Desirable Difficulties Perspective on Learning

Instructors and students alike are susceptible to assuming that conditions of instruction that enhance performance *during* instruction are the same conditions that enhance long-term learning. That assumption, however, is sometimes dramatically wrong: Manipulations that speed the rate of acquisition during instruction can fail to support long-term retention and transfer, whereas other manipulations that appear to introduce difficulties and slow the rate of acquisition learner can enhance post-instruction recall and transfer. Such manipulations, labeled *desirable difficulties* by the author, include spacing rather than massing study opportunities; interleaving rather than blocking practice on separate topics; varying how to-be-learned material is presented; providing intermittent, rather than continuous, feedback; and using tests, rather than presentations, as learning events. That learning profits from contending with such difficulties provides a valuable perspective on how humans learn.

Learning versus Performance

Basically, current *performance,* which is something we can observe, is an unreliable index o*f learning,* which we must infer. The distinction between learning and performance goes back to research carried out during the 1930s-1950s, research that provided evidence that considerable learning could take place across periods when there were no systematic changes in performance. Experiments on *latent learning*, for example, showed that rats, after a period of apparently aimless wandering in a maze, then demonstrated considerable learning when some target behavior, such as finding a baited goal box, was reinforced. Similarly, human and animal experiments on *overlearning*—that is, providing additional learning trials after performance had reached an asymptotic level and was no longer changing—demonstrated that such trials continued to enhance learning, as measured by reduced forgetting or accelerated relearning.

More recently, a variety of human-memory experiments have shown the converse is true as well: Substantial changes in performance can be accompanied by little or no learning. Massed practice on a task, for example, often leads to rapid gains in performance, but little or no effect on learning, as measured by long-term retention or transfer.

Perspective on Learning

That confronting certain difficulties can enhance learning serves to emphasize some unique characteristics of how humans learn and remember, or fail to learn and remember. We do not store information, for example, by making any kind of literal copy of that information. Rather, we encode and store new information by relating it to what we already know—that is, by mapping it on to, and linking it up with, information that already exists in our memories. New information is stored in terms of its meaning, as defined by its associations to other information in our memories; storing information, rather than using up memory capacity, creates opportunities for additional storage.

The retrieval processes that characterize human memory are unique, too, and differ markedly from a "playback" of the type that might characterize a typical recording device. Retrieval of information is inferential and reconstructive, rather than literal, and the process is fallible, in part because what is accessible from memory is heavily dependent on current cues, including environmental, interpersonal, body-state, and mood-state cues, as well as more explicit cues. In addition, and importantly, the act of retrieving information is itself a potent learning event. Retrieved information, rather than being left in the same state it was in prior to being recalled, becomes more recallable in the future than it would have been otherwise, and competing information associated with the same cues can become less recallable in the future. Using our memories, in effect, alters our memories.

From an instruction standpoint, the goal is to create conditions that foster storage and enhance later retrieval, not just at a delay, but also in multiple contexts. We want, in short, to create durable and flexible access to to-be-learned information and procedures. Towards achieving that goal, the conditions of learning need to induce encoding and retrieval processes that are substantial and varied, and incorporating desirable difficulties helps to induce those processes. Using tests or generation activities as learning opportunities, versus presentations, for example, exercises retrieval processes that will be needed later. Varying the context, examples, and problem type engages processes that can lead to a richer and more elaborated encoding of concepts and ideas, which can, in turn, support transfer of that learning to new settings. Interleaving, rather than blocking, instruction on related, topics can aid in encoding the higher order relationships that capture similarities and differences among those topics.

It goes beyond the scope of this entry to provide a detailed discussion of how each desirable difficulty might enrich encoding and/or retrieval processes, but one common characteristic is that such manipulations are likely to induce more *transfer-appropriate processing*—that is, processes of the types that will be required in post-instruction environments.

The Word *Desirable* Is Important

Finally, it is necessary to emphasize that many, perhaps most, of the difficulties that can be created for learners are *not* desirable. Desirable difficulties are desirable because responding to the challenges they create requires encoding and/or retrieval activities that support learning. To the extent, in fact, that a given learner is not equipped to overcome a difficulty that would otherwise be desirable, it becomes an undesirable difficulty. Thus, for example, requiring that some information or procedure be generated, rather than simply presenting that information or procedure, introduces a desirable difficulty, one that can foster a learner's subsequent ability to

produce that information or procedure, but the learner must be equipped, by virtue of prior knowledge and current cues, to succeed in the generation—or it becomes an undesirable difficulty.

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Cross References

See also Memory Recall, Dynamics; Modal Model of Memory; Forgetting; Spacing Effect, Practical Application; Transfer of Training

Further Reading

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