based instruction are scant and difficult to obtain. Researchers and educators do not yet fully understand how classroom discussion relates to other features of effective classrooms—choice of texts and tasks, instruction in flexible use of multiple strategies, engagement, and a classroom ethos that makes students feel safe posing questions and making thinking visible. Teachers' skills in organizing and facilitating discussions are almost surely an important determinant of the efficacy of student discussion. Less clear is the "minimum" level of skilled facilitation needed for productive student discussion.

Disciplinary Content-Based Instruction

To many students today, school tasks and experiences too often seem purposeless. History and science are lists of facts to be memorized, static bodies of information that

have little bearing on the present and that are encapsulated in thick textbooks with questions at the end of each chapter.

Disciplinary content instruction—the third approach to teaching comprehension—counters such student disengagement by involving adolescents in authentic literacy and disciplinary practices. Disciplinary content instruction embeds reading to learn in a "need to know" setting, where learning is authentic and directed toward solving some problem or answering some question in a content area that students are actively addressing. Reading becomes a tool for knowing. Disciplinary content instruction engages students in problems and questions typical of a particular academic discipline and in the literacy practices through which the work of the discipline is conducted and communicated.

Scientists, for example, record their data; look for patterns in the data; compare previous explanations, methods, and findings with new findings (their own and others'); and leave records of their work for other scientists to consult. Historians examine accounts of the past on the basis of when, why, by whom, and for what purpose an account was created and where different accounts agree. For them, discrepancies between accounts of the past are the "stuff" of historical argument. Literary critics engage with literary works by exploring moral and philosophical themes and dilemmas and by examining how various literary devices and forms (irony, symbolism, or short story, for example) enable an author to transcend the literal story world. Often students read simply to find out how problems are resolved; in a more interpretive mode, they may gain insight into their own behaviors and beliefs through the literary world.

Interventions designed to emphasize disciplinary content instruction and the literacy practices associated with the disciplines are beginning to demonstrate positive results. The principles guiding the design of these interventions are derived from lessons learned from strategy-based and classroom discussion-based work as well as from small-scale classroom-based research studies. These latter studies indicate that well-designed multiple-source, content-specific inquiry instruction does indeed provide students with opportunities to learn the expanded set of literacies they need in the twenty-first century. Disciplinary content instruction exposes students to processes akin to practices in which disciplinary experts engage in "doing" their own work; it also helps students link content with communication.[78] Evidence from empirical studies indicates a variety of positive effects on adolescents.

For example, when adolescent students construct historical narratives from information found in multiple documents, they learn to think more critically about what they read and engage more deeply with the text sources.[79] When elementary students engage with science content, their skills using data as evidence and making sense of multiple representations improve.[80] And when students twelve to fifteen years of age learn to create structured claim-plus-evidence arguments from multiple sources of scientific information, they improve their reasoning and science content knowledge.[81] In literature, when adolescents are made aware of interpretive processes they already use to understand texts from their everyday worlds such as rap songs and are shown how they are relevant to particular literary problems, many become more successful at interpreting complex literary works.[82]

Figure 1. Sample Item from Advanced Placement Biology Assessment

1. Plants lose water from their aboveground surfaces in the process of transpiration. Most of this water is lost from stomata, microscopic openings in the leaves. Excess water loss can have a negative effect on the growth, development, and reproduction of a plant. Severe water loss can be fatal. Environmental factors have a major impact on the rate of plant transpiration.

(a) Using the data at right and the axes provided, **draw** a graph showing the effect of temperature change on the rate of transpiration. **Explain** the shape of the curve from 23 degrees to 28 degrees.

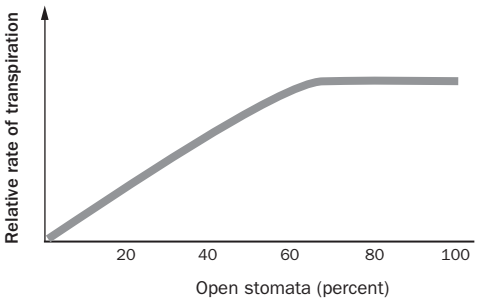
(b) Humidity is an environmental factor that affects transpiration rate. Using the axes provided, **draw** a curve that illustrates what you predict would be the rate of transpiration with increasing humidity and constant temperature. **Justify** the shape of the curve based on your prediction.

(c) The curve at right illustrates the rate of transpiration related to the percent of open stomata on the leaf of a particular plant. **Explain** why the curve levels off with increasing percentage of open stomata per area of leaf.

Transpiration Rate Versus Temperature

Temperature (°C)	20	23	27	28
Transpiration rate (mmol/m² @ sec)	1.5	3	5	4.5

Open Stomata Versus Rate of Transpiration



Source: College Board, AP Biology Course and Exam Description, Effective Fall 2012 (New York: The College Board, 2012).

One important cautionary note regarding disciplinary content-based instruction is that students attempt to use their pre-existing knowledge when interpreting the content-area material. For example, they may interpret the motives of historical figures in terms of motives with which they are familiar. Linda Levstick and Keith Barton recommend using this strategy to transition third and fourth graders into the study of history.[83] Not surprisingly such reasoning can sometimes lead to misconceptions or causal misattributions. For example, Bruce VanSledright recounts an episode from a fifth-grade classroom: students were asked to explain the disappearance of the Roanoke colony. They reasoned that the colonists starved and, further, that they starved because the governor ate all their food. VanSledright speculated that their interpretation was based on a Disney cartoon depiction of a colonial pioneer settlement run by a very obese governor.[84]

Just as experts in specific disciplines use different literacy practices when they read in their areas of specialization, instructional programs teach students to "read like a scientist" or to "read like a historian" by cultivating different literacy practices.

Reading Like a Scientist. One distinguishing feature of science practice is the use of representations and models to analyze situations and solve problems involving biological, chemical, and physical systems. Science literacy requires being able to translate among different representational forms to understand, reason about, and express key relationships among quantified variables. An item from the forthcoming College Board Advanced Placement (AP) test in biology illustrates these science literacy practices (figure 1).[85] It begins with a brief paragraph conveying several general principles related to how plants lose water, then provides a simple table that particularizes the relationship using temperature (an environmental factor) and water loss expressed as transpiration rate. For a student who does not already know the content in question, the paragraph provides the

basic information about the underlying causal mechanism of water loss. The three questions that follow ask the student to convert the data in the table into a graph; to predict and graph the impact of a second variable on the transpiration rate; and to interpret and explain the relationship of a third variable to the transpiration rate. Successful performance on this item would reflect proficiency at several reasoning practices of science, most importantly analyzing information in multiple forms of text, zeroing in on or selecting the most relevant information for each question, and synthesizing the information to generate predictions and explanations and support them with evidence.

Of many interventions using disciplinary content instruction in science, five stand out: Scientist's Notebook;[86] In-Depth Expanded Applications of Science (IDEAS);[87] Concept-Oriented Reading Instruction (CORI);[88] Seeds of Science/Roots of Reading;[89] and Reading Apprenticeship in Biology.[90] The first four target elementary and middle school students while the fifth focuses on high school students. Empirical studies, in some cases randomized field trials, have established the efficacy of each for improving science content and practices as well as comprehension of science text.[91]

The five programs share a common set of features, which vary as appropriate for the age and grade of the students. Learning objectives are framed in terms of underlying models of the science constructs, causal relationships, and mechanisms that explain the scientific phenomenon in question, like the water loss example from the AP test. Students work with data in multiple representations. A starting point for a science unit is frequently a process for eliciting students' conceptions of the phenomenon or their predictions regarding "what would happen if…" questions. Students use data they collect themselves or find through close reading of text to prove or disprove their predictions. The programs vary in the emphasis they place on explicit instruction in strategies for reading science information. Close reading of texts also supports inquiry by describing mechanisms and processes that are not "visible." Students communicate their thinking in writing and in whole class and small group oral discussions, often collaborating as they interpret data in light of the patterns they find and information they read. Finally, students reflect on how and why their ideas have changed over the course of their investigations.

Reading Like a Historian. Engaged reading is at the core of history as a discipline. Indeed, a mainstay of the AP test in history is the document-based question, a free-response essay task that asks students to use the documents that the test provides for them, together with the history they have already learned, to analyze or explain a historical event or policy. A sample item from the College Board's website is illustrative.

> **Directions:** The following question requires you to construct a coherent essay that integrates your interpretation of Documents A-I and your knowledge of the period referred to in the question. High scores will be earned only by essays that both cite key pieces of evidence from the documents and draw on outside knowledge of the period.
>
> 1. Analyze the international and domestic challenges the United States faced between 1968 and 1974, and evaluate how President Richard Nixon's administration responded to them.[92]

The item provides eight documents, which include excerpts from Nixon's speeches and

inaugural addresses, a political cartoon, a graph of the consumer price index from 1968 to 1975, correspondence between Nixon and Ho Chi Minh, an excerpt from a journalist, and an excerpt from a statement made by a Nixon strategist. Each document includes source information such as the author, date, and place of publication. Essays that rank at the top of the scoring scale (as listed on the College Board website) must include a clear thesis that is developed through analysis and evaluation of the documents in conjunction with "substantial and relevant outside information" about domestic and international challenges. Students must organize the outside information to make a clear and compelling case for the thesis, using such history reasoning strategies as sourcing, corroboration, and contextualization, and the close reading of documents that these entail.

Even students who have taken AP history courses struggle with the AP exam's requirement that they integrate historical facts into explanations or arguments that can support a thesis.[93] The AP class requires a dramatic adjustment in most students' view of history —from seeing it as a body of known facts to seeing it as an inquiry into the past whose trail of evidence is often incomplete. Such a "revisioning" requires an equally dramatic change in the teaching of history—from a litany of "who, what, where, when" to a process of piecing together the historical record to create evidence-based interpretive arguments.

Instruction that enables students to take such a dramatically different view of history stresses multiple perspectives on a historical event, as reflected in documents written at different times relative to the event (primary, secondary, and tertiary documents) and by individuals with different perspectives on the event.[94] Close reading of documents begins with analysis of their sources and the context in which they were created and proceeds to ask whether and what information is consistent or inconsistent across multiple documents. Teacher prompts focus students on the aims and evidence used by a document author, on the words and phrases that lead students to accept the author's account, and on information left out of a particular account.[95] Characteristics of source and context are critical in understanding the consistencies and inconsistencies across multiple documents. Teachers typically provide various ways for students to keep track of the sources of claims and evidence, along with their evaluations of that evidence. Collaborative conversations both in whole class and small groups enable students to challenge each other's thinking, an experience that often brings to light a tendency toward "presentism"—the imposition of current norms and values on the actions and beliefs of actors from the past. To counter that tendency, instructional programs commonly emphasize the place of the documents, events, and actors in the economic, cultural, technological, and political circumstances at the time of the event in question. These programs also juxtapose documents with conflicting information and have students explore ways to reconcile the accounts, thus helping to move students away from thinking that "everyone is entitled to their own opinion" and toward being able to evaluate alternative accounts of historical events.[96]

Disciplinary Content-Based Instruction: Lessons Learned

The descriptive and small-scale studies of promising approaches for building content-based literacy skills share several design features adapted to specific content areas: classroom discussion with specific

instructional routines for fostering disciplinary thinking; inquiry-oriented tasks and texts that enable students to answer questions using discipline-specific practices; and tools that support students' reading, writing, and sense-making activities.

Classroom discussion serves several functions, including introducing content in the younger grades to help establish the knowledge base that will be necessary once students have sufficient procedural literacy skills. Discussion provides a vehicle for externalizing the habits of mind—thinking and reasoning processes—characteristic of specific disciplines, as well as the academic language associated with them. Teachers can use particular "language frames" that facilitate conjecturing, engaging in "what would happen if" thinking, elaborating and seeking deeper explanations, proposing claims, offering evidence for claims, and contesting the claims of others. When student thinking is externalized, it can become the object of thought itself, increasing students' awareness of what they know and how they know it. Discussion also provides a window into student thinking that teachers can use to adapt and plan subsequent instruction.

Classroom discussion does not substitute for engagement with text, both reading and writing. Programs with promising results select carefully the kinds of tasks and texts they offer students and leave room for student choice. They offer tasks that highlight dilemmas, unsolved puzzles, and discrepancies for students to address. They pose authentic questions that motivate students to do the hard work of reading and struggling with seemingly conflicting ideas. Selecting appropriate texts and tasks requires anticipating the knowledge and conceptual skills students will need to use the texts to accomplish the tasks successfully through close reading and disciplinary reasoning practices. Merely giving students a question to answer, some sources to consult, or some activities to do does not ensure understanding or critical thinking. The kind of reading and reasoning required depends on how the question or activity is related to the sources provided.[97]

Tools include prompts, note-taking structures, and graphic organizers that help students systematize and track the information they want to communicate as well as their own thinking. Although educators and researchers are familiar with how students work with the particular tools used in the various programs, they are as yet uncertain how to reduce gradually the level of support as students develop proficiency in reading to learn content. The new technologies of the twenty-first century also are likely to offer powerful new tools for content area reading with understanding.

Implications for Teaching: Integrating Literacy and Content Learning

What will it take for American students to become proficient in the twenty-first-century literacies? The evidence indicates that students must become skilled in developmentally appropriate forms of *doing* history, mathematics, science, literary analysis, and the arts. Engaging consistently in reading and writing like a historian, like a mathematician, like a scientist will enable students to analyze, synthesize, evaluate, and make decisions regarding the validity and trustworthiness of information. Students must learn how texts function within a discipline and understand the inquiry frames and purposes that readers bring to texts and other artifacts of the discipline. Most teachers, however, have

themselves had little exposure to or experience with these literacy practices. To enable students to master these literacy skills, teachers must have opportunities to develop the pedagogical content knowledge that allows them to integrate content learning and literacy practices within the discipline. They must understand how to support the learning of their students through classroom discussions that foster engagement with content and text, as well as through use of the discourse practices specific to the content area, in a classroom context that stresses thinking and inquiry.

Professional development that builds the capacity of teachers to foster this kind of learning environment requires long-term investment and commitment. Teachers need to re-envision reading and writing as tools for developing subject-matter knowledge as well as practices inherent in generating new knowledge. The transformation can be facilitated by teachers' being able to see into other classrooms through videos; increasingly as remote cameras become more advanced, virtual classroom visits may also be possible. But simple exposure to different ways of teaching and learning are not enough to support and sustain change. Many reform projects have identified the need for teacher networks or learning communities that support and foster the ongoing learning that is necessary for sustaining and deepening instructional improvement.[98] Effective teacher learning communities also depend on school- and district-level commitment to a sustained process that builds coherently toward shared goals.

The literacy demands of the twenty-first century and beyond raise the bar on what American students need to achieve. For them to rise to the challenge, we as a society must recognize and meet not only their needs but also those of their teachers. An emerging knowledge base suggests strongly what needs to change and how it needs to change. We need to support educators in making that change.

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