Chapter 10
Understanding and Reasoning with Text

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ABSTRACT

Consider the assignment that teachers have been giving their students for years: “Write an expository essay on a scientific topic. Example topics may include global warming, human memory, or the spread of infectious diseases. You must have at least three references.” The instructor makes it clear that the paper should have a thesis or claim that is supported by evidence. Claims might be that global warming will be disastrous only for some nations, why it is futile to teach mnemonics to young children, or that cell phone use causes cancer. From the perspective of the student (and cognitive psychologists), this assignment is challenging at any grade. The challenge is that the assignment entails a number of complicated and interconnected tasks. For example, reading a research paper requires the reader to make inferences that span sentences and paragraphs (in addition to a whole host of other processes), and to understand the logical and rhetorical structure of the text as a whole. If the paper describes an experiment, the student must additionally understand how to determine whether the data support the conclusion (i.e., the scientific method). In most cases, the student must also integrate the content of several papers (sources) into a coherent structure. This process involves evaluating the credibility of the sources, selecting relevant pieces of information from each, and putting them into a coherent argument structure. No wonder such assignments are met with groans.

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INTRODUCTION

At a fundamental level, each of these processes entail reasoning, the process of specifying how one idea logically leads to or supports another. That is, sentences support inferences; data support conclusions; reasons support claims; quality credentials support credibility, and so on. However, reasoning is difficult to teach. Students need practice with individualized feedback, which is not always possible in the classroom. Members of the Discourse and Technology Group at Northern Illinois University are designing applications to help students assess and improve their ability to reason with texts. The applications include assessing reading comprehension strategies (RSAT), enhancing scientific reasoning (CT Tutor and Operation ARIES!), teaching appropriate sourcing and integration skills (SAIF), and improving argument comprehension and evaluation skills (CASE).

One common aspect of all of these applications is that they use relatively simple algorithms to assess students’ performance based on their verbal input. By simple, we mean approaches that provide reasonable estimates of whether student products reflect attainment of key constructs using the least computationally demanding methods. The primary goal of these projects is not to advance the state of the art in Natural Language Processing. On the contrary, we are using the simplest, most computationally feasible techniques we can find in concert with cognitive instructional principles and discourse processing theories, enable us to provide effective assessment and feedback for learning. We believe simple methods are possible and appropriate when one can develop models of the students’ cognitions and the task, and a range of student products that should underlie the key constructs in the student and task models (Mislevy, 1993; Pellegrino & Chudowsky, 2003; Pellegrino, Chudowsky, & Glaser, 2001). The objective of this chapter is to describe the methods used by each of these applications along with a discussion of the strengths and weaknesses of each. Then we discuss some general issues that are common to all of the applications.

BACKGROUND

A student’s interaction with text in the context of learning involves a complex sequence of cognitive processes, some of which are shared across tasks and some are task-specific. On a basic level, the student reading to acquire knowledge for writing a research paper must simply understand the material from each text. Text comprehension is itself a complex task that requires comprehension of individual statements, recognizing connections between statements, relating statements to prior knowledge, and integrating these elements into a coherent representation of the text (e.g., Graesser, Singer & Trabasso, 1994; Kintsch, 1988; 1998). The Reading Strategy Assessment Tool (RSAT) was designed to assess high-school and college students’ use of successful reading strategies during comprehension. Such reading strategies are important because they help readers construct a coherent mental representation of a text and have been shown to be predictive of comprehension (Magliano & Millis 2003, Magliano, Trabasso, & Graesser, 1999).

On a more global level, our hypothetical student must be able to reason more deeply with and about the texts they are reading (Rouet, Britt, Mason, & Perfetti, 1996). Our other projects focus on the student’s use of their text representation in various reasoning tasks. The Critical Thinking tutor (CT Tutor) helps students critically evaluate scientific studies, Operation ARIES! (Acquiring Research Investigative and Evaluative Skills) teaches the scientific concepts needed to evaluate studies, Cultivating Argument Skills Efficiently (CASE) teaches students to comprehend, evaluate and produce arguments, and Sourcer’s Apprentice