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The Multisource Nature of Learning: An Introduction

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Both psychology experiments and school curriculum have often focused on memory for isolated facts and definitions. In psychology, the most heated debate concerning this problem has been between the proponents of experimental and naturalistic traditions. Neisser (1978), for instance, questioned the value of laboratory research on memory for real-life situations arguing that "if *X* is an interesting or socially significant aspect of memory, then psychologists have hardly ever studied *X*" (p. 4). He noted that this is not only true of preBartlett associationism but also of the more recent research on schema theory (e.g., Anderson, 1977; Bransford & Johnson, 1972; Mandler & Johnson, 1977; Rumelhart, 1975). Banaji and Crowder (1989), on the other hand, stated that real-life inquiry alone "would lead the psychology of memory into the same stultification as studying backyard astronomy with the naked eye, chemistry in the kitchen, and biology with a walk through the forest" (p. 1188).

A similar debate goes on in the area of professional practice. Schon (1987) sums up the problem in an analogy. The area of professional practice, he notes, consists of the high, hard hill of research-based knowledge overlooking the soft, slimy swamp of real-life problems. Up on the hill, simpler problems respond to the techniques of basic science whereas down in the swamp complex problems defy technical solution. Thus, the educational practitioner faces a rigor-or-relevance dilemma. Should "he remain on the high ground where he can solve relatively unimportant problems according to prevailing standards of rigor, or shall he descend to the swamp of important problems and nonrigorous inquiry" (Schon, 1987, p. 3)?

Whether or not one must choose between rigor and relevance is debatable. For example, a distinction is possible between the (occasionally misused) rigor that preexists in certain methodological tools of science (to which Schon, 1987, seems to refer) and the rigor that the investigator can build flexibly, creatively, or even artistically into the process of systematic observation—using whatever methodological tools, existing or new, that fit the situation. If this is true, research-based systematic inquiry is unlikely to be the inevitable cause of the gulf that divides professional education and real-world problem solving. A more likely cause is what Bartlett (1932) called the *assumption of simplification by isolation*: In order to

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simplify something for inquiry, learning, or remembering, we must break it down into its separate components.

Bartlett's (1932) research, as well as more recent developments in psychological research, point to a strategy opposite to simplification by isolation—namely, *simplification by integration*. The latter suggests that human beings function well in the soft, slimy swamp of the real world because they have a natural talent for simplifying complex real-world problems by coordinating and integrating the influences of the multiple sources that simultaneously bear on these problems. This was the idea behind the symposium, conducted at the 1989 annual meeting of the American Educational Research Association, that served as the precursor for this special issue.

Simplification by Isolation

analytic approach

Bartlett (1932) suggested that this assumption, and not the process of scientific inquiry, was responsible for the gap between rigor and relevance. He distinguished between the methodological tools scientists use and the process of systematic observation. Like all tools, he noted, the strengths or weaknesses of experimental techniques depend on the prior arrangement of prerequisite conditions established by the investigator.

According to the assumption of simplification by isolation, a response is simple if it "is cut off from the simultaneous functioning of other responses with which it is normally integrated" (Bartlett, 1932, p. 5). Referring to the influence of this assumption on the work in experimental psychology of the time (e.g., Myers, 1931), Bartlett illustrated the problems involved in trying to achieve this kind of simplification using the work of Ebbinghaus with nonsense syllables. In Bartlett's own experiments, relevance was not at the expense of rigor, because he treated experimental methods as tools for handling "instances in which numerous conditions are simultaneously operating" (p. 7).

Simplification by isolation continued after Bartlett (1932) in its most extreme form in stimulus-response behaviorism. More recently, the assumption has manifested itself, though less blatantly, in a bewildering number of forms and guises: the assumption of the autonomy of syntax (Chomsky, 1965), the assumption that mental structures can be formalized independently of their organismic sources (Neisser, 1967), the definition of learning as computing (Pylyshyn, 1984), and the view of learning processes as computational abstractions (McClelland, Rumelhart, and the PDP Research Group, 1986), to name only a few examples. In all these, the quest for rigor has been at the expense of relevance. For instance, it is unclear if the rigor that preexists in mathematical formulas can automatically generalize to cognitive learning when such formulas are used to derive learning processes. Such lack can contribute to the gap that separates rigor and relevance and to the crisis of confidence noted by Schon (1987) in professional knowledge and education.

The roots of the assumption of simplification by isolation are as firm in practice. Schools break down complex skills like reading into their components (sounds, letters, words, etc.). The assumption is, to rephrase Bartlett (1932), that component skills are easier to learn when they are separated from other skills with which they are ordinarily integrated. Similarly, it is often assumed that basic concepts, facts, and definitions must be mastered in isolation before authentic real-world aspects of complex subject matters can be learned. Under the overwhelming influence of the assumption of simplification by isolation, the severity of the problems with this kind

of approach can hardly be appreciated. Imagine trying to grow leaves, flowers, fruits, and trunks one after another in isolation in order to assemble them later into trees capable of survival in the woods. There is little reason to believe that memorizing sounds, letters, words, or definitions is any more likely to produce authentic reading skills.

Simplification by Integration

A response is simple—more easily investigated, taught, understood, learned, or remembered—if it occurs in simultaneous functioning with other responses with which it is naturally integrated. A person does not normally approach a complex situation "detail by detail and meticulously build up the whole. In all ordinary instances, he has an over-mastering tendency simply to get a general impression of the whole" (Bartlett, 1932, p. 206). Therefore, trying to discover laws of learning applicable to complex real-world problems by exploring how letters, numbers, or clusters of letters and numbers are rote memorized is analogous to trying to grow trees in pure water.

Because growth is a multisource process, it occurs best when the diverse sources that are necessary are present and operating simultaneously. For trees, the sources reside in the air, the ground, and the body of the tree itself. Learning is multisource precisely in an analogous sense. The multisource nature of learning would require multiple sensory modalities for concurrent access to qualitatively diverse sources of information in the outside world, but outside sources would not be all. Remembering, far from being a single-source retrieval process, also involves integration of information from qualitatively diverse internal and external sources.

From time to time, psychologists (James, 1884; Minsky, 1980) have spoken of the dangers of practicing simplification by isolation (see Iran-Nejad, Clore, & Vondruska, 1984). Because of its inherent seductive nature and its firm roots in daily experience, this assumption has had, and may continue to have, a lasting and recurrent influence on academic thinking and practice. However, a solid body of research has been accumulating, beginning with the work of Bartlett (1932), that promises to turn the tide in favor of simplification by integration. This research indicates that the more meaningful, the more deeply or elaboratively processed, the more situated in context, and the more rooted in cultural, background, metacognitive, and personal knowledge an event is, the more readily it is understood, learned, and remembered (Ausubel, 1963, 1977; Brown, Collins, & Duguid, 1989; Chi, 1978; Craik & Lockhart, 1972; McCombes, 1989; McKeachie, 1984; Steffensen, Joag-dev, & Anderson, 1979).

However, only recently have researchers begun to view integration as the dynamic process the multisource nature of learning requires (Brown, Bransford, Ferrara, & Campione, 1983; Iran-Nejad, 1980, 1987). During the early days of modern cognitive psychology (Neisser, 1967), integratedness was considered a property of static knowledge structures in long-term memory. An event would be learned more readily to the extent that it made contact with integrated long-term memory structures (Rumelhart, 1980). This is, of course, not what simplification by integration means here. Rather, it refers to the ongoing process that brings together the diverse influences of the many sources bearing on the solution to a complex problem. In fact, multisource theories have been proposed as solutions to problems for which static structural theory has no answers (Bereiter, 1985; Iran-Nejad & Ortony, 1984; McKeachie, 1984).

In This Issue: Aspects of the Multisource Nature of Learning

Focus on the Process

The articles in this special issue integrate, each from a different point of view, theory and research bearing on the unifying theme of learning as a multisource phenomenon. One obvious aspect of the multisource theme reflected in all the articles is the shift away from the traditional focus on knowledge structures. The multisource theme has brought into sharp focus the mental processes necessary for real-time coordination of diverse sources of learning. This shift is evident in Shuell's analysis of phases of learning, Iran-Nejad's discussion of learning as reconceptualization of previously learned knowledge, and Hidi's view of the relationship between interest and attention. It also plays an important role in the articles by Garner and Bereiter.

Situated Processes That Are Also Domain-Independent

Another area of remarkable consensus is the focus on situated aspects of learning. This is reflected in Shuell's discussion of domain-specific phases of learning, in Garner's theory of the role of setting in the deployment of cognitive and metacognitive strategies, in Iran-Nejad's discussion of the spontaneous role authentic real-world contexts play in learning during early years of life, in Hidi's distinction between text-based and situational interest, and in Bereiter's contextual modules. Most intriguing, however, is the repeated emergence in these articles of situated processes that can also be viewed as domain-independent. Phases of learning, for instance, are situated in specific domains. They are also domain-independent because learning in different domains is expected to go through more or less the same phases.

generality not domain-independence

Simplification by Integration, Contextual Modules, and Phases of Learning

At the heart of the multisource theme lies the idea of diverse sources converging on a coherent organic whole. This aspect is addressed directly in the article by Bereiter and less directly in other articles. The multisource theme suggests a beginning, an ongoing process, and an eventual outcome. The starting point is a complex problematic situation or an indeterminate zone of practice characterized by uncertainty, conflict, and uniqueness (Bartlett, 1932; Schon, 1987). Bereiter's notion of difficult learning is a particular example. The multisource theme suggests that one must not try to simplify matters by dissecting the situation into isolated parts because of the possibility of ending up in a hall of mirrors with an infinite number of factors whose higher order interactions are too complicated to explicate (Bereiter, 1990). Like Bartlett, Bereiter takes the opposite route of simplification by integration leading to the characterization of the organic whole he aptly called the contextual module. It is possible to show how the process of simplification by integration might pass through a number of qualitatively different phases of the kind discussed by Shuell (cf. Iran-Nejad, 1989; Iran-Nejad & Cecil, in press).

Self-Regulation Processes

Simplification by integration of multiple sources is not a mechanical process. It is an organic process in which the individual "adapts in the total and multifaceted way that we might imagine a species of fish to adapt to a particular kind of aquatic environment" (Bereiter, 1990, p. 612). What coordinates the influences of diverse sources in this organic process is self-regulation. Various aspects of the self-regulation

process are discussed by Garner and Iran-Nejad and are implicit in Hidi's treatment of attention to text-based events as well as in Bereiter's discussion of contextual modules.

Conclusion: What Kind of a Learning Theory

The multisource theme has brought together the major aspects of a unified approach to the study of learning as a multisource phenomenon. Such an approach must explain, as Bereiter argues, difficult learning. It must also clarify what kind of rigorous educational research is relevant and what sort of educational practice in schools leads most readily to learning and to learning of the right kind. The multisource approach suggests that abandoning the practice of simplification by isolation and adopting the strategy of simplification by integration are essential first steps.

A unified approach to learning must specify what kinds of internal processes mediate the influences of diverse internal and external sources and must do so without abandoning crucial mentalistic concepts such as attention, curiosity, interest, motivation, and metacognition. As our understanding progresses in this area, we may begin to comprehend how very young children can be so effective in learning their functional knowledge of the world and their mother tongue and yet be as ineffective as they sometimes are later in life in their use of learning strategies and their mastery of school subjects.

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