TEACHING FOR DEEP UNDERSTANDING

What Every Educator Should Know

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We root our case for deep understanding as the overarching goal of public schooling in six straightforward claims.

1. Many specific facts have a very short half-life.
2. You can have your cake and eat it too (or you don't need to trade off good test results).
3. The experience of deeply understanding something encourages further learning.
4. Most real-life tasks require serious, self-directed problem solving.
5. The broader context of our lives places a premium on deep understanding for survival.
6. The alternatives are not very compelling . . . If not deep understanding, then what?

OUR CASE FOR DEEP UNDERSTANDING

Schools now live in a policy world populated, for example, by the No Child Left Behind Act, which requires schools to meet annual yearly performance targets, weeks of time consumed by student testing, a narrow focus on literacy and numeracy, the constant threat of school reconstitution if external achievement standards are not met, and a host of other demands for greater public accountability. In this world, deep understanding, on the face of it, seems an unlikely focus for teaching and learning. Rather, the natural press would seem to be toward the achievement by students of ever more specific, explicit, and readily measured outcomes. This book is about why such a direction actually thwarts the aspirations most of us have for our children and what we can do about it. It aims to arm teachers, school and district administrators, teacher union staff, teacher educators, and parents with the knowledge needed to foster deep understanding among students on a large scale.

Our motivation for developing this research partnership was the conviction that deep understanding for all students ought to be—but is not currently—the overriding goal for public schooling. Deep understanding seems like such an obvious purpose for education that, at first blush, making a case for it, as we do in this book, may seem unnecessary. All teachers assume that students' understanding (depth aside) is the purpose of their instruction—certainly, none would claim to be teaching for misunderstanding or shallow understanding.

Whether assumed and obvious or not, there are overwhelming indications that, at all but the most advanced levels of education, deep understanding is rarely achieved by most students. Many of our own adult students, for example, have told us that until they became immersed in their doctoral research, formal education had simply expanded their superficial understanding of an increasing amount of codified knowledge in their chosen fields of study.

The North American Curriculum

It is often said that the purposes of schools are unclear and often contested, in spite of an official curriculum in most states and provinces literally teeming with things to be "covered." This only goes to illustrate, once again, the difficulty of seeing the forest when one is constantly required to focus on the trees.

The Canadian province of Ontario, the context in which we did this work, shares with many states and provinces a similar orientation to accountability. A key feature of this orientation is the proliferation of expectations or standards to be met by students. Their sheer number makes it extremely difficult either to discern the overall image of an educated person in any holistic way or to achieve deep understanding in relation to any one of them. "More is less" when deep understanding is the goal. Using the Ontario curriculum as a case in point, by the end of the eighth grade, elementary school students are intended to encounter, learn, or otherwise come to grips with a total of 3,993 specific expectations (we counted)! On average, there are about 500 specific expectations

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for each grade until Grades 7 and 8, where specific expectations jump significantly (to 584 and 586 in Grades 7 and 8 respectively).[1]

If the school day averages five hours and the school year 190 days, students have about 950 hours to meet about 500 specific expectations, or about 1.9 hours for each expectation, at least theoretically. Of course, not all five hours of each day in an elementary school is focused on the curriculum.[2] So the real time per expectation is probably closer to 1.5 hours. From a teacher's perspective, this means 1.5 hours to ensure that all 25 to 35 students in one's class master each expectation, roughly 3 minutes per student. Seems a bit tight, doesn't it?

The curriculum for many North American school systems has often been described as "a mile wide and an inch deep." Small wonder.

In this book, we provide some perspective on the forest that is the North American curriculum. We describe what it feels like to be a teacher shepherding one's students through this forest. Suffice it to say, for the moment, that there is quite a lot of prickly and annoying underbrush to cut through to make much progress with one's charges. And before we dismiss such annoyance as trivial, we should remind ourselves of the central role that student welfare plays in the job satisfaction of our best teachers.[3] If teachers are annoyed and dissatisfied with the curriculum, we should be concerned about the value of that curriculum for our children.

THE CASE FOR DEEP UNDERSTANDING

Arguments about the purposes of schooling are often couched in either highly philosophical or ideological frameworks. We think that neither approach is actually very helpful for engaging a large proportion of either professional educators or policymakers, not to mention the public. So instead, we root our case for deep understanding as the overarching goal for public schooling in six straightforward claims.

Many Specific Facts Have a Very Short Half-Life

It's hardly news that what we hold to be true is always evolving, so we don't think this claim requires much defense. Regarding the physical world, for example, while what we observe directly may seem undeniably factual, our explanations for what we observe and how things got to be that way have gone through at least several paradigm shifts in the space of most of our lifetimes. In the medical world,

[1]The Ministry of Education is currently reviewing the curriculum. The Social Studies/History and Geography curriculum has been revised and is being implemented in 2005–06. However, the expectations have been reduced only slightly; some of the expectations have been combined; and many of the concerns expressed by elementary teachers were not incorporated into the revisions.

[2]There are, for example, snow suits to be contended with, voluntary activities such as Jump-Rope-for-Heart, bomb threats to be dealt with, upset students who require the immediate and full attention of the teacher, bus delays, and so on.

[3]See, for example, Desimone and Le Floch (2004).

recommended treatments for many illnesses change every decade at least in response to rapidly changing understandings about how the body works. As an example from the social sciences, dominant explanations for how people learn have shifted quite fundamentally as behavioristic, information processing, and social constructionist theories have gained and then waned in support among learning theorists; "brain research" has begun to dominate many people's beliefs about how learning occurs. Even our understanding of historical "facts" changes as we adopt different lenses on the past.

That said, some would argue that there is a corpus of facts and concepts that children should master if they are to participate in the human conversation. Advocates of this view, perhaps most notably Hirsch (1987), go so far as to list these facts and argue for their inclusion in the curriculum. Adopting deep understanding as an overriding goal for education does not come into conflict with this position as directly as might seem to be the case. After all, the recommended corpus of facts and concepts likely does dominate the conceptual starting points that many people share in order to unpack the meaning of their present experiences. Furthermore, the curriculum must have some subject matter to understand. But when deep understanding is the goal, subject matter is the stimulus for thought and exploration—not just the facts to be memorized.

You Can Have Your Cake and Eat It Too (or You Don't Need to Trade Off Good Test Results)

For those attracted to a curriculum that emphasizes the mastery of predetermined knowledge and skills, adopting deep understanding as an overriding goal for schools should be particularly compelling. Growing evidence suggests that students benefit from a curriculum that fosters deep understanding; they perform at least as well as and sometimes better than students not so exposed on the tests typically used to assess student progress and hold schools accountable for student performance.

This claim has received support in several recent analyses—see, for example, Weglinsky's (2004) analysis of evidence from both the U.S. National Assessment of Educational Progress (NAEP) and the Third International Mathematics and Science Study (TIMSS). Both sets of data allow for the comparison of student performance on basic skills with performance on critical thinking, higher order thinking skills, and other outcomes associated with understanding. As well, both sets of data provide information about the forms of instruction used by teachers. Across most subjects, both sets of data associate better student performance with forms of instruction that emphasize deep understanding.

A review of evidence from TIMSS, as well as a half dozen other sources, came to a similar conclusion (Tighe, Seif, & Wiggins, 2004). And Ross and McDougall (see Chapter 5 of this volume) conclude from their review of a wide array of additional evidence about mathematics achievement:

> You would expect that students who were taught in traditional ways would do better on traditional objectives, but this is not the way it turns out. In most studies of this type, students who have been taught using the deep understanding approach do better on traditional tests than students who were taught using traditional methods. (p. 36)

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Technology for Understanding

Marlene Scardamalia

In this chapter, Marlene Scardamalia discusses determinants of understanding—prior knowledge, discourse, and effort to understand—and how information and communication technologies address these factors. She points out that technology is seldom used to promote deep understanding, but it could, and should be.

1. Is the technology used in your school appropriate for teaching for deep understanding?
2. How does your current use of technology enhance or detract from teaching for understanding?

The learning sciences are a relatively new field, located at the intersection of learning research and technology development. Problems of understanding have been a focus of research in the learning sciences over the past quarter-century. Much of this research has dealt with problems of understanding in particular subject areas, but learning science research has also yielded general findings relevant to achieving understanding in all areas. The following three factors deserve special attention because they are often neglected in both traditional and constructivist approaches to teaching for understanding:

1. Prior knowledge—Prior knowledge is a major determinant—frequently the major determinant—of what will be understood and also of how it will be understood. Prior knowledge provides the framework, schema, or mental model within which new information is interpreted (Anderson & Pearson, 1984). Misconceptions typically arise when prior knowledge differs in a fundamental way from the intended knowledge.

2. Discourse—Experiments, observations, reading, and various kinds of firsthand experience yield information. The converting of such information into knowledge does not take place automatically. It requires reflection, which in turn depends preeminently on discourse (Brown & Campione, 1996). Discourse that is limited to the sharing of information and opinions does not serve this reflective purpose.

3. Effort to understand—Activities such as experimentation and use of manipulatives frequently fail in many students to produce the desired understanding. Further investigation shows that those who achieved it were actively trying to understand whereas those who failed to grasp the intended principles focused only on the activity itself (Bereiter & Scardamalia, 1989).

Information and communication technology (ICT) approaches to teaching for understanding differ considerably in the ways they deal with or fail to deal with these three factors.

ICT DESIGNED TO PROMOTE UNDERSTANDING

Three distinct lines of ICT development have implications for increasing depth of understanding:

1. **Computer-assisted instruction (CAI)**. The teaching of concepts and principles has been a major interest of instructional scientists working in this field. Designers of CAI aim to optimize presentation sequences for information, thus enabling students to master designated concepts.
2. **Simulations, games, laboratory tools, and other hands-on resources**. ICT has considerably expanded the possibilities of "learning by doing" in the classroom.
3. **Supports for explanation, argument, and knowledge building dialogue**. These range from the ubiquitous threaded discussion forums to software environments expressly designed for sustained work with ideas.

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The most commonly used ICT in schools, however, is not any of these. It is productivity software—word processors, presentation software, spread sheets, facilities for producing Web pages, and so forth—designed for business use. An international survey showed this to be the case worldwide, even in schools identified as innovative (Kozma, 2003). Although there are special versions of productivity software for schools, they are

generally simplifications designed for ease of use but otherwise similar to the business applications. One might expect such technology to be neutral as regards learning with understanding, but in fact, there are growing complaints that it encourages attention to presentational style rather than content, thus militating against pursuit of understanding. (Such complaints are arising even in the business literature: Executives are accused of lavishing too much effort on flashy presentations and not enough on the quality of information and ideas.)

Another widely used type of ICT that is ostensibly neutral with regard to understanding is course delivery systems. Developed for higher education but now making their way into schools, course delivery systems are essentially tools for putting conventional courses online. Hence, they provide for electronic reading lists; online lectures, readings, and other instructional "objects"; and electronic submission of course assignments, quizzes, discussions, and e-mail communication between instructor and students. As in conventional courses, teaching for understanding is the responsibility of the instructor or course leader and depends on the kind of information delivered and the kinds of activity promoted. Far from being neutral with regard to pedagogy, course delivery systems transfer traditional courses to an online format, along with their bias toward information transmission rather than constructivist educational approaches.

Most of the CAI used in schools is of the drill-and-practice variety, which makes no pretense of teaching for understanding.

The remainder of this chapter concerns itself with the three ICT approaches that are directly aimed at teaching for deeper understanding. In all of these cases, it is difficult to make general evaluative statements because quality ranges from low to high. Also, there is so much diversity within each type that it is difficult to say what constitutes quality. We can, however, point out some of the less obvious strengths and weaknesses of each type of resource and offer suggestions about how ICT may be used in efforts to foster deep understanding.

IMPLICATIONS FOR TEACHING

To serve purposes of deepening understanding, schools should be using technologies that provide students with . . .

1. Simulations that allow for deeper exploration
2. Discourse that supports sustained inquiry and idea improvement
3. Web search tools that zero in on explanatory rather than merely topical information
4. Knowledge building environments that provide a coherent framework for pursuit of understanding

Such technologies exist but are underused.

COMPUTER-ASSISTED INSTRUCTION

The oldest of the three approaches, CAI, varies from simple drill-and-practice software to sophisticated applications that use artificial intelligence to gauge the state of the learner's knowledge and to select strategic moves to enhance it. Most of the CAI used in schools is of the drill-and-practice variety, which makes no pretense of teaching for understanding. This is true even of most programs that purport to teach reading comprehension or mathematical problem solving. In effect, they merely provide drill and practice on comprehension or problem-solving test items. Nevertheless, instructional design theory, the scientific discipline underlying CAI, has been much concerned with teaching for understanding, and there are CAI programs in science,