CHAPTER

7

The Wisdom of Practice: Lessons Learned from the Study of Highly Effective Tutors

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> One can predict that in a few more years, millions of school children will have access to what Phillip of Macedon's son Alexander enjoyed as a royal prerogative: the personal services of a tutor as well-informed and responsible as Aristotle.
>
> —*Suppes (1966, p. 207)*

As Suppes (1966) notes, for thousands of years, there has been general agreement about the most effective means of teaching children, namely, the individual tutorial. From the ancient Greeks and Romans through the Age of Enlightenment, the children of the rich and powerful (and any others lucky enough to receive any formal instruction) were educated by professional tutors. Even in the midst of the heated debates about the nature of children that characterized 17th- and 18th-century Europe, thinkers as diverse in their

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philosophies as Locke, Hobbes, and Rousseau all agreed on the unsurpassed efficacy of individual tutoring.

Today, as we enter the 21st century, tutoring remains the ideal, the gold standard as it were, of education. In one particularly prominent review of the literature, for example, Benjamin Bloom (1984) documented the major gains in performance that typically result from one-on-one tutoring and suggested that the central task for educational researchers remains the search for other, it is hoped, more practical and cost-effective, instructional techniques that might produce effects on student learning and motivation as powerful as those of personal tutelage. Indeed, even programs in which slightly older students are asked to serve as personal tutors for their younger schoolmates appear to produce substantial gains in both learning and motivation (e.g., Levin, Glass, & Meister, 1984).

At the same time, despite its obvious effectiveness, tutoring has received, until very recently, surprisingly little experimental attention (Wood, Bruner, & Ross, 1976). Presumably, the lack of research interest in tutoring is primarily the result of its high cost, at least as compared with traditional group-oriented instructional methods where single teachers are responsible for teaching 30 or more students. In most public schools, individual tutoring remains a luxury and a rarity. Even today, it is primarily the children of the well-to-do who are able to benefit from individual tutoring, which is paid for by their families, along with a much smaller number of less-advantaged children identified by their schools as requiring exceptional levels of assistance, who receive some individualized instruction as part of various targeted remediation programs (e.g., Clay, 1991; Slavin, Madden, Dolan, & Wasik, 1996).

In the past 10 to 20 years, however, a number of researchers have begun to investigate the process, and not just the results, of tutoring—to examine what makes tutoring such an effective instructional technique. Interestingly, this recent interest has stemmed in large part from the advent of powerful personal computers with the potential, as Suppes had noted in the earliest days of computing, to provide a cost-effective means of providing each child with an individual tutor (e.g., Lajoie & Derry, 1993; Larkin & Chabay, 1992; Lepper & Chabay, 1988; Putnam, 1987; Wenger, 1987). Although there are many ways in which computers are different from people and many things that computers can do better than people, it has seemed to many recent researchers that a better understanding of the dynamics of successful human tutoring might help us to design more effective computer tutors as well (McArthur, Stasz, & Zmuidzinas, 1990; Merrill, Reiser, Merrill, & Landes, 1995).

BACKGROUND

Certainly, this was true in our own case. Having first become interested in the educational uses of computers as a particularly felicitous laboratory for study-

ing both the determinants of children's intrinsic motivation and the effects of different forms of motivation on children's learning (Lepper, 1985; see also Cordova & Lepper, 1996; Parker & Lepper, 1992), we subsequently came into contact with a variety of earlier efforts by cognitive scientists to use the computational power of the computer to design "intelligent tutoring systems" (Sleeman & Brown, 1982; Wenger, 1987). Generally, these programs seemed well-designed for the efficient transmission of information and feedback to the student, based on that student's current knowledge and misunderstandings of the topic, as assessed by research in cognitive psychology. Indeed, it was often exciting to see these designers building research findings from psychology and education into their programs.

These same programs, however, often seemed to take little account of the affective, motivational, and socioemotional states of the student. Instead, they frequently seemed to presume that the student using these systems would be constantly attentive, highly motivated, and concerned solely with learning as much as possible in as little time as necessary. How else could one explain the existence of tutorial computer programs like the one that sought to correct the fundamental misunderstandings of a struggling remedial student who had asserted that 87 multiplied by 43 yielded 32 with the following pithy commentary:

> Your answer is wrong.
>
> Possible causes of error:
>
> 1. You multiplied the number in the multiplicand by the number directly beneath it in the multiplier, and you wrote down the carried number, ignoring the units number.

It seemed almost as if programs like this were being designed for robotic, rather than for human, learners—for pupils whose sole mission in life was to improve their task performance as rapidly as possible.

Such assumptions seemed to us unrealistic, especially since these tutoring programs were often explicitly designated as having been designed for use with previously unwilling and unsuccessful students, already identified as requiring remediation in a given area. We began, therefore, to search the educational literature for research on the actual process of tutoring that might help us to highlight the importance of motivational as well as cognitive factors in the tutoring process that we had found missing from the research on computer-based tutors. Surprisingly, although there were clear demonstrations of the overall instructional effectiveness of such techniques, there was virtually no relevant literature on the process of one-to-one human tutoring. In contrast to the many volumes that had been written regarding teaching techniques in the standard classroom, where one teacher must simultaneously seek to instruct and motivate 30 different children who vary in their current levels of

achievement and motivation, almost nobody had tried to examine the tutorial process systematically.

Of course, it is possible at a glance to identify several general factors that undoubtedly contribute to the greater effectiveness of tutorials, compared with traditional classroom practices. Most prominently, tutorials provide a venue for learning that is inherently more individualized, more immediate, and more interactive than most common school settings. Let us consider each of these factors, briefly, in turn.

Individualization. First, and more obviously, the tutorial is inherently individualized. In contrast to standard classrooms, in which single teachers must divide their attention and energies across 30 different students, the student in a tutorial session has the complete attention of the tutor. This individualization, in turn, permits the tutor to elicit from each student a much higher level of on-task attention and effort. It is, in addition, a virtual prerequisite for the high levels of both immediacy and interactivity that also characterize the tutorial process.

Immediacy. Thus, in an individual tutorial, both knowledge of results and other forms of feedback and instruction are received by students as, or shortly after, they work on specific problems or activities. Reinforcement for correct work is therefore more effective, and constructive feedback is more likely to be understood and receive attention. Corrections can be made "on-line," and general principles can be related to specific instances at once. This situation is quite unlike much of current formal education in the classroom where homework assignments, papers, and problem sets are often returned with grades and other relevant feedback days or weeks after completion of the work itself.

Interactivity. Similarly, instructional methods in a tutorial are typically more interactive than those in a normal classroom, in the sense that the tutors' choices about what activities to present, what assistance to offer, what encouragement to give, and so forth usually depend heavily on the tutors' careful observations of their students. Both tutors' goals and strategies, in short, depend on information they receive from students (both verbal and nonverbal) and on their perceptions of the current skills and knowledge and the current level of motivation of their tutees. As a result, tasks, feedback, instruction, encouragement, and so on, can all be tailored to the cognitive and motivational profiles and requirements of individual students.

Although these general considerations are of critical importance, our hope was to understand better the more detailed dynamics of successful tutorials. If we wanted to see what more specific factors were critical in producing the substantial gains that individual tutoring seemed capable of producing, how-

ever, it appeared we would have to investigate that question ourselves. In the end, we decided to do just that.

STUDYING "EXPERT" TUTORS

The remainder of this chapter, then, seeks to provide a brief overview of some of the main findings of a set of studies, conducted over the past decade, of what makes individual tutoring such a successful educational method (e.g., Lepper, Aspinwall, Mumme, & Chabay, 1990; Lepper, Drake, & O'Donnell-Johnson, 1997; Lepper & Chabay, 1988; Lepper, Woolverton, Mumme, & Gurtner, 1993; Woolverton, in preparation). Some of these factors, as we shall see, are fairly obvious. Others are less so, though, and become apparent only after detailed observation and careful study. These latter, more subtle factors in the success of the tutorial method, we believe, are often the result of successful tutors trying to accomplish sometimes conflicting cognitive, information-transmittal, versus motivational or affective, goals at the same time, as we describe later in this chapter.

Our studies involved a simple procedure. First, we sought to identify individuals who seemed likely to be highly effective as tutors. We did so by asking a number of schools, teachers, and tutoring agencies to identify for us people whom they considered particularly qualified and highly effective (or likely to be highly effective) as individual tutors. We then interviewed these nominees and, once we had documented that they had indeed had experience in teaching or tutoring in the relevant domain and age range, invited them to participate in our studies by actually serving as a tutor for a number of different students.

These tutoring sessions were videotaped and transcribed for analysis. Learning by the tutees was assessed via traditional written tests on the material covered, which were administered both before and after the tutoring sessions. Motivation was assessed via self-report measures as well as ratings of the videotaped sessions. In addition, tutors were asked to watch the videotapes of their own sessions and to provide a running commentary on what they could recall about what they had been thinking and feeling and what options they had been considering as each session progressed. A number of our best tutors were also interviewed more generally regarding their perceptions and philosophies about tutoring.

To simplify our analytic task somewhat, in all of our studies the topic of study involved some aspect of elementary mathematics, ranging from basic addition to fractions to multistage word problems. Similarly, the students who served as our tutees were all elementary school students who ranged, depending on the topic under study, from first through sixth grade. In most of our studies, as well, the students selected as tutees had been identified by their schools as particularly in need of remedial help on the topic, although we

have recently also collected data from one sample of highly successful students who will serve as a contrast group as well.

Highly effective or "expert" tutors were then identified on the basis of their actual degree of observable success, across a number of different tutees, in promoting student learning and motivation. The tutoring sessions conducted by these highly effective tutors were analyzed from a number of perspectives and were contrasted with tutoring sessions conducted by less experienced or by equally experienced but objectively less successful tutors. The goal of our analyses was to begin to identify the goals, strategies, and specific techniques that might contribute to the success of an individual tutorial.

SOME GENERAL PRELIMINARY FINDINGS

Before we turn to the results of our comparisons between more and less empirically effective tutors, however, there are a number of preliminary findings from this project that will help to contextualize these comparative results. Let us begin by highlighting these general findings, then, if only in capsule form.

The Tutorial Process

The first "preliminary" finding from our observations of tutorial interactions is that there were, at least in the domain of mathematics, some general commonalities in the nature of the typical tutoring sessions that seemed to be shared by virtually all of our experienced tutors, regardless of their level of relative success. Specifically, there seemed to be in our tutoring sessions a series of recurrent phases, in which the goals and strategies of the tutors characteristically shifted as their students received problems, assistance, feedback, and instruction. Because a knowledge of this "phase structure" of the tutoring sessions will provide a useful background and context for understanding the differences between more and less effective tutors to be considered below, it is worth outlining this structure here.

In particular, once past an initial "introduction" period (in which tutors typically introduced themselves and the topic that was to be studied, and sought to establish some initial rapport with the student), most of the tutoring sessions we observed showed the following recurrent sequence of phases as students worked through a series of problems:

Problem selection. First, the tutors selected a problem for presentation to the student. These selections were based, in large part, on the tutors' diagnoses of their students' current knowledge and (mis)understandings of the material to be covered and on their perceptions of the students' present motivational state. In this initial phase, the tutors' general goal seemed to be to select a problem that would provide either a good learning experience, a

motivational boost, and/or an opportunity to gain diagnostic information about the students' current state of knowledge and misconceptions.

Problem presentation. Second, the tutors presented the selected problem to the student, often accompanied by various encouragements, exhortations, admonitions, or problem descriptions. In this presentation phase, the tutors' main aims seemed to be to provide students with helpful information or forewarning about features of the problem and/or to motivate students and encourage their involvement and persistence at the activity.

Problem solution. In the third phase, control shifted somewhat to the tutee, as the student proceeded to try to solve the problem that had been presented by the tutor. During this third phase, typically, tutors sought to provide sufficient scaffolding, assistance, encouragement, and feedback to permit their students to reach a correct solution to the problem. Only very rarely, however, did tutors (once a problem had been presented) actually provide the students directly with correct solutions or explicitly direct them in correct solution procedures.

Reflection. Once the problem had been correctly solved, tutors frequently sought to encourage the student to reflect on the solution process—to articulate the meaning of the problem, to discuss the lessons that had been learned or the steps that had been followed, or to consider the relationship of this problem to other problems or to other contexts.

Instruction. Finally, when necessary, tutors can provide fairly direct instruction about concepts or procedures that the student has not previously encountered. Because our particular tutoring protocols involved primarily remedial students who had already been exposed at some length, and without much success, to didactic instruction on the topics to be covered, this phase proved relatively uncommon in our sample. In other uses of tutoring to present new concepts and procedures, however, such concerns would presumably prove much more crucial and prominent.

A General Framework

A second crucial background finding is that our best tutors seemed to devote constant and considerable attention to motivating and providing emotional support for students, as well as to simply providing feedback and transmitting information. Indeed, the simultaneous focus of effective tutors on both affective and cognitive factors in the tutoring process is itself one central feature of our general model of expert tutoring. Although space limitations preclude an extended presentation of this analysis, our basic presumption is that highly successful tutors seek to develop and maintain a "working model" of each

tutee that encompasses both the current emotional and knowledge states of their students, updating the working model as they gather more information and observe the students progressing through the tutoring session.

Indeed, for purposes of understanding the goals and strategies of excellent tutors, it has proved to us a useful oversimplification to think of these tutors as constructing and maintaining two separate types of diagnostic models of their students.

Cognitive models. The first of these involves a cognitive model that is focused on the student's current state of knowledge/ignorance and on the possible systematic misunderstandings or "bugs" that may characterize that student's understanding of the material. Here we have in mind the sort of diagnostic informational model that has long been assumed and studied by those involved in the design of intelligent tutoring systems (e.g., Burton & Brown, 1979; Sleeman & Brown, 1982; Wenger, 1987).

Motivational models. The second of these, by contrast, involves an affective model that focuses on the student's apparent current level of motivation, attention, interest, and self-confidence in the relevant domain of study. Diagnostic models of this latter sort, concerning student motivation, have received considerably less attention in previous research (del Soldato & du Boulay, 1995; Derry & Potts, 1998; Lepper & Chabay, 1988).

Both of these working models, we presume, are continuously modified and updated during the course of an effective tutoring session, as tutors watch students confront, solve, discuss, and/or fail to master actual problems. Subsequent judgments and decisions about tutorial goals and strategies are then predicted to be, in an interactive and responsive fashion, a joint function of the tutor's models of these two aspects of their students' current functioning. In particular, there are obviously three basic relationships that may exist between the pedagogical implications of a tutor's hypothetically separate models of an individual tutee's present cognitive and present motivational states. At any particular choice point in a tutoring session the implications of a purely cognitive versus a purely motivational analysis may be either entirely congruent with one another, simply independent of each other, or directly in conflict with one another. Each of these three cases, we believe, has different implications for what decision the tutor is likely to make.

Consider, for example, the simple case of a tutor making a decision about what problem to next give a particular student, under these three different conditions:

Congruent. First, the tutor's cognitive versus motivational diagnoses about the student may yield implications for action that are entirely congruent with one another. If the tutor infers (for instance, from the student's immedi-

ately prior successful performance on several problems of the same type) that the student both (a) fully understands and (b) feels completely comfortable with a particular type of problem, then the situation is simple. Both cognitive and motivational analyses would suggest that the next problem to be presented should be significantly more difficult than the problem just solved. Moreover, since such a decision follows from both models, we would expect this decision to be an easy one for tutors, and we would expect most tutors to behave in the same fashion when faced with this same situation.

Independent. A second possibility is that either the tutor's cognitive or motivational analysis independently suggests some decision that might have positive effects on one dimension, without any direct effect on the other.[1] If the tutor, for example, believes that the student (a) fully understands the current problems, but (b) is entirely disinterested in the task at hand, the tutor may decide not only to select a more difficult problem, but also to present that problem in a context that is personalized according to the student's interests (e.g., a problem involving sports or music).

Conflicting. Finally, a tutor's cognitive versus motivational analyses may point in precisely opposite directions. Thus, a tutor who feels that the student (a) does not understand the problem well but (b) is nonetheless overconfident and anxious to move to more complex problems may experience a sense of clear conflict, and that tutor's decision may depend on his or her perception of the relative strength and importance of these two competing factors for this particular student. In one such case, we have seen a highly effective tutor deliberately select a problem that the tutor expected would "look" more difficult to the student, without any increase in actual difficulty level; in another instance, we have seen an equally successful tutor choose to present a more difficult problem but with an unusually high level of verbal scaffolding designed to help the student avoid an abject failure. More generally, such cases of direct conflict between the implications of cognitive and motivational diagnoses are predicted to be most likely to prove difficult for tutors, to result in pedagogical "compromises" between efficient information transfer and motivationally supportive pedagogy, and to produce potentially counterintuitive tutoring strategies or techniques. Our discussion below highlights the ways in which truly expert tutors demonstrate these strategies and techniques.

[1]In the long run, of course, any strategies that do have an immediate positive impact on either learning alone or motivation alone should also have positive subsequent effects in both domains. Thus, even under highly controlled experimental conditions, "purely cognitive" factors that demonstrably enhance learning can also be shown to later enhance intrinsic motivation as well (e.g., Bandura & Schunk, 1981). Conversely, "purely motivational" factors that demonstrably enhance intrinsic interest can also be shown to later enhance learning as well (e.g., Cordova & Lepper, 1996).

THE "EXPERT" TUTOR

A critical finding from our observations of tutorial interactions, then, is that there *are* individuals who do seem to qualify as "expert" or highly effective tutors. Thus, in all of our samples, we were able to identify some tutors who proved empirically effective in promoting both learning and motivation, in all or virtually all of the students with whom they worked. The students tutored by these expert tutors showed, on independent measures of cognition and motivation, clearly greater gains than would have been expected solely on the basis of their initial levels of achievement in the domain.

In fact, by most standards, the progress achieved by our very best tutors in a limited number of individual sessions was often truly remarkable. These most successful tutors were not just effective; they were often superb. At their best, they were able to turn initially resistant, alienated, and seemingly helpless students into interested and excited participants in the learning process. At their best, they were able to help remedial students to progress through what would normally have been weeks or months of curriculum material in a very short time. Moreover, gains in students' learning remained apparent following and outside of the tutoring situation, showing that these gains were not simply the result of differences in the immediate support and scaffolding that tutors provided during the experimental sessions.

Similarly, another important finding was that there did seem to be some commonalities, on at least a number of dimensions, in the goals, strategies, and techniques of those tutors who were highly successful. Indeed, when we compared the various sessions conducted by our best tutors as they each worked with a number of different students, there was a quite surprising level of consistency in their individual approaches across different tutees. Although these top tutors were indeed very responsive to differences among the children they tutored, they did display characteristic styles of instructing and motivating students. Though quick to respond to differences in students, these tutors did so within a basic framework that they established and maintained. Equally important, there were at least some elements of these tutors' approaches that appeared in common across different particular expert tutors, suggesting the potential utility of an analysis of these common elements in the styles of these highly effective individuals.

THE *INSPIRE* MODEL

With this general background, then, let us turn to some of the more specific strategies and techniques that we found to be especially characteristic of our most effective tutors, as compared with their less effective or less experienced counterparts. Many of our specific findings from these comparisons, we believe, can be summarized in what Lepper, Drake, and O'Donnell-Johnson

(1997) have called the INSPIRE model of tutoring success. This acronym seeks to highlight seven critical characteristics of demonstrably "expert" tutors in our studies: the ways in which our best tutors proved simultaneously Intelligent, Nurturant, Socratic, Progressive, Indirect, Reflective, and Encouraging. Let us then examine each of these specific factors, in turn, in more detail.

Intelligent

It must seem like a truism to begin by asserting that highly effective tutors are highly knowledgeable and intelligent. Other things being equal, who would ever have argued the opposite? Nevertheless, it may still prove instructive to examine the several sorts of knowledge that our best tutors seem to possess:

Subject-matter knowledge. Certainly excellent teachers in any context must be expected to know thoroughly the material they are teaching. Still, we found ourselves impressed by the depth and breadth of the subject-matter knowledge that our top tutors displayed. For example, compared with their less effective counterparts, our highly effective tutors were more likely to provide relevant historical information about the topic that they thought might be instructive or motivating to students, and they were much more effective in using concrete manipulatives and visual models to help illustrate difficult problems to students. Perhaps most important, these top tutors seemed able to produce a much wider variety of real-world analogies that could be used to help students understand difficult new concepts, such as negative numbers and fractions.

Subject-specific pedagogical knowledge. Equally striking in our tutoring protocols were differences between our most and least effective tutors in what has been called subject-specific pedagogical knowledge. Our best tutors knew, for example, what sorts of problems were most likely to prove especially difficult for students or to elicit particular sorts of errors from them. They even seemed to know which sorts of problems were likely to *appear* more difficult to students even though they were not, and which sorts of problems were likely to *appear* easier to students than they really were.

General pedagogical knowledge. Finally, our best tutors also seemed to show greater general pedagogical knowledge than their peers. Thus, they were more likely both to use and to be able to articulate the variety of instructional and motivational techniques detailed in the following sections.

Nurturant

At the same time, our best tutors were not simply highly knowledgeable automatons; they were also highly supportive and nurturing of students. At the outset of

each tutoring session, for instance, they were more likely to begin by trying to establish some personal rapport with their students—conversing with the students about their interests in and outside of school, their friends and families, their teachers, and the like. Throughout the tutoring sessions, these tutors displayed warmth and concern. They were continuously attentive to their students, they empathized with students' difficulties, and they showed confidence in their students' ability to succeed at the task. Again, although such strategies may sound like they should be intuitive, we did on occasion witness sessions with less effective tutors that resulted in students crying or burying their heads in their hands, despite the fact that such tutors may have come highly recommended by school districts where they served as classroom teachers.

Socratic

In contrast to our first two features of intelligence and nurturance, which may seem self-evident as desiderata of good tutors, our third feature is potentially more counterintuitive. In particular, our best tutors seem to prefer a Socratic to a more didactic approach, at least when they are working with students who have a history of failure at the topic.

Questions, not directions. The first and most obvious feature of our top tutors' Socratic approach can be seen in their constant use of questions, rather than directions or assertions, in working with tutees. Although their questions may often be leading or informative, these tutors try to draw as much as possible from the student and to impose as little as necessary on the student. Indeed, more than 90% of the remarks that our best tutors make are likely to be in the form of questions.

Hints, not answers. In a related vein, our most effective tutors also seek to avoid directly giving students answers. Instead they prefer to offer hints or suggestions, to help students take the next step on their own. Moreover, good tutors often persist in this strategy, offering five or six hints in succession if their initial efforts prove unsuccessful in leading students to the correct answer. Indeed, if we did not have clear outcome data establishing the great success of these same tutors, it would be easy to believe that such an initially inefficient strategy might prove quite dysfunctional. Yet it appears that the advantages of this Socratic approach, at least with remedial students, must far outweigh its superficial inefficiency.

Productive versus nonproductive errors. Finally, in clear contrast to their less effective counterparts, our best tutors displayed a more highly nuanced and sophisticated understanding of the different types of errors that students may make (Lepper et al., 1997). Whereas our less effective tutors tended to respond in a similar fashion to almost any error that students made, our most

effective tutors distinguished different types of errors that had different implications for action by the tutor. At the simplest level, for instance, our best tutors would often simply ignore small errors, especially when these errors did not prevent the tutee from reaching a correct answer, although such errors might also lead these tutors to provide subsequent problems that examined these issues further. Our less successful tutors, however, seemed unable to let any error pass, no matter how trivial or inconsequential.

More important, our best tutors seemed to distinguish between what we might call "productive" and "nonproductive" errors. In particular, to these tutors, some student errors seemed "productive," in the sense that tutors believed that their occurrence would provide good occasions for students, with some subtle guidance from the tutor, to discover their own mistakes in a manner that would promote lasting learning. Such errors were therefore deliberately allowed to occur by the tutors, so that they could then be systematically "debuggged," as described below. By contrast, these tutors also believed that there were other student errors that (a) could be corrected only by a more direct and explicit intervention by the tutor, and (b) if left uncorrected, would lead the student down a dysfunctional path. When "nonproductive" errors of this sort occurred, then, these same excellent tutors were quick to intervene in a more immediate and direct fashion.

Progressive

Yet a fourth characteristic of our expert tutors concerns the planful and progressive structure they create in the tutoring situation. Aspects of this general approach can be seen in a number of domains, including tutors' selections of problems for presentation to students, their systematic techniques for addressing student errors and misconceptions, and their use of a variety of predictable routines across the tutoring session.

Problem progression. Thus, in contrast to many less effective tutors, our expert tutors clearly plan their tutoring sessions to involve a systematic progression of problem types of increasing difficulty or complexity. Although the rate of progression may vary considerably with different students, these better tutors always begin with problems deliberately selected to allow them to observe and diagnose their students' initial levels of knowledge and misunderstanding. Subsequent problems are then selected that provide opportunities for the correction of any systematic misunderstandings or "bugs" that students have displayed. Once students have proved competent and confident at a given problem level, then, new and more difficult problem types are introduced, and the same cycle of diagnosis, debugging, and increased difficulty is repeated. Surprisingly, our less effective tutors do not regularly use these seemingly self-evident tactics.

Systematic debugging. A similar, highly systematic progression is evident, in reverse, in our best tutors' attempts to correct or "debug" students' underlying misconceptions. Here, because these tutors' general goal is to prompt students to discover for themselves the reasons for their errors, excellent tutors who confront students who have made errors that reflect basic misunderstandings routinely begin with very general hints and questions. Only if these initial general prompts fail do these tutors start to become increasingly specific and pointed in their questions and suggestions, until the student attains the desired insight.

Progressive routines. Likewise, there is a more general sense in which the tutoring sessions of our most successful tutors are more systematic and progressive than those of our less successful tutors, because our better tutors are generally much more effective in structuring their tutoring sessions through the use of recurring routines. Such routines help to make clear to students the structure of the tutoring session and, in turn, help to focus the students' attention on appropriate issues at different phases of the tutorial. As students internalize this structure, less and less guidance is needed from the tutor to make the tutorial run smoothly.

Indirect

Closely related to this Socratic stance adopted by our most effective tutors is a fifth characteristic, namely, the indirect style that these tutors typically employ, especially in working with students known to have a history of difficulty in the relevant domain of study. Once again, as with their Socratic approach, it is the strength of tutors' commitment to this style, rather than its existence, which most impressed us in the protocols of our top tutors. These tutors are not just politely indirect with their tutees; they are excruciatingly so, and this indirectness can be seen in both the negative and the positive feedback they provide to students.

Negative feedback. Thus, few readers will find it surprising that our highly effective tutors are more likely to avoid overt criticism of their pupils. After all, direct negative feedback of this sort can clearly have deleterious effects on the motivation of students, especially those who have low levels of confidence in their abilities to begin with. What is rather more surprising, however, is that these tutors often manage to avoid *ever* saying *explicitly* that the student has made an error. Rather, in the face of an incorrect problem step or a mistaken answer to a question, these tutors are likely to pose a question that indirectly implies the existence of some error and, sometimes, the location of that error. Their goal is to prompt students into retracing their own steps and "catching" their own errors, while avoiding the negative motivational consequences of pointing explicitly to mistakes and failures on the part of the students.

Positive feedback. Less pervasive, but potentially even more surprising, are our findings concerning the positive feedback that highly successful tutors offer following student successes. For relative to their less successful peers, these top tutors also seem less likely to provide explicit or effusive praise to students, especially praise directed at the person rather than the process of problem solving. Although our less effective tutors appear to believe that frequent and profuse direct praise would prove motivating to their students, our outcome data suggest the opposite—that the adverse effects of turning the tutoring session into a highly evaluative context, at least for students at risk, may outweigh the potential benefits of greater positive reinforcement.

Reflective

To this point, our description of effective tutors may give the impression that these tutors are focused solely on procedural, as opposed to declarative, knowledge, on learning what, rather than why. Such an impression would be inaccurate, however, because our top tutors also devote considerable effort to encouraging reflection and articulation by students. More than their less effective counterparts, good tutors clearly seek to impart an understanding of underlying general principles, as well as specific procedures and strategies for solving problems.

This commitment to teaching for understanding can be seen in several related aspects of the protocols of highly effective tutors. These more effective tutors are more likely to ask students to articulate what they are learning, to explain their reasoning and their answers, and to generalize or relate their work in the tutoring session to other contexts and problems. At the same time, in keeping with their generally Socratic approach, it is important to emphasize that these tutors do most often attempt first to *elicit* these articulations, explanations, and generalizations from their students. These student-generated reflections may then be shaped and elaborated, if needed. Only when these tutors are convinced that such less direct tactics have proved insufficient, will they directly provide their own explanations or generalizations to their students.

Articulation. Thus, one common characteristic of our best tutors is their penchant for asking students to reflect aloud on what they have just done, immediately after a successful problem solution. In so doing, these tutors seek both to gain information from students about possible misunderstandings that might not have been evident from their solutions to the preceding problem and to help students to be able to understand, at a conceptual level, the operations they had used to solve the problem. Indeed, one particularly successful tutor had students keep a running, written list in their own words of the general "lessons" they had learned from the problems they solved during the tutoring session.

Explanation. Similarly, these tutors are also likely to ask students to explain their answers and their procedures, periodically, after successful problem solutions. If, as is often the case, students provide an explanation that is accurate but incomplete, the tutor will elaborate on the student's response, providing a model of a more complete explanation.

Generalization. Likewise, these tutors are also likely to ask students periodically how the work they had just done, or the problem they had just solved, might relate to some other type of problem or to some real-world situation that students would be familiar with and interested in.

Encouraging

Finally, by describing our best tutors with the term "encouraging," we intend to encompass a wide range of techniques and strategies that our expert tutors employ to keep students interested, attentive, and involved with the topic at hand. These motivational strategies, which have been spelled out in more detail by Lepper et al. (1993), can be seen as falling into five basic categories. These categories reflect five potentially complementary sources of motivation for learning that tutors seek to sustain and increase (Lepper & Malone, 1987; Malone & Lepper, 1987):

Confidence. First, our best tutors are centrally concerned with bolstering students' feelings of competence and mastery, and these concerns are heightened when students begin tutoring sessions with a past history of failure in the classroom and a low level of confidence in their ability in the domain at hand. As noted above, however, our most effective tutors do not simply praise these students more often or more profusely. Rather, their strategies for enhancing students' feelings of competence are considerably more subtle. They frequently emphasize, for instance, the difficulty of the problems they are presenting, implicitly giving students an excuse if they do have difficulty and implicitly increasing the value of success for them if they do succeed.

Challenge. At the same time, our best tutors also do not constantly reassure students about their abilities, even when those students have been selected on the basis of their need for remedial help. Instead, our top tutors are more likely to challenge their students, to goad them into a desire to "show" the tutor just how much they can accomplish. Moreover, in their selection of problems to present and their decisions about how much help to provide on each, these tutors seek to confront students with problems that will be difficult, though not impossible, in the belief that such moderately high levels of challenge will be most effective in motivating students.

Curiosity. Third, our most successful tutors are also more likely to try to pique their students' sense of curiosity, to make them want to find out the answers on their own. These tutors are, for example, more likely to ask students to predict in advance how a current problem might prove similar to, or different from, a previous problem, so that they can see their own expectations confirmed or disconfirmed. Similarly, they may deliberately highlight inconsistencies between different facts or procedures that the student has previously learned in different contexts, to provoke the student to seek some resolution.

Control. In like fashion, our best tutors also seek to provide their students with a sense of personal control in the tutoring situation. Where it is possible to do so without negative instructional consequences, for instance, these tutors offer students choices or comply with their requests.[2] They may also emphasize a student's sense of agency directly, and as noted above, they will generally avoid the sorts of direct didactic methods that would be likely to undermine a learner's feelings of control.

Contextualization. Finally, our top tutors seek to place otherwise purely abstract problems, especially in mathematics, into meaningful and interesting contexts. Students will be more motivated by a problem, these tutors believe, if that problem can be personalized so that students can see its relevance to familiar real-world contexts that they already care about. Likewise, these tutors believe that students will be more motivated to become involved with and to persist at problems that have been embedded in inherently enjoyable and provocative stories or fantasy contexts that make contact with the preexisting interests and knowledge of students.

SUMMARY

In short, our most effective tutors differ in many ways—in their goals, their strategies, and their specific knowledge and techniques—from their equally experienced, but less successful, counterparts. Nevertheless, the general picture, we hope, is clear: Our best tutors are those who are concerned *simultaneously* with students' learning on the one hand and their motivation on the other. Thus, these tutors do not consider their task to be merely the efficient provision of feedback and information as some early theories of learning might have implied (Lepper & Chabay, 1985). Nor are they willing to sacrifice learning for

[2]Unfortunately, the literature does suggest that students may sometimes make nonoptimal decisions about instructionally critical aspects of their learning if given total control over such factors (Lepper & Malone, 1987; Steinberg, 1989). As one example, children who have had a history of failure in the domain under study will often choose to stick with easier problems at which they are sure they can succeed, at the expense of opportunities for further learning, if they are given the opportunity to choose the problems they will try.

the sake of motivation, as critics of the so-called "self-esteem" movement in the schools have described (Stout, 2000). Rather than "dumbing down" the instructional content by presenting easy problems or preventing student errors in an attempt to preserve students' self-esteem, these tutors demonstrate knowledge of a wide array of systematic techniques, both for presenting information to students and for encouraging student involvement and persistence at a task.

These tutors share a generally Socratic approach, in the sense that they seek to draw as much as possible from the student and to impose as little as possible of themselves on the student. They ask questions, but do not give directions. They offer hints, but avoid giving answers. The feedback they provide students, regularly after failure and sometimes even after success, is typically indirect, to minimize the evaluative pressure of the situation. And, when they are at their best, they are superb, producing both high levels of student interest and attention and extensive learning in a quite limited period.

IMPLICATIONS

There are many reasons for studying what makes excellent tutors so effective at instructing and motivating their students. From a theoretical perspective, on the one hand, we see the study of individual tutoring sessions as a particularly informative laboratory for studying the dynamics of effective learning in general. In contrast to the vastly more common studies of learning in traditional classrooms, where issues of behavioral control, classroom management, simple time-on-task, and whole-class instruction often dominate discussions, studies of individual tutoring sessions permit us to examine in much greater detail the process of instruction, the types of feedback and assistance that promote learning, and the strategies that most enhance student motivation.

Because we believe in Kurt Lewin's dictum that "there is nothing so practical as a good theory," we believe that the *practical* importance of detailed observations of real-world learning that can contribute to the formation of more effective theories of motivation and instruction should not be underestimated. In addition, studies of the goals and strategies of especially effective tutors should also contribute to the improvement of current educational practices in a number of more immediate and direct ways.

First, such studies can serve as a basis for the design of more effective computer-based tutors. As we noted at the start of this chapter, the past 10 to 15 years have witnessed the development of a variety of computer-based tutors, and many of these programs have been based on considerably oversimplified models of the tutoring process. Traditionally, such programs have featured highly direct and didactic instruction to students, often pointing out each error the student makes, giving the correct answer to the student, describing the misconceptions underlying each error, and explicitly demonstrating correct solution processes. Usually little explicit attention, beyond

the inclusion of simple praise statements, is given to attempts to enhance or maintain student interest in the material; instead, an inherently attentive and motivated learner is simply presumed by these programs.

Clearly what highly effective human tutors do when they are at their best is quite different, as we have described above. Although we recognize that there many potentially critical differences between human and computer tutors that may influence the effectiveness of particular tutoring techniques (Lepper & Chabay, 1988), it nonetheless seems evident to us that the effectiveness of many computer tutors might be enhanced by a more complex, research-based model of the determinants of effective tutoring.

Moreover, the same may be true for many of the human tutors who currently work with children. Certainly, we found that even our most effective tutors almost never reported having received any formal training in working with students individually. Instead, most of their courses and student-teaching experiences were focused, quite reasonably, on the more common whole-classroom or small-group instructional settings. Hence, data of the sort collected in our studies may help to provide the basis for designing some systematic training for those who are likely to serve as tutors for our children.[3]

As increasing numbers of even less experienced tutors become involved with children, both through parent or other volunteer tutoring programs at school and through commercial after-school tutoring programs, the need for effective tutor-training programs can only increase. Indeed, the success of formal educational intervention efforts, such as Clay's (1985, 1991) Reading Readiness program and Slavin's Success for All model (Slavin et al., 1996), that include the provision of periodic access to individual tutors for all students having academic problems, has provided a considerable further impetus to the regular use of human tutors in schools here and abroad.

Similarly, the detailed study of the techniques and strategies of expert adult tutors may even have implications for programs that seek to involve other students as tutors for younger, or less capable, peers (e.g., Fitz-Gibbon, 1977; Graesser, Bowers, Hacker, & Person, 1997)—programs that have been identified as perhaps the single most cost-effective intervention that our schools could implement with minimal difficulty tomorrow (e.g., Levin et al., 1984). Plainly, there will be many respects in which the dynamics of cross-age tutoring will necessarily differ from those of adult tutoring, for we certainly cannot expect young students to develop the same levels of knowledge and expertise as their older counterparts. Nonetheless, an increased understanding of effective tutoring methods may help us to create better structures, materials, and training procedures for students who are to serve as tutors in such cross-age tutoring programs.

[3]Yet one further domain in which tutoring may become increasingly available in the future involves individual tutoring offered via the Internet. In this theoretically interesting setting, individual tutors virtually interact with individual students in real time, with a shared computer display serving as a "white board" that both parties can see and use.

Finally, if we consider the study of expert tutorials more generally, as a laboratory for the study of highly effective learning, there may even be lessons to be learned for traditional classroom practices as well. When we consider the truly extensive efforts devoted by our best tutors to maintaining students' motivation, along with their general commitment to Socratic and inquiry-based strategies, the contrast with many traditional classroom practices seems striking. Instead, the goals and strategies of our expert tutors seem much closer to those of classroom teachers who seek to integrate into their classrooms the use of inherently interesting and demonstrably meaningful "projects" and other discovery-oriented educational techniques (e.g., Bruner, 1966; Edwards, Gandini, & Foreman, 1993; Katz & Chard, 1989; Lampert, 1986). In this respect, perhaps the most general lesson to emerge from our studies of highly successful tutors is that encompassed in the ancient proverb about the process of truly effective learning:

I hear and I forget. I see and I remember. I do and I understand.

Teachers' Questions and Answers

Q: I have two related questions. First as a teacher, I truly believe those characteristics described in your chapter do make effective tutors and teachers. However, oftentimes when a teacher uses the kind of strategies described in your chapter (Socratic, inquiry-based, indirect positive feedback, etc.), these tend to be received by students (especially those who are not very successful) with some resistance, especially at the beginning. Was this observed in your studies? What can be done to minimize this response from students? Were there any differences in reactions between remedial and successful students?

Second, I wonder if there were any observed differences when using indirect positive feedback among remedial versus successful students or with students of different ages? Although I have found indirect feedback to be the most effective, as a teacher one of the hardest things for me is to achieve a balance with respect to positive feedback—not enough, too much, too direct, too indirect. Any suggestions on how to achieve this balance?

A: You raise really important questions about what is perhaps the most complex aspect of our expert tutors' strategies, namely, their generally indirect and Socratic style. As your questions suggest, the use of this approach may sometimes require art, as well as science.

A first issue concerns students' possible resistance to such techniques, especially at the outset. Although we did not see much of this response in the tutoring sessions we observed, we have seen this sort of resistance in many other settings. We think that it occurs primarily when students are trying simply to "get through" the material as quickly as possible and therefore see an indirect approach, relying on hints and questions rather than answers

and directions, as inefficient and likely to prolong a tutoring or teaching situation.

This problem typically takes a different form for remedial versus successful students. For remedial students, resistance usually stems from a desire just to get through as quickly as possible, without any concern for actually learning the material. Hence, they would prefer it if they were just given the answers so that they can leave a situation they find an embarrassing reminder of their lack of competence in a domain. For more successful students, in contrast, this same response can occur for slightly different reasons, when they feel that they understand things well, but have simply forgotten (or never learned) some specific point that is now preventing them from going forward. Again in this situation, indirect techniques may be seen as simply slowing these good students down.

The hard part, of course, is how to prevent this reaction. We think there may be three reasons why we did not see this response very often in the tutoring sessions we studied. First, the sessions were a fixed length, so that there was no possibility of exiting the situation more quickly by simply "taking dictation" from the tutor. Second, our best tutors seemed to be very effective in using a variety of techniques to convince even the most problematic students that they really could learn the material, despite their past difficulties. Third, these tutors also seemed to find ways of making their students want to learn. Of the many techniques that we saw, perhaps the most striking was the ability of many of these tutors to make the tutoring session into a sort of game for students. Most generally, we think that students will generally accept these techniques once a good relationship has been established between teacher and student.

Finally, as you note, there certainly is a difficult balancing act that teachers using these techniques must negotiate, especially when it comes to the use of praise and positive feedback. Unfortunately, there is no simple answer to this one. On the one hand, feedback has to be clear: students must know when their responses are right and when they are wrong. On the other hand, praise must always be credible. In our sessions, tutors who praised remedial students who had succeeded at very simple problems as having "a great math mind" or being "a real whiz" clearly did not achieve the goals they had intended, as the incredulous looks on their students' faces plainly indicated. On the other hand, if there is not already a positive relationship between tutor and student, the tutor may need to make more use of explicit praise, and overt statements of confidence in the student's ability, at the start of a session, to build student confidence that the tutor is on his or her side.

Q: At the private school where I work, a fair number of teachers do not have an education degree. However, they do have advanced degrees in their subject areas and are excellent teachers. One of the characteristics of highly effective tutors mentioned in your chapter was their high general pedagogical knowledge. Did this knowledge come from having taken courses in the field of

education or from experience? Did most of these highly effective tutors have formal education training? From the standpoint of school administrators who very often have to read resumes of prospective teachers to decide which candidate will be hired, which if either of the two, subject-matter or pedagogical knowledge, seemed a more critical component of a highly effective teacher in the modern classroom?

A: In our sample, all of our tutors, the best and the worst alike, had had formal training in education, because that was one of the criteria by which we chose them. At the same time, in interviews, none of our tutors remembered ever receiving much training in one-to-one, as opposed to whole-class or small-group, situations. They seemed to think, therefore, that most of what they knew about tutoring they had learned by experience.

Obviously principals are often faced with choices among candidates with different sorts of credentials and training, in specific subjects versus general education, and this is an important issue. To be asked whether subject-matter expertise or general pedagogical expertise is more important, though, seems difficult. In the work of our best tutors, the two seem so intertwined that it is like asking whether a person's right leg or left leg is more important to walking. If we had to guess, we would say that it probably depends somewhat on the grade level of the students and the nature of the topic: that the more advanced the students and the more complex the topic, the more critical specific subject-matter knowledge is likely to be.

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Improving Academic Achievement

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