Rejoinder:

Situative Versus Cognitive Perspectives: Form Versus Substance

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James Greeno has written a reply to our recently published challenge (Anderson, Reder, & Simon, 1996) to the soundness of many educational implications that have been drawn from the "situated learning" movement. Greeno's response (p. 5, this issue) has largely taken the discussion onto a more abstract plane rather than disputing our recommendations for educational practice. Along with his meta-level discussion, he has described several results and made a number of comments that help to clarify the educational issues.

Greeno acknowledges the persuasiveness of our evidence for our findings and recommendations, and agrees that there is a consensus between the cognitive and situated perspectives on certain important educational issues. So we want to begin our response by emphasizing those issues on which we all seem to be in agreement.

1. Learning need not be bound to the specific situation of its application. Instruction can often generalize from the classroom to "real world" situations. Greeno cites a list of studies from the situated camp which are consistent with this conclusion. We no longer have to contemplate abandoning the classroom but can focus our attention on those factors that promote transfer from one situation to other situations. Our original paper contained pointers to the abundant research in cognitive psychology describing and examining these factors.

2. Knowledge can indeed transfer between different sorts of tasks. Again Greeno cites situated papers which, if they do not provide new evidence for this proposition, at least accept it. Thus, we can aspire to see mathematics education transfer to science, engineering, and jobs which require it. We need not teach every different competence anew. Again, our original paper provided references to the very powerful empirical and theoretical base that has developed in cognitive psychology for understanding such transfer.

3. Abstract instruction can be very effective and one need not teach everything in concrete, almost vocational settings. Greeno points out some looseness in our use of the terms "concrete" and "specific." If we caused any confusion we apologize, but apparently it is not in dispute that real value is to be found in the abstractions that students are taught in school. Again, the issue is how one makes abstract instruction effective, and again we cited cognitive research addressed to this question.

4. Instruction need not take place only in complex social situations. There is great value as well in instruction that focuses on parts of a competence and learning that occurs individually. Again, the issue is when and where to use what type of instruction, and again we can point to cognitive research that addresses these questions. However, much more research is needed on the question of when group learning is valuable in the classroom. Most of the research on group learning has been restricted to adult populations learning job-like skills.

While important reforms may be needed in American education, the consensus seems to be that these reforms are not in the direction of turning the classroom into a workplace; there is merit in the powerful abstract intellectual tools that have been developed throughout human history. There certainly are issues of how to teach mastery of these tools effectively, and cognitive psychology provides a great deal of guidance here. Of course, many issues arise in the classroom that psychology cannot yet answer. However, here teachers should look to their common sense and professional experience for the answers—not to recommendations, unsubstantiated by empirical research, that claim a basis in situated learning.

If there is this broad consensus, then is there anything left to argue about? Greeno's article indicates that he thinks so. Much of the argument is about the language that is appropriate for describing these issues. It is clear that Greeno believes that there is something significant in these linguistic choices. Unfortunately, the situated language that he prefers often has a fuzziness that has led many persons who employ it to believe that the four points discussed above are not settled by the evidence, but are still at issue.

We also find on just a few occasions that Greeno's attempt to restate the cognitive position in his own words mischaracterizes that position, and we will attempt here to correct these mischaracterizations. Greeno sometimes suggests that we have not understood the situated position. That is certainly a possibility, but the alternative possibility is that we

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have sometimes declined to use situated language (what Patel, 1992, called "situa-babel") because we do not find it a precise vehicle for what we want to say. In reading the literature of situated learning, we often experience difficulty in finding consistent and objective definitions of key terms. We will comment on some of these below.

One significant issue which Greeno clearly identifies is whether we can come to a better understanding of ourselves and education by taking the perspective of the group or the perspective of the individual. This is really a clash of two methodologies for the attention of the research and educational community. Here we will argue that the cognitive methodology has delivered real educational applications in a way that the situated methodology has not and, we believe, fundamentally cannot.

Greeno's Questions

Greeno took each of our claims and posed a "cognitive question" and a "situated question" that these claims answered. This rhetorical maneuver enabled him to make certain criticisms of the cognitive approach by focusing on the form of its questions, as he interpreted them. Going through his four questions one by one, we will address these criticisms, which seem to be more linguistic than substantive.

Question 1

Greeno's cognitive version: How tightly bound is the knowledge to the context in which it is acquired?

Greeno's situative version: Does activity that occurs in one type of situation have aspects that were learned as practices and interactions with the resources available in that type of situation, and does it have aspects that were learned as practices and interactions with resources in some quite different type of situation?

For the life of us, we fail to see the difference between these questions although we confess to feeling some attraction to the simpler and more direct cognitive version. Perhaps there is a difference if one believes that "knowledge" is not what is learned; but then the supposed difference becomes entirely a matter of the definitions one chooses for "knowledge" and "learning."

In our original paper we discussed at length the empirical and theoretical evidence indicating whether and when learning must occur in the situation of intended application; and as indicated earlier, Greeno appears not to disagree with our conclusion that often it can occur effectively elsewhere. Apart from this issue, the difference in the questions seems entirely a matter of whether one prefers to use language found in situated discourse or that found in cognitive discourse.

Question 2

Greeno's cognitive version: Will complex skills be acquired more successfully if instruction in various independent subskills is presented separately or in situations where all of the subskills are needed? In particular, will skills of complex social activities be learned more successfully if their independent subskills are learned in situations involving individual practice?

Greeno's situative version: Which combinations and sequences of learning will prepare students best for the kinds of participation in social practices that we value most and contribute most productively to the development of students' identities as learners?

While both versions of the question could be more succinctly stated, something is going on here that is more consequential than a difference in the language of two intellectual tribes. A rhetorical language game is being played to portray the cognitive version as dehumanizing and the situative version as promoting individuality. The cognitive version repeats various forms of the word "skill" (as in the goal of acquiring "complex skills"), whereas the situative version uses the value-saturated phrases "participation in social practices that we value most" and "students' identities as learners."

It is rather amazing that the cognitive perspective, which focuses on individual human beings and their minds, could be viewed as dehumanizing, while the situative perspective, which absorbs the individual in the group, could be portrayed as individualizing. At least since Riesman's (1950) contrast between societies dominated by inner-directed versus other-directed personalities, and Whyte's (1956) dramatic account of dehumanization through loss of individuality in business organizations, our society has been paying increasing attention to the importance of the individual as more than merely a component of a social group.

In point of fact, although one sees oscillations since the beginning of American history in the relative weight attached to individuals and groups, securing a proper balance between the individual and society has been a salient theme of American social thought and political competition. We do not really know what Greeno means by a student's "identity as a learner," or to what extent he pictures that identity as being submerged in a "group identity." But we do know that all of our cognitive research careers have been focused on the unique things that happen in each learner, although surely not independently of what they have learned and what they experience in social contexts.

Elsewhere in this section Greeno says, "The dispute is about whether to understand these processes simply as the acquisition of skills, in which it does not matter whether students understand how what they are learning relates to anything other than school." We decry this "mere skill" terminology and its implications of irrelevance that have taken hold in situated language. Our dictionary defines a skill as "the ability to use one's knowledge effectively and readily; a learned power of doing a thing competently."

Cognitive psychology has always been deeply concerned with meaning and the relations of the parts of knowledge to the rest of the world. This is the most fundamental issue on which the cognitive revolution broke from behaviorism, and concern with meanings and relations permeates cognitive research and its applications.

Question 3

Greeno's cognitive version: Does knowledge transfer between tasks?

Greeno's situative version: When someone has become more successful at participating in one kind of situation, are there other kinds of situations in which that person would be more adept?

Again we fail to see a real difference between the two versions of the question, although the situative version is clearly more behaviorist in its formulation. A radical be-

haviorist like Skinner would have objected to the cognitive version because it contains the "mentalistic" construct "knowledge," a word to which Greeno seems to object throughout his essay. Indeed, it is curious how much the situated position sounds like Skinner's description of his behaviorist Utopia:

> Since our children remain happy, energetic, and curious, we don't need to teach "subjects" at all. We teach only the techniques of learning and thinking. As for geography, literature, the sciences—we give our children opportunity and guidance, and they learn for themselves. In that we dispense with half the teachers required under the old system, and the education is incomparably better. Our children are not neglected, but they're seldom, if ever, taught anything.
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> Education in Walden Two is part of the life of the community. We don't need to resort to trumped-up life experiences. Our children begin to work at a very early age. It's no hardship; it's accepted as readily as sport or play. A good share of our education goes on in workshops, laboratories, and fields. It's part of the Walden Two code to encourage children in all the arts and crafts. (Skinner, 1948, pp. 119–120)

Cognitive psychology grew up to challenge this simplistic conception of human competence, which focused on the external (including the social) setting and ignored everything that was going on in the human mind while competence was being acquired. Cognitive psychology has shown, in numerous settings, how an understanding of the mental processes of learning and applying knowledge and skills can produce improved methods of instruction and learning.

Question 4

Greeno's cognitive version: What are the relative advantages and disadvantages of abstract instruction, as opposed to instruction for specific activity, especially for jobs?

Greeno's situative question: What kinds of abstract representations can contribute productively to meaningful, general learning?

In this case, if it were not for Greeno's labeling we would not have been able to guess which was the cognitive and which was the situated question. In particular, the emphasis on jobs appears elsewhere to be an earmark of the situative position. However, throughout Greeno's paper there is a theme that the cognitive approach cannot explain meaningful learning. Early in the paper Greeno asserts that reasoning is "adaptive in ways that are not explained well by current versions of cognitive theory." He gives no instances of what these ways are nor any evidence of failure to explain them, but he seems to imply that the only application that cognitive psychology can have to mathematics is the teaching of algorithmic skills.

Although it is unclear here what Greeno means by algorithmic skills, elsewhere he seems to equate them with equation-solving and other symbol manipulation and to imply that cognitive psychology cannot deal with mathematical reasoning, discovery, and modeling. In fact, there are quite successful information-processing applications to (among others) mathematical reasoning (e.g., Anderson, Greeno, Kline, & Neves, 1981), mathematical induction (Johnson-Laird, 1983), mathematical modeling (Larkin, 1981; Singley, Anderson, & Gevins, 1991), and mathematical solutions to physics problems (Bhaskar & Simon, 1977; Simon & Simon, 1978), problems stated in natural language (Novak, 1977; Paige & Simon, 1966), problems of discovering scientific laws (Langley, Simon, Bradshaw, & Zytkow, 1987; Qin & Simon, 1990), and algebraic and graphical reasoning about economics problems stated in natural language (Tabachneck, Leonardo, & Simon, 1994).

The Social Versus the Individual

The substantive issue raised by Greeno is whether the more profitable research path is one that takes individual or social activity as the principal unit of theoretical focus. The cognitive approach in no way denies the importance of the social. From birth we are social creatures; much of what we learn is social and many of the circumstances of our learning are social. Presumably, the situated view would correspondingly not deny that there are individuals interacting in all situations, that these individuals have minds, that much of their individuality comes from the (socially and individually acquired) knowledge contained in those minds, and that they are not just cogs in a social wheel.

While we certainly recognize the profoundly social nature of the human species, Greeno's suggestion that "all learning involves socially organized activity" is either false or vacuous. Anyone who has explored the structure of a beautiful flower or of a coral reef knows that learning about something can have a joy quite independent of any social structure, instruction, interpersonal interaction, or group participation. Research in cognitive psychology today is rife with demonstrations of implicit learning, where we become facile at doing tasks without any conscious awareness of what we are learning. To be sure, all these learning examples involve participants who are in a general social context (i.e., who have considerable interaction with other human beings). If this is what is meant by "all learning is social," the claim simply comes down to saying that we humans are social animals.

One can deny that "all learning involves socially organized activity" while agreeing that the social structure of learning is very important. As we acknowledged in our original essay, the situated movement has performed a valuable service in emphasizing the important contextual and social aspects of cognition. However, the situated position has not shown that it provides the right theoretical or experimental tools for understanding social cognition. Such understanding can only be achieved through serious attention to what goes on in the human mind, and not simply through external observation of social interaction.

We fail to find in Greeno's essay any instances that show how the situated perspective advances the cause of education. Rather, there are only comments as to how much harder things are when social context is taken into account. Absorbed in that perspective, we could be forever lost in appreciating the complexity of the situation and never get on to doing something about it. Specifically, the situated perspective has not provided the abstractions or analytic power for extracting principles that can generalize from one situation to another.

In contrast, because of its commitment to looking for near-decomposability (which Greeno describes quite accurately), the cognitive perspective provides us with ways of making progress. The first step is to analyze the complex

social situation into relations among a number of individuals and study the mind of each individual and how it contributes to the interaction. This inevitably involves understanding the great deal of social knowledge that resides in the mind and how the person has learned to interact with the social and physical environment. It does not ignore the social but it does try to understand the social through its residence in the mind of the individual.

The real power of the information-processing approach comes not just from its decision to focus on the individual but from its decision to analyze the knowledge possessed by the individual and how it is, and can be, acquired. Looking again for near-decomposability, the cognitive approach attempts to break this knowledge down into different units and their relations. This is the factoring assumption that Greeno refers to and which he acknowledges to have been "successful and productive in supporting the advances in cognitive science."

One of the greatest contributions of representing knowledge in terms of its constituents is to allow us to make progress on the issue of transfer, which is at the heart of educational goals. Greeno acknowledges the power of the Singley and Anderson (1989) approach to transfer, based on the effort to identify the units of knowledge.

However, the cognitive approach has been more than a scientific success. The effort to decompose knowledge into its units has had large, positive educational payoffs. In our own work, we have fashioned highly successful computer-based instruction based on this task analysis (Anderson, Corbett, Koedinger, & Pelletier, 1995). Zhu and Simon (1988) in their instructional efforts in Chinese schools have shown that what is critical is not the computer but the careful cognitive task analysis of the units that need to be learned.

But the demonstrations go far beyond our efforts. Bruer's (1993) book gives many case-studies demonstrating the power of cognitive task analysis. For instance, Case and Griffin (1990) performed analysis of early school mathematics and found that at-risk children lacked knowledge of number properties that are critical to learning that mathematics. By teaching this aspect of mathematics to students, they greatly increased their success at first-grade mathematics. As another instance, Palinscar and Brown (1984) did an analysis of the skill required for advanced reading. They found that older children who scored poorly at reading lacked the valuable skills of summarizing, clarifying difficulties, asking questions, and so on. By teaching these skills to students they were able to raise their reading comprehension scores from the 20th to the 56th percentile.

It is concrete results such as these which the cognitive approach provides and which we do not see forthcoming so far from the situated approach. We concur with Greeno that the two approaches should be judged by their abilities to improve education.

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