Using Advances in Cognitive Science to Improve Students Study Skills and Reading Comprehension

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Abstract

National and international assessments of reading, science and math indicate that students and adults in the United States lag behind citizens of other developed nations. While there are many reasons for this lag, recent advances in cognitive science and technology have uncovered promising ways to intervene and help struggling students. This chapter will review recent developments from the cognitive literature that can potentially shed light on solutions for improving students' study skills, as well as their general reading comprehension. We draw upon the available literature from reading strategy research and recent advances in assessment. Collectively, while this research indicates that the construct of reading is evolving, modern reading interventions are positioned to help prepare students for 21st Century literacy activities.

Key words: study skills, reading strategies, assessment

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Background and context

Both national and international surveys of reading, math, and science indicate that students in the United States continue to fall behind students in other developed nations. For instance, only 26% of 12th grade students are proficient in math and 38% of 12th graders are proficient in reading on the National Assessment of Educational Progress (U.S. Department of Education, 2013). Probably even more alarming is the fact that the average scores on the reading and math NAEP tests have remained unchanged since 2009. Data from international assessments is also alarming. The results from the Programme for International Student Assessment (PISA) indicate that only 8% of 15 year olds across all countries score at the higher levels in reading (5 or 6) (OECD, 2014). In sum, there is evidence to suggest that both young and old learners in the U.S. and other nations have room for improvement on a wide range of skills, especially in reading

Raising the Bar for Proficiency. While student performance on existing measures is concerning, current and future efforts may magnify skill gaps. For instance, recent large scale efforts have suggested expanding what it means to be proficient. These include the Common Core State Standards for K-12 education in the U.S. (National Governors Association Center for Best Practices & Council of Chief State School Officers 2010), new social studies (NCSS, 2013) and science (NRC, 2012) standards, the Partnership for 21st century skills (Partnership for 21st Century Skills, 2008) in the business sector, and other assessment reforms (Bennett & Gitomer, 2009; Gordon Commission, 2013; IAEEA, 2013; Schraw & Robinson, 2011). Collectively, these and other sources advocate that what it means to be proficient is evolving with

simultaneous advances in technology and how people communicate and interact (Leu et al., 2013)[1].

For example, researchers and educators are arguing for an expanded construct of reading and associated skills (Afflerbach et al., 2013; Alexander, 2012; Coiro, 2009; Goldman et al., 2011; Deane, Sabatini, & O'Reilly, 2012; Leu et al., 2013). A fresh view of the construct argues that reading in the 21st century is selective and purpose driven (van den Broek, Lorch, Linderholm, & Gustafson, 2001). Students are expected to integrate, synthesize (Goldman et al., 2012), and evaluate (Metzger, 2007) multiple sources of information (Britt & Rouet, 2012) to satisfy their specific purposes and goals for reading. Increasingly, students are encouraged to collaborate and communicate with one another (NGA & CCSSO, 2010) as they solve problems and make decisions (Sabatini, O'Reilly & Deane, 2013), often in digital environments (Coiro, 2011). Collectively, these new standards, expectations and arguments for updating the construct of reading will undoubtedly impact future test scores- educators could potentially be faced with new skill gaps.

Overview of the paper. Despite these challenges, recent advances in instruction, technology, and assessment have the potential to help address the skill gaps. The purpose of this paper is provide a review of the literatures in cognitive science and education and how they can be used to help improve student learning, study strategies, and organizational skills including students with or at risk of learning disabilities. Although there are many skills and strategic approaches, this paper specifically focuses on advances in learning from text sources, that is, reading for understanding or general literacy. We begin with a discussion on what makes

[1] Both the PISA and PIAAC assessments are very progressive in their approach to measuring competencies that are relevant to 21 century learning. Interested readers are encouraged to see the framework documents (OECD, 2009a,b)

reading and learning challenging, then proceed to provide an overview of empirically supported strategies and recent advances in assessment design relevant to study skills. It is our hope that a multifaceted approach that combines strategy instruction coupled with more useful assessments will provide a better foundation for improving students' study habits and learning performance.

Reading Comprehension: the Construction of Meaning from Incomplete Texts

Reading comprehension is a complex process that involves the integration of a wide range of skills (McNamara & Magliano, 2009). Given this complexity, it is not surprising that many students have difficulty understanding what they read. While there are a wide range of reading theories and areas of dispute (Cain & Parrila, 2014), most theories of reading comprehension propose the idea that the reader constructs a mental model of the text while reading (Graesser, Singer, & Trabasso, 1994; Gernsbacher, 1997; Kintsch, 1998; Myers & O'Brien, 1998; van den Broek, Young, Tzeng, & Linderholm, 1999; Zwaan & Radvansky 1998). A mental model is a representation of the text that contains the key ideas, the relation among those ideas, and the basic organization of the texts. The model may contain some verbatim words or phrases, but it is usually a truncated version of the texts in the student's own words. Building a mental model requires the student to engage in a number of processes including finding the main ideas and distinguishing them from irrelevant details (Franzke et al., 2005), extracting the organization and macro-structure of the text (Meyer & Ray, 2011; Meyer & Wijekumar, 2007), and integrating the text with their prior knowledge (Kintsch, 1998).

The challenges of building a quality mental model from text are also exacerbated by the nature of the texts. Texts can be perceived as lengthy, disconnected, and incoherent by less knowledgeable readers (Beck, McKeown, & Gromoll, 1989; McNamara & Kintsch, 1996). This

is because authors often leave out "unnecessary" elaborations and connections between ideas that they "assume" their readers already know. Thus, students need to infer connections among ideas and also draw upon their background knowledge to infer the gaps in text (Ozuru, Dempsey, & McNamara, 2009). In other words, reading and learning are active processes that require effort, attention, motivation, and self-regulation (Goldman, 2004; Hacker, Dunlosky, & Graesser, 2009; McNamara, 2007; Schaffner, Schiefele, & Ulferts, 2013). These cognitive demands may be especially challenging for students with learning disabilities, as has been found in the existing literature (Catts, Tomblin, Compton, & Bridges, 2012; Cirino et al., 2013; Reed & Santi, 2015; Thiede, Anderson, & Therriault, 2003). Below, we describe some strategy instruction approaches and interventions that are designed to improve reading and learning through active processing.

Reading Strategy Training

Reading and learning are complex processes that can go off track in a number of ways. To the extent techniques and interventions can be developed to help comprehension, students should be better prepared for college and career readiness and 21st century learning. We refer to the term strategy here as a technique or collection of techniques that are designed to improve understanding and learning, thus, the foundation to what are sometimes referred to as study skills. Strategies are typically effortful and conscious activities.[2] Students may plan to use strategies before they read, while they are reading, or after they read (McNamara, Ozuru, Best, & O'Reilly, 2007). Strategies may be selected when students notice problems in their understanding (metacognition), when current processing or an initial strategy is ineffective (self-

[2] Over time, strategies could become or appear to be automatic in highly skilled readers.

regulation), or when students want to strengthen their understanding of texts for later recall. Strategies may help improve comprehension and learning by reducing memory load, simplifying complex ideas, enriching the context, making implicit ideas explicit, providing an organizing frame, connecting distal information, making connections to existing knowledge, and providing multiple traces or modes of information (see McNamara, 2007).

A Four-Prong Strategy Framework

The Center of the Framework: Metacognition and Self-regulation. There are a wide range of individual reading strategies. However, keeping track of the various strategies can be difficult and confusing, as different strategies are often designed to address different problems. To manage some of this complexity, McNamara and colleagues developed a four-pronged framework that organizes related sets of reading and learning strategies (McNamara et al., 2007). At the center of the model is a set of metacognitive and self-regulatory strategies. These strategies serve as the executive management system for the four prongs. In essence, students need to monitor their understanding (metacognition) and take action to select appropriate strategies to address any comprehension gaps or misconceptions (Hacker, Dunlosky, & Graesser, 2009; Zimmerman & Schunk, 2001). These metacognitive and self-regulatory skills "oversee" the process of comprehension, how well it is going, and help determine suitable courses of action to enhance learning goals.

There are a number of ways to help promote metacognitive and self-regulatory processing. These techniques include strategies such as rereading (Rawson Dunlosky & Thiede, 2000); note taking (Faber, Morris, & Lieberman, 2000), generating key words (Thiede, Dunlosky, Griffin, & Wiley, 2005); and summarizing text (Thiede & Anderson, 2003). While

these are not metacognitive activities in and of themselves, they do require students to be aware of their understanding at different levels. For example, while note taking helps students identify problematic areas of text, generating key words and summarizing helps students focus on the important ideas of a text

Another simple but effective way to stimulate and promote metacognitive and self-regulatory type processing is self-testing. Often referred to as the "testing effect" (McDaniel, Anderson, Derbish, & Morrisette, 2007), self-testing can be an effective way to determine whether a student knows and has learned the content sufficiently. In short, students who are tested on content understand and learn more (McDaniel et al., 2007), and make more appropriate metacognitive judgments (Finn & Metcalfe, 2007)[3] than students who do not test themselves. Self-testing may reveal problems or gaps in understanding, and guide further study and deeper processing, because students become more aware of "what it takes" to learn the material at a deep level. In any event, metacognitive and self-regulatory processes can occur at any phase of learning and tend to guide the use of other strategies contained in each of the four prongs discussed below. The four prongs in the framework serve as a set of actions and strategies that can be leveraged at different points in the comprehension and learning process.

Prong 1: Preparing to Read. Before reading, students can select from a host of strategies that help them *Prepare to Read.* The prepare-to-read prong is designed to serve a number of functions including goal setting (Bråten, Gil, & Strømsø, 2011; McCrudden et al., 2011); the activation of relevant knowledge, schemata, and frames (Kintsch, 1998, Ozuru et al., 2009); and

[3] Students typically overestimate their confidence when judging their learning. However, after testing, they typically underestimate their confidence which is arguably a better strategy than over confidence because it forces the student to be more vigilant and take additional action.

question generation to guide reading (Graesser & Lehman, 2006; Graesser, Ozuru, & Sullins, 2009).

A popular strategy commonly used in education settings that exemplifies the *preparing to read* strand is previewing (Spires, Gallini, & Riggsbee, 1992). During the previewing strategy, students are expected to preview key sections of the text before they read. The key sections include the title, chapter headings, bold and italics words, and chapter review questions. The purpose of this strategy is to both activate relevant knowledge on the topic and provide the student with an idea of what the text will be about. While the preview strategy is designed to set expectations, it also serves as way to ask questions that guide further reading. If unknown words, sections or topics are encountered during the preview, students can generate questions that can structure later reading. In this way, previewing can serve metacognitive and self-regulatory functions.

A slightly different take on the previewing strategy is called *KWL, or Know, Want (to Know), Learn* (Cantrell, Fusaro, & Dougherty, 2000; Ogle, 1986). In the KWL strategy, students are instructed to carry out three sets of related activities before, during, and after they read. Like the previewing strategy, students are first instructed to skim the key sections of text before they read, generate pre-reading or guiding questions, and activate their relevant background knowledge (i.e., Know & Want to Know phases). After previewing, students are expected to read the text and try to find out answers to their guiding questions. After reading, students write down what they have learned in relation to what they already knew. This part of the process also involves producing answers to pre-reading questions (i.e., learning). The KWL strategy is designed to activate and integrate background knowledge and to ensure that students are

monitoring and regulating their reading. In essence, the prepare-to-read prong sets the stage for later reading strategies that are enacted *while* reading.

Prong 2: Interpret Words, Sentences, and Ideas in Text. The second set of strategies called *Interpret Words, Sentences, and Ideas in Text* occurs before or *while* students read text. This prong is designed to help students construct a coherent model of the text. As students read, they need to know the meaning of the words and how the words and concepts are related to each other. At the word level, some estimates indicate that students need to know at least 90-98% of the words in text in order to form a general understanding (Hsueh-Chao & Nation, 2000). In terms of relevant strategies for prong 2, students can use dictionaries (Chiu & Liu, 2013) or outside resources to look up the meaning of the words, or they could use the surrounding context to infer the meaning of unknown words (Baumann et al., 2003; Penno, Wilkinson, & Moore, 2002).

Going beyond the word level, students also need to comprehend sentences. One of the simplest strategies to help understanding is to reread the text (Millis & King, 2001; Rawson, et al., 2000). Rereading can sometimes reduce working memory demands, strengthen one's mental representation of content, or help clarify areas that were previously skimmed over too quickly. However, sometimes rereading is not enough and students need to try other strategies that may help them represent the text in a different way. When students encounter a problem, they may try to paraphrase the sentence (Youjia, Woods-Groves, Ford, & Nobles, 2014). Paraphrasing transforms the meaning of the sentences into the student's own words. Paraphrasing may make the information more memorable by activating nodes that are more familiar to the student's vocabulary and discourse structures. While the ability to paraphrase might not be causally

related to comprehension, there is a positive relationship between the number of inaccurate paraphrases and poor understanding (McNamara, 2004).

Beyond words and individual sentences, students also need to make connections across proximal and distal sentences. Creating these types of connections is sometimes called bridging inferences (McNamara, 2004). Information that is separated across sentences is often left unstated in many texts. Readers have to infer them in order to reduce gaps in coherence. While this process might seem easy and automatic for skilled readers, it is difficult for less skilled readers (Cain et al., 2001; Magliano & Millis, 2003). Fortunately, inference training has been successful in improving student comprehension (Yuill & Oakhill, 1988).

In addition to teaching inferences, students may also benefit from knowing the various organizational patterns, or text structures, that are common in expository and narrative text (Meyer, 1987). Texts often contain predicable structures such as description, problem/ solution, cause effect, compare contrast, and so forth. Familiarization with a variety of text structures can help students recognize when a particular text structure is being used. With the appropriate structure in hand, students may be in a better position to make connections across sentences. Indeed, strategy instruction that focuses on text structure have been successful in improving reading comprehension (Meyer & Ray, 2011).

Prong 3: Strategies that go Beyond the Text. The third prong of the strategies framework is called '*Strategies that go Beyond the Text*'. While the first two prongs are designed to *prepare* students to read and to help students form a basic understanding of the text, the third prong is designed to *build upon or extend* what was read, such that it is learned and remembered. This extension can occur in the form of integrating information with background knowledge (Kintsch,

1998; McNamara de Vega, M., & O'Reilly, 2007), generating questions (King, 1994), consulting other sources for further reading, using visualization and imagery strategies (Oakhill & Patel, 1991), or elaborating and explaining the meaning of the text to oneself (McNamara, 2004).

The questioning strategy is an exemplary approach for encouraging students to think beyond what is written in text. Although the questioning approach has taken on many forms, it consists of teaching students differences between superficial verses deep questions (see, Graesser, & Person, 1994; Graesser, Ozuru, & Sullins, 2009), or using question prompts that help structure question generation. In its most generic form, students are asked to answer "why" questions to help them elaborate the text content, as in the elaborative interrogation strategy (O'Reilly, Symons, & MacLatchy-Gaudet, 1998; Pressley et al, 1988). A more structured form of the questioning strategy was developed by King (1989; 1994; 1995). It provides a set of question prompts to the reader that can be used to generate questions to a wide range of text types and topics. Some examples of these question prompts include: "How is … related to … ?"; "What are strengths and weakness of..?"; What would happen if…?"; "What are the implications of…?"; "Why is … important?"; How does …apply to everyday life?"; and "What is another way to look at…?". The aim of these prompts is to encourage students to actively process the text by thinking critically, elaborating the text with background knowledge, and to enrich their mental model of the text, making it more stable and information more easily retrieved.

Enrichment is a key factor in other strategies in the third prong, such as imagery and visualization strategies (Oakhill & Patel, 1991). Asking students to form an image of the text may help create a second, visual representation that can be used to elaborate a lexical or linguistic representation (see dual code theory, Pavio, 1986). This is in line with classic research that shows visual images are sometimes better remembered than raw text (Shepard, 1967).

Having more pathways to the content elaborates the representation and makes it more memorable. In a more involved elaboration strategy, students are asked to physically act out the story or events in the text, or manipulate physical models of the text (Glenberg, Jaworski, Rischal, & Levin, 2007). The process of acting out the story is said to strengthen the representation thorough embodiment. Understanding often involves action and engaging in the physical action discussed in text helps enable deeper processing.

Probably the most exemplary strategy in the third prong are variants of the self-explanation strategy (Chi et al, 1994; McNamara, 2004). A simple instantiation of the self-explanation strategy is enacted when students are asked to explain what the text means to themselves and how it relates to what they already know. More elaborated versions of the strategy utilize a combination of other strategies in the four prongs including metacognition (comprehension monitoring), prediction, paraphrasing, drawing bridging inferences, and elaboration (McNamara, 2004). This more elaborated version of self-explanation called Self-Explanation Reading Strategy training of SERT has been effective in improving the quality of students' self-explanations and comprehension for readers with less knowledge (McNamara, 2004). In sum, strategies in the third prong are designed to encourage students to elaborate and enrich the text representation by questioning, explaining, and integrating their background knowledge with the text content.

Prong 4: Strategies to Organize, Restructure, and Synthesize. The fourth and final prong in the strategy framework is called '*Strategies to Organize, Restructure, and Synthesize the Text Content*'. Strategies in the fourth prong are designed to strengthen the students' mental model by focusing on the global and interconnected elements of the text. The primary strategies in this strand are the use of text structure (Williams, 2007), graphic organizers (Griffin, Malone,

& Kammenui, 1995; Robinson & Kiewra, 1995), knowledge/concept maps (Vitale & Romance, 2007), and summary writing (Head, Readence, & Buss, 1989; Radmacher & Latosi-Sawin, 1995).

Graphic organizers are visual representations of the text that depict the text structure (e.g., compare-contrast, problem solution). They can be represented in tables, charts, or figures. Knowledge maps are similar to graphic organizers, but may represent a larger body of knowledge and highlight the relations between the various concepts. Summaries on the other hand are concise written representations of the text. In any event, both graphic organizer and summary writing strategies are designed to reduce memory load and highlight the organization of the text. In both cases, important concepts are selected, irrelevant concepts or details are omitted, and the structure and relations among the key ideas are represented. Although graphic organizers and summaries can be completed while students are reading, they might best be used after students have read the text. As concise representations, graphic organizers and summaries can be a useful resource when studying or preparing for exams and courses (Bean, Singer, & Frazee, 1986; Radmacher & Latosi-Sawin, 1995).

Reading Strategies: Summary and Limitations. The above review covered a range of reading strategies that have been shown empirically to be successful in improving students' comprehension and learning from text sources. The central aim of this work has been to encourage readers to actively process the text and to use what resources are available to identify comprehension difficulties and fix them. While there is a wealth of literature on the effectiveness of using strategies to improve reading and learning, many of the studies have been conducted with small sample sizes and the treatment effects are often measured soon after the intervention has been implemented rather than examining the lasting effects over time. Reading

skill is complex and it develops over time. Obtaining long lasting and stable effects of reading interventions is challenging (Denton, Wexler, Vaughn, & Bryan, 2008; Kim, Samson, Fitzgerald, & Hartry, 2010). Although there are a number of reasons for not obtaining effects, such as the nature of the assessment used to measure the intervention (O'Reilly, Weeks, Sabatini, Halderman, & Steinberg, 2014), educators should be cautious about expecting large gains without engaging in an intensive and ongoing treatment program. Despite this word of caution, teaching reading strategies in the classroom is likely to have some benefit for students. Next, we turn to describing some recent efforts aimed at designing assessments that support students' acquisition of strategies and study skills that enhance learning from text sources.

Using assessment to promote learning and study skills

In this section, we explore some recent developments in assessment design that may impact learning in the future. Traditionally, one thinks of assessment as divided into achievement or summative testing (assessment *of* learning) versus classroom or formative assessment (assessment *for* learning). Summative assessments are designed to maximize the information about students' ability on a unidimensional scale, while maintaining strong psychometric properties, and cost and time efficiency (Sabatini, Petscher, O'Reilly, & Truckenmiller2015). Formative assessments, by contrast, are designed to help students and teachers reflect on their understanding of content, with the goal of providing insights to guide future learning and instruction (Black & Wiliam, 1998).

To this mix, Bennett and Gitomer (2009) have promoted the idea of assessment *as* learning – designing assessments that model effective learning and instructional practices, attempting to make the assessment experience valuable in and of itself. We have already noted

that self-testing is a proven stimulus for learning and recall of the content tested (McDaniel et al., 2007), and that questioning (King 989; 1994; 1995) – a central feature of all assessments – is an empirically supported strategy for enhancing learning. It only makes sense to consider the design of assessments as an opportunity to promote, model, and reinforce the value of using reading strategies and study skills to help students learn and comprehend text. Given this rationale, a new generation of assessments has been emerging that draws upon the learning science literature to inform assessment design (Bennett & Gitomer, 2009) by using more authentic tasks, moving beyond traditional forms of multiple choice items (Rupp, Ferne, & Choi, 2006), including a social communicative and collaborate element (NGA & CCSSO, 2010), increasing the range of technology enabled environments (Leu et al., 2013) and seeking to provide information that is useful for instruction (Gordon Commission, 2013).

For the remainder of the paper, we will explore two large scale research projects that have primary goals of increasing the utility of assessment of, as, and for learning to promote strategies and study skill behavior in students (but see also Coiro, 2011; Goldman, et al. 2011; Hannon & Daneman, 2001; Hannon & Frias, 2012; Katz & Macklin, 2007; Lawless et al., 2012) for other exemplary innovations in assessments). The first project is called *Cognitively, Based Assessments of, for, and as Learning* or CBAL for short (Bennett & Gitomer, 2009; ETS, 2014a). CBAL is a research initiative funded by ETS since 2007 that is designed to create innovative summative and formative assessments for K-12 students in reading, writing, English language arts, math, and science. The second project is a federally funded initiative by the Institute of Education Sciences called Reading for Understanding or RfU for short (ETS, 2014b; IES, 2010). The RfU initiative was designed to improve students' reading comprehension through

intervention and assessment. The ETS team was charged with the task of building innovative reading comprehension assessments for students in prek-12th grade.

At the heart of these new assessment designs is providing the student a goal or purpose for reading, thus, encouraging the use of reading strategies and study skills that a student typically employs when learning content. Before reading any texts, students are provided with a plausible purpose for reading a collection of source materials. Usually, this purpose describes some overarching goal the student has to achieve by the end of the assessment. This may require students to solve a problem, make a decision, evaluate alternative solutions, or to produce a flyer. The reading purpose provides students with a standard of coherence (van den Broek, Risden, & Husebye-Hartman, 1995) for judging what information is relevant (Rouet & Britt, 2011) to the reader goals. As a secondary aim, the purpose also provides a context that is potentially more realistic and engaging than what is typical in a standard "testing genre"[4] (Hornof, 2008).

In addition to providing a purpose and context for reading, students are also given a wide range of source materials to work with. Sources can range from traditional printed texts, to electronic sources such as simulated web sites, blogs, e-mails, and chat forums. The sources are sometimes reliable and trustworthy, and other times they may contain errors, biases, or fallacies in reasoning. The test takers engage in a wide range of tasks that require them to integrate and synthesize multiple texts and evaluate the sources for quality, completeness, and to correct the errors. Such multiple text (Bråten, Gil, & Strømsø, 2011; Britt & Rouet, 2012) and evaluation tasks (Metzger, 2007; Wiley et al., 2009) in digital environments (Coiro, 2009; Leu et al. 2013)

[4] Some people have argued the prevalence of testing has resulted in a unique testing genre that implicitly defines what students should expect and how they should approach the testing, tasks, items and texts. Implicit in this argument is that testing represents an artificial genre that does not reflect how people interact and solve problems in the real world.

are common in research and the new standards (NCSS, 2013; NGA & CCSSO, 2010; NRC 2012) and other assessment reforms (Partnership for 21st Century Skills, 2008).

Although the above constructs and task demands are in line with creating a higher standard for what it means to be a proficient reader and learner in the 21st century, by themselves they do not help learning and development. One of the key aims of these assessments is to balance the goals of measuring higher level skills, while simultaneously supporting learning. This is achieved in a number of ways.

First, test takers are quizzed on their relevant background knowledge (prong 1- preparing to read) on the topic before they read any texts (O'Reilly & Sabatini, 2013). This is designed to encourage student metacognition (the center of the 4 prong framework-metacognition and self-regulation) by modeling the practice of reviewing what one knows, and how that might be relevant to what one is about to study or learn (Ogle, 1986; Spires et al., 1992). It also provides an estimate of how much the student knows about the topic before reading (Shapiro, 2004). This information can be used to contextualize the reading score (e.g., Did the student have enough knowledge to answer the items? Did they know too much?). Alternatively the measure of background knowledge can be used instructionally: if test takers have a low level of background knowledge on the topic, students can seek (or instructors can provide) additional resources to create a meaningful context for subsequent reading. In some assessment designs, the background knowledge questions are presented *before and after* students read texts that contain the answers to the background knowledge questions. This design allows test users to determine if students learned information after reading (prong 3- strategies that go beyond the text). In this way, student learning is directly measured in the assessment.

A second technique used in the design of the assessments is to sequence tasks and items to model learning and study strategies. For instance, texts may be sequenced such that students are first given easier texts that introduce the topic and provide a context at a high level (prong 1). This design feature models how to *build up* ones background knowledge in support of learning new topical content. Subsequent texts are then presented that dig deeper into more complex issues, concepts and relations (prongs 2, 3 & 4). With the knowledge base gained earlier in the assessment, students are better prepared to answer, and learn from more demanding texts and questions later.

Third, efforts are taken to provide clear expectations of what is required of the students, so that they can apply these requirements outside of the assessment context (prong 3). For instance, before students write a summary (prong 4), students are given a set of guidelines they should follow that is associated with the scoring rubric (e.g., include only main ideas, no outside information, no plagiarism). In other cases, they are given specific criteria to be used to evaluate website sites such as “Is the source trustworthy?”, “Is it out of date?”, “Is it biased?”, etc. Again, these are practices that could be applied by a student when learning content outside of the assessment.

Fourth, in modern education and workforce settings, students and colleagues often collaborate in groups in order to build shared understanding, negotiate goals, or seek help and support (prong 3). In a group setting, people can receive help or provide help to others as they solve problems. In these assessments, examinees are introduced to simulated peer students and teachers to help facilitate various assessment goals. Simulated teachers and other authority figures provide guidance and hints on how to perform tasks. Simulated students can serve similar functions, but they may also require the test taker’s help. In some cases, simulated

students provide interpretations of the text that may contain errors or misconceptions, and the test taker has to identify the errors and correct them. Errors can be strategically introduced in the assessment to help reveal difficulties in test taker's understanding or their component skills. Collectively, simulated teachers and peers can serve as a useful assessment tool to elicit desired responses from students, support test taker performance, as well as providing a more authentic and potentially less anxiety provoking testing experience for students.

Fifth, many of the specific reading strategies reviewed earlier in the paper are also included in the assessment design. These reading strategies include the use of prediction, paraphrase, summarization, graphic organizers, and the questioning strategy (prongs 1, 2, 3 & 4). By integrating a range of reading strategies into the design, the assessment is promoting the teaching and use in the classroom, as well as encouraging students to use reading strategies as they learn and study. In this way, strategies can both serve as a way to measure reading ability, and potentially as a way to improve it by modeling good practice.

An example of the explicit signaling of assessment as learning is illustrated in a collection of assessments called the "study group" family (O'Reilly et al., 2014). Study group assessments of reading comprehension have been built for topics in U.S. history, biology, and English literature[5]. While the details of each assessment are unique to the domain (i.e.., disciplinary reading, Goldman, 2012) they do share a common design and structure. Table 1 presents the set of structured tasks and sequence for the biology study group form. Before beginning the test students are told: "You are preparing for an upcoming science test. In order to prepare for the test efficiently, you and some classmates decide to form a study group. You are

[5] Although the study group assessments have texts, tasks and items that sample aspects of disciplinary thinking, ultimately they are designed to measure overall reading ability.

responsible for helping each other identify key concepts, review and learn from readings, and organize information." Though space precludes a detailed description of the rationale for the sequence and content of each section, we hope the reader is able to infer how one approach to strategy use and study skills is modeled in the structure of this assessment. By encouraging students to think of completing a simulation of studying for an exam (or in other cases to prepare to write an essay), we are striving to design tests that may themselves be worthy of teaching to.

Implications for students with learning disabilities.

The policy and practice for students with learning disabilities has been trending towards prevention and pro-active support of students at-risk versus a wait-to-fail identification approach (Reed & Santi, 2015). As part of this trend, schools have been encouraged to use response to intervention models (Fletcher & Vaughn, 2009; O'Reilly, Sabatini, Bruce, Pillarisetti & McCormick, 2012). The trend has also been towards inclusion of students with disabilities in general education programs versus pull-out classrooms, with greater emphasis on the application of effective research-based instructional interventions for all students (Reed & Santi, 2015).

While interventions targeting struggling and learning disabled adolescents have met with mixed results (Flynn, Zheng, & Lee, 2012; Solis et al., 2012), we see promise in a more sophisticated integration and alignment of assessments and strategy-instruction approaches. That is, with innovative assessments that both model and measure strategic reading and study skills, teachers will be more motivated and empowered to implement effective strategy instruction in their classrooms, and more able to examine whether that instruction was effective via its impact on student assessments scores. Similarly, students will see a more transparent relationship

between their strategic and study skill practices and the assessment tasks that measure their learning.

Assessments emerging from projects such as CBAL and RfU are designed explicitly with the goal of fostering strategy use and effective instructional practices that have been recommended for students at-risk or with reading-based learning disabilities. For example, Reed & Santi (2012) note that common recommendations for addressing the needs of LD students include: explicit vocabulary instruction in content area texts; supplementing student's background knowledge of relevant concepts; providing instruction in making inferences in relating ideas in a text; and improving students' metacognitive strategies by answering questions, paraphrasing, or writing summaries. These are all explicit features included in the next generation of assessments we have been describing (O'Reilly & Sabatini, 2013; Sabatini, O'Reilly, & Deane, 2013; Sabatini et al., 2014).

Finally, we observe that much of the study skills and strategy research reviewed in this chapter has been conducted with students from late elementary through middle and secondary school, when the complexity of texts and the demands of learning disciplinary content from text is continuously increasing (ACT, 2006). We note also that 21st century reading takes place increasingly and predominantly in digital environments. This context represents both challenges and opportunities for students with learning disabilities. On the one hand, digital environments increase the complexity and variety of text sources, and therefore demands new skills of search, navigation, source evaluation, and multiple text integration (Leu et al., 2013; Rouet & Britt, 2012). On the other hand, the digital reader has both more literacy support tools (e.g., spell checkers, dictionaries) and ready access to background knowledge to support reading and learning (e.g., hyperlinks to word definitions and to encyclopedic background knowledge).

Again, the new assessments described in this chapter also model and measure digital literacy reading and learning skills, further supporting their application for all students. We do agree with others (e.g., Kosanovich, Reed & Miller, 2010), however, that new assessment and intervention approaches will require significant teacher professional development. This is especially the case at the middle and secondary level, where reading instruction is no longer taught explicitly, and may require supplemental instructional support (e.g., study skill classes). The supplemental support would likely take place outside of the general education classroom to provide sufficient time and intensity for learners with disabilities to practice strategies and develop the habits of mind to use them effectively in applied contexts.

Summary and Conclusion

In this paper, we have reviewed some of the empirically supported techniques to enhance student strategic reading or study skills, focusing primarily on reading text sources for understanding and learning. We argued that recent advances in cognitive science have uncovered promising ways to intervene and help struggling students. We presented results organized by the four prong model (McNamara et al., 2007). We then presented new research on assessment design that seeks to promote 'assessment of, as, and for learning' – assessments that model and require the application of reading strategy and study skills as part of the assessment experience, thus, encouraging wider spread use and teaching of study skills. Collectively, while this research indicates that the construct of reading has shifted, there is also great promise that approaches to reading for understanding instruction (and assessments) are positioned to help prepare students for 21st Century literacy and learning demands.

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Table 1 sections contained in a study group scenario for science.

Section 1: Practice – What do you already know?
Section 2: Read and summarize important texts.
Section 3: Consider evidence and connect science to policy.
Section 4: Understand and apply scientific terms.
Section 5: Say it in your own words.
Section 6: Review scientific data.
Section 7: Check your understanding.