

# MULTIMEDIA AND MULTIPLE INTELLIGENCES

BY SHIRLEY VEENEMA AND HOWARD GARDNER

**T**echnology does not necessarily improve education. Take a simple innovation like the pencil: One can use it to write a superlative essay, to drum away the time, or to poke out someone's eye. The best television has educated thousands, while the daily network offerings dull the sensibilities of millions.

The same is true of interactive technology, which is getting so much ink these days: It could become a valuable education tool, but only if we use it to capitalize on our new understanding of how the human mind works. In this essay, we examine one particular example of interactive media, a CD-ROM about a Civil War battle, and how it takes advantage of the more complex view of intelligence that has emerged in recent decades.

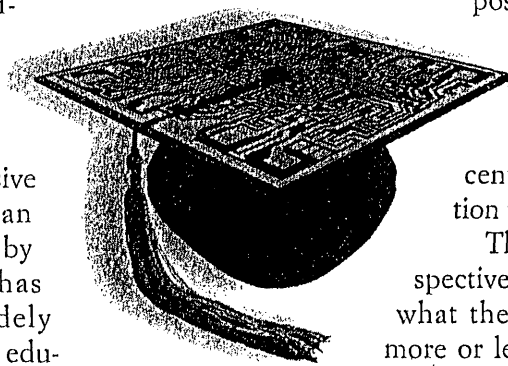
## THE COGNITIVE REVOLUTION

Just 40 years ago, a new movement in science began to coalesce. Now termed cognitive science, this field seeks to integrate insights from several disciplines (including psychology, linguistics, artificial intelligence, and neuroscience) in order to put forth a more comprehensive understanding of the human mind. The approach fostered by the cognitive revolution has enormous, if not yet widely appreciated, implications for educational practice.

Even in science, one cannot have a revolution without an enemy. In the case of the cognitive revolution, there were two separate, though related, foes. The behaviorist perspective, as epitomized in

the work of B.F. Skinner, disdained any concern with the mind and its contents: All that mattered, from the behaviorist perspective, was that an organism perceived a stimulus and responded to it or that the organism acted in some way and was positively or negatively rewarded for so acting. In education, the apotheosis of the behaviorist perspective was the teaching machine, which remains central in computer-assisted instruction today.

The second antagonist, from the perspective of cognitivists, was the view that what the mind contains is intelligence—more or less of it. Individuals, according to this perspective, are born with a certain amount of intelligence, which for better or worse is essentially fixed. Few asked just what intelligence was or how it could be improved, increased, or transformed—indeed, the not entirely whimsical definition put forth by psychologists was that “intelligence is what the tests test.” The IQ



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test and its descendants, in such measures as the Scholastic Aptitude (now Assessment) Test, are the contemporary monument to this way of thinking.

In direct response to these entrenched perspectives, cognitivists argue that individuals do not just react to or perform in the world; they possess minds, and these minds contain mental representations—images, schemes, pictures, frames, languages, ideas, and the like. Some of the mental representations that individuals are born with or form at an early age prove enduring, but many other representations are created, transformed, or dissolved over time as the result of experiences and reflections upon those experiences. The mind, like a computer, processes and transforms information, and it is vital to understand the nature of this computing machinery—or, perhaps more aptly, these types of computing machinery.

While nearly all cognitivists would agree with this rough portrait, disputes abound about the nature of mental representations—about what they consist of, how they are expressed, how they relate to brain structures, and dozens of other issues. Fortunately, those of us interested in educational progress do not have to follow, let alone take sides, in these disputes. But two central ideas in the cognitivist's arsenal do have important implications for education.

## TWO KEY COGNITIVE IDEAS

First of all, the mind is not comprised of a single representation or even a single language of representations. Rather, all individuals harbor numerous internal representations in their minds/brains. Some scholars speak of "modules of mind," some of a "society of mind." In our own work, we speak of the possession of multiple intelligences, which span the range from linguistic and logical intelligences (the usual foci of school work) to musical, naturalist, and personal intelligences.

According to multiple intelligences theory, not only do all individuals possess numerous mental representations and intellectual languages, but individuals also differ from one another in the forms of these representations, their relative strengths, and the ways in which (and ease with which) these rep-

resentations can be changed. There are at least eight discrete intelligences, and these intelligences constitute the ways in which individuals take in information, retain and manipulate that information, and demonstrate their understandings (and misunderstandings) to themselves and others. For example, in their understanding of the American Civil War, some individuals would favor a linguistic or narrative approach; others can be most easily reached through an artistic depiction; and still others might resonate to the personal dimension—how an internecine struggle affects neighbors and relatives and even generates ambivalence within one's own self. While most individuals can use and appreciate these different perspectives and intelligences, over time each of us constructs our own amalgam of intelligences. Surprisingly (and counter to the claims of classical intelligence theory), strength or weakness in one area does not predict strength or weakness in other areas. And it is here that we encounter a seminal educational enigma.

Until now, most schools all over the world have been selection devices. These institutions have honored a certain kind of mind—ideally, one that combines language and logic—and tried to select individuals who excel in these forms. In most schools individuals who favor other mental representations have received little honor.

The cognitivist's acknowledgment of different kinds of minds opens up enormous educational opportunities. If individuals do differ from one another and if we want to reach as many of them as possible, it makes little sense to treat everyone in a one-size-fits-all manner. Rather, we need to understand the specific minds involved in an educational encounter; and insofar as possible, we should base our education, including choices of technology, on that knowledge. And so, whether the course be history or physics or dance, we should try to teach individuals in ways that are consonant with, or that stretch, their current mental representations. Equally, we should give individuals the opportunity to exhibit their understandings by means of media and representations that make sense to them.

A second, quite surprising finding from cogni-

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tive research is that many early representations are extremely powerful and prove very difficult to change. It is as if, in the first years of life, the mind/brain becomes engraved with a certain scheme or frame by which it apprehends parts of experience. Often this scheme is seen as inadequate, and so educators inside and outside of school seek to transform the initial engraving. They may well feel that they have been successful in bringing about this transformation because the student has acquired more information, especially more facts. Yet, in a majority of cases, even good students at good schools do not really alter their representations. Indeed, when students are examined outside the scholastic context, they often give the same answers as students who have not even studied the subject matter or discipline in question. It is as if school consists of layers of powder that obscure rather than alter the initial engraving; and once that powder has blown away, the original representations have changed very little.

The "smoking gun" demonstration of robust mental representations occurs in physics. Even college students who have done well in written tests of mechanics actually hold on to understandings that are close to those offered by young school children. Their mental representations remain unschooled. Far from being restricted to physics, however, such misconceptions prove to be the rule across the curriculum. Whether the discipline is another science, mathematics, social studies, the humanities, or the arts, the first mental representations formed early in life turn out to be quite enduring. Only in those cases where students have been deeply involved with a topic over the course of months, or even years, is there convincing evidence that a new, better, and more adequate mental representation has come about.

If one wants to educate for genuine understanding, then, it is important to identify these early representations, appreciate their power, and confront them directly and repeatedly. Only then is it possible, in a reliable manner, to construct more adequate mental representations that themselves become robust and enduring.

**A**s we have already emphasized, technologies alone cannot identify—let alone achieve—central educational goals. That is the task of the community, and it is hardly an easy or idle one. Stimulated by reflections on the

cognitive revolution, we propose here two important educational goals:

- the encouragement of deeper forms of understanding within and across the disciplines; and
- the "opening up" of the educational process to the widest spectrum of children, especially those who do not stand out in the traditionally canonical intelligences of language and logic.

#### WHY STUDY ANY PARTICULAR DISCIPLINE OR CONTENT?

Why study anything we teach in school? That is a question we must ask of all schooling, whether or not technologically enhanced. Some disciplines we readily deem worthy of attention. History, for example, offers us a laboratory for the study of past human experience in which to anchor our perceptions of contemporary life and the future. Why study the American Civil War or any particular battle? If, for example, we believe that knowledge of the American Civil War helps students to understand many of the tensions in our nation today, then particular battles warrant inclusion insofar as they advance understanding of specific aspects of the war or the study of history in general.

Traditionally, American history curricula include the battle fought at Sharpsburg, Maryland, on September 17, 1862, on account of its military and political significance. (Revealing the still charged nature of the encounter, even today northerners call this battle Antietam, while to southerners it remains the battle of Sharpsburg.) The facts are these: the Union army, under the command of

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George B. McClellan, stalked Robert E. Lee's Confederate army as it moved to invade the North to get food and supplies. Both armies converged just outside the town of Sharpsburg and engaged in what turned out to be the worst one day of slaughter in American history. Although neither side could claim a decisive victory, Lee's first invasion of the North had failed, and no longer did it seem possible that England would recognize the Confederacy. Indeed, the very goals of the conflict changed when Lincoln seized the occasion to announce the Emancipation Proclamation, linking freedom for the slaves to the war goals.

Most textbooks present this material in such straightforward form. They may well provide an illustration or two. They generally convey the impression that there is a single, authoritative view of the battle, and, depending upon the background of the authors, often relate the battle from the perspective of either the North or the South. Assessments generally ask students to give back this information in factual form. Such a style of presentation and assessment is particularly appropriate for individuals who favor linguistic modes of learning. And such presentations rarely challenge the widespread assumption among students that there is a single objective account of a battle and that the Civil War featured a battle between Right and Wrong.

In what follows, we describe a CD-ROM design, *Antietam/Sharpsburg*, that transcends the usual textbook account. (Full disclosure: One of us, Shirley Veenema, co-designed the CD with James Sheldon.) First, *Antietam/Sharpsburg* recognizes and allows us to take advantage of the fact that intelligences of one student can differ from intelligences of other students in significant ways. And, second, it strives to inculcate deeper forms of understanding and attempts to deal directly with misconceptions and stereotypical habits of thought.

Our example reflects our belief that applications of the new technologies should provide ways for a variety of minds to gain access to knowledge, but

in no way are we jettisoning the major rationale for including history in a liberal education. Indeed, effective use of the technology reinforces both senses of the word *discipline*: Students should apprehend the major focus of thinking involved in a discipline like history and should do so in a steady, cumulative, and inherently disciplined way. Our example suggests ways in which new media might help students to approach an important historical event and to achieve deeper forms of understanding of that event.

#### CAN TECHNOLOGY ENHANCE UNDERSTANDING?

The CD-ROM *Antietam/Sharpsburg* uses accounts and representations from eyewitnesses to tell the story of the battle and offers a close-up view of the physical site and artifacts. Carefully selected primary source material in a variety of media highlights the idea that our knowledge of this battle comes from the representations left us by observers

who encoded their impressions in specific symbolic forms, such as the written journalism of the time, photographs, drawings, and telegraph and signal reports.

Different observers saw particular aspects of the battle. George W. Smalley, correspondent for the *New York Tribune*, started the day

near a cornfield where the fighting started and then moved on to several other sites, including General McClellan's headquarters. Felix Gregory de Fountaine, the correspondent for the *Charleston Courier*, identified his position as "upon the centre" where he could see little or nothing of the fight upon the left. Our contemporary narrative is constructed from the physical representations left us by observers like these. No single observer could see the whole battle and tell us the comprehensive story or give us one authoritative interpretation of what happened.

The idea that there exists a singular perspective is surprisingly hard to change. In fact, too often the seductive idea that there is a "right" view leads students to readily embrace the perspective of any perceived authority—teacher, textbook, or

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"expert"—instead of realizing that students themselves need to weigh the evidence, evaluate sources, and come up with interpretations and justifications. In *Antietam/Sharpsburg*, an emphasis on multiple observers counters head-on the idea that there is a single interpretation and one "right" dramatic narrative.

**T**echnologies like CD-ROM that are capable of presenting both pictorial and textual renderings of a battle from several perspectives can help to dissolve single-dimensional perspectives; they counter the bias toward a single narrative for history and good guy versus bad guy roles in a conflict. As we noted earlier in our discussion of cognitive representations, such stereotypical ways of thinking impede deeper understandings and prove hard to change. Consequently, they need to be addressed directly. The variety of approaches and media now available may, in fact, provide fertile opportunities to eradicate these and other common misconceptions that are formed early in a student's life.

The reality of a battle is also far more complex than what we typically see in the movies, or what nineteenth-century audiences saw in paintings and prints that showed orderly ranks of soldiers responding to the directions of their leader. Often on horseback, the leader apparently knew exactly where they were to go and gallantly led forward his obedient and patriotic forces. In reality, battles are typically chaotic, life-and-death situations, fought by individuals pumped high with adrenaline. It is a rare post-battle account that can capture this complexity.

As in any battle, geography played a role at Sharpsburg: Cornfields offered no cover for troops battling back and forth; hills offered advantageous positions for Southern troops holding off Northern troops attempting to cross a stream; and an old roadway sunken from erosion and the weight of wagons provided a natural trench from which Confederates could train their rifles on Union troops. Moreover, troops on both sides had yet to accommodate their maneuvers to opponents' newly advanced weaponry. Most strategic information was communicated by word of mouth or notes; signal flags and the telegraph carried news of the smoke-enshrouded conflict to George McClellan and the Union troops.

The multiple media of a technology like CD-ROM make possible complex renderings of an

event, but particular understandings need to be a design priority. For example, photographic sequences and text that "walk" the battlefield in *Antietam/Sharpsburg* are designed to help students understand the relationship of the geographic terrain to strategies and course of the battle. In decoding telegraph reports that convey a sense of just how hard it was to know what was going on during the battle, students may realize how difficult it was to communicate under fire, and why there were so many missteps and conflicting messages.

#### CAN TECHNOLOGY OPEN UP EDUCATION TO MORE STUDENTS?

What observers reported at Sharpsburg went far beyond sheer physical location. While we can't know what any observer actually thought, the form of representation and symbol system used by each witness profiles a characteristic way of thinking. Reporters from the *New York Tribune* and the *Charleston Courier* used words to fashion strikingly different descriptions of events, actions, and personalities. Alfred Waud, the artist who did pencil and chalk sketches for *Harper's Weekly*, drew aspects of the conflict in which he paid careful attention to the nuances of soldiers' positions and facial expressions. The signal officers did more than just wave flags to encode messages; by the force and speed of their motions, they conveyed to those far away the pace and tension of the battle.

If we believe that the mind is neither singular nor revealed in a single language of representation, our use of technologies should reflect that understanding. Technologies like CD-ROM that include a variety of media may well be able to help more students form rich representations of an event and cultivate deeper understandings. However, it is unrealistic to expect this to happen by simply adding more information and more media. Instead, our authoring has to have the explicit goal of greater access for more students, and we need ways to assess what and how they have learned.

**T**he guided paths in *Antietam/Sharpsburg* provide one example of what such authoring might be like. There are four paths, ranging from structured to exploratory, for learning about the battle: map, observers, battlefield walk, and archives and activities. None relies exclusively on language, and each instead provides several means of representing the battle. The

"map" path uses a collage presentation of photographs, historical images, text, and audio to present an overarching narrative of the battle and suggests some of the reasons why the battle was important in the war.

The "observers" path uses physical representations left by the eyewitnesses to convey details of events from multiple perspectives. At any point it is possible to leave both the map and observers paths in order to browse additional related material and then return to the presentation.

Some people may find the ebb and flow of battle to be incomprehensible without a walk through the landscape to trace out the movements of troops at each site. By means of virtual reality movies, the "battlefield walk" path in *Antietam/Sharpsburg* allows one to "walk" the sites and learn things about the battle that can be understood only by experiencing the landscape. Through photographs assembled as motion sequences, it is possible to feel what it was like to fight in the dense tangle of trees in the North Woods or what it was like to look over the hill at the approaching enemy from the Sunken Road.

Like the other paths, the "archive and activities" path provides different modes of interacting with the material—this time with only one's own direction. There are options to browse the image, text, or reference archives. Here, too, the goal is to help more students know an event in its complexity, in ways that encourage richer mental representations and forms of understanding. For unless students have opportunities to learn in ways compatible with their variety of minds, school will continue to benefit only students who are strong in traditional linguistic and logical ways of thinking.

#### HOW CAN WE KNOW WHAT STUDENTS LEARN?

Students who understand the battle at Sharpsburg should be able to show this understanding in several ways. Some students might use language to argue, question, and make connections to other battles, other units of study, and their own lives. Others might explain the course of the battle and thereby show that they have worked out a narrative story. Students might also display their understandings by means other than words. They might put on a play, make a series of sketches or a short video, compose martial or funeral music, or

portray the battle in signal or Morse code. They could even use several media to publish a page on the World Wide Web.

As more students use virtual environments like CD-ROM, we must be resourceful in providing ways for students to demonstrate what they have learned. We cannot assume that these new media are better—or, for that matter, worse—than more traditional modes. Rather, we must search for direct evidence that students more fully appreciate the need to take into account multiple perspectives, the partially subjective nature of interpretation, and the risks of a simplistic "good/bad" interpretation of complex events. New technologies provide avenues for demonstrating these understandings; but producing assessments that differentiate genuine from surface understanding constitutes a significant challenge.

**W**e also need to think critically about the risks and benefits of products like *Antietam/Sharpsburg*. For example, students might seem engaged but understand little because their response reflects more an attraction to the medium than an understanding of the battle. Interpretation may become overly subjective and relativistic in the absence of canonical text. Additionally, working extensively with one battle requires time, which means sacrificing coverage of other relevant aspects of the war.

On the other hand, such mediated experiences may enable students to engage rich, textured material in ways that give a more rounded understanding. They may also be encouraged to think more creatively and critically by encountering material and mastery that goes beyond summary text. Structures like guided walks can minimize media meanderings or cul-de-sacs. In fact, an experience that encourages understanding in a closed environment like a CD-ROM may ultimately benefit students more than unlimited access to unstructured information on the Internet. The CD-ROM might help students develop a search strategy for the Internet, one based on information needed to further their understanding of some particular aspect of the battle or war. One student might use the American Memory collections at the Library of Congress, for example, to see how Alexander Gardner's photographs of the battlefield at Sharpsburg compared with his earlier work; another might want to read soldiers' letters from the battlefield.

But beyond a specific technology like CD-ROM, we need to think about any technology in relationship to our educational goals. For how we use our technology is but one way students will learn to value deeper forms of understanding and find ways to use their own abilities. For example, how we use an application like *Antietam/Sharpsburg* will depend on whether our goals are to teach historical reasoning, to allow individuals to make sense of original sources, to sensitize students to the radically different perspectives of various observers and various participants, to appreciate analogies for the battle of Antietam (for example, contemporary Bosnian battlefields), or to explore the relationship of traditional historical texts to a television series such as *The Civil War* by Ken Burns and fictional works like *Gone With the Wind*. Unless educators are clear about these goals and their own priorities, the technology will become a tool of obfuscation rather than clarification.

**U**nlike some spheres of society, few ideas in education are wholly new. There have always been educators who have sought to enhance student understanding, educators who have tried to understand the minds of all of their students, and educators who have exploited the latest technology. By the same token, none of the aims we have outlined depend specifically on CD-ROM technology. The ingenious teacher of times past could make available different perspectives of an event, use various media of representation, and even lead students through a real or imagined trek across the battlefield.

Yet sometimes a series of quantitative differences can yield a qualitative difference. New multimedia work, such as the CD-ROM we have described, may enable ordinary students to gain an understanding that may have been accessible only in the extraordinary classroom in years past. Moreover, the actual procedures used in such a mediated presentation—for example, the guided walk, the ready shift across perspectives—may stimulate the development of new mental representations that can be used in the study of other topics, even when a CD-ROM may not be available.

To be sure, the technology in itself cannot spawn a revolution in educational approaches or results. Even as it was possible in earlier days to have a rounded understanding of the Sharpsburg

battle, it would be possible tomorrow to use the CD-ROM to pursue quite banal goals, such as a comparison of the facts that are provided in the different written reports. Here teachers' favored forms of assessment give away the game: It matters enormously whether a well-crafted unit on the battle of Antietam culminates in an objective multiple-choice test, a straightforward request to recite or narrate the principal events of the battle, or the posing of a provocative comparison to be discussed in essay form. It is even possible to fashion more ambitious and adventurous forms of assessment, such as the creation of a multimedia work of art that captures the response to Alexander Gardner's photographs, or a teaching lesson for younger students using *Antietam/Sharpsburg*. These more adventurous forms give maximum opportunities for students to draw on their own distinctive blend of intelligences, thereby both giving them new venues for demonstrating their understandings and broadening the ensemble of possibilities for their peers and their teachers.

**N**early every serious student of contemporary education agrees that we need to make concerted efforts to reach a greater proportion of youngsters with a variety of intellectual strengths and styles, and that the education we offer them should proceed from the mastery of facts to the capacity to understand and interpret. These more ambitious goals do not themselves depend upon the cognitive revolution, but the cognitive revolution has stimulated a better understanding of how students learn as well as the production of more effective educational materials.

European and Asian countries routinely surpass the United States in educational accomplishments, not because their technology is more glitzy, but because the educational enterprise is taken more seriously. Technology in itself cannot alter our scholastic trade deficit. But by reorienting our educational mission and judiciously designing and using technology that meshes with that mission, the United States—and other nations—can achieve far more success with much larger numbers of students. The approach we have described represents one of a growing number of promising innovations that can be readily put into practice and rigorously assessed—and even enjoyed for their intellectual and sensory pleasures. □