SUMMARY

Rohrer, D., & Taylor, K. (2007). The shuffling of mathematics practice problems boosts learning. *Instructional Science*, 35, 481-498. Doug Rohrer, University of South Florida, drohrer@cas.usf.edu

Introduction

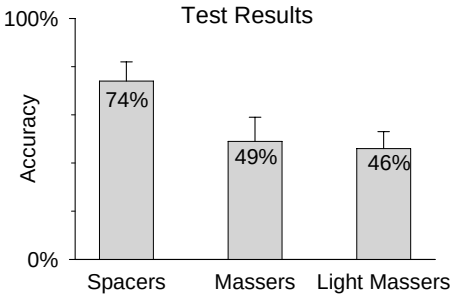
Although mathematics students devote most of their individual effort to working assigned problems, the role of practice problems receives relatively little attention from researchers and textbook authors. We present two experiments that examined whether a rearrangement of practice problems boosts test performance.

In most mathematics textbooks, each lesson is followed by a set of practice problems comprised almost entirely of problems corresponding to that lesson. Thus, with this format, most or all of the problems relating to a given topic are *massed* into one practice set and not *distributed* across multiple practice sets. In most algebra textbooks, for example, virtually all of the quadratic formula practice problems appear immediately after the lesson on the quadratic formula. This format also ensures that that the problems within each practice set are *blocked* by topic and not *mixed* with other kinds of problems.

In contrast to the *massed-blocked format*, a very small number of textbooks use a *distributed-mixed* format. With this arrangement, a small proportion of the problems within each practice set relate to the immediately preceding lesson, and these practice problems are mixed with the other practice problems. For example, after a lesson on the quadratic formula, the following practice set would include only a few problems relating to the quadratic formula, and these would be randomly mixed among the other practice problems within that practice set. The remaining quadratic formula practice problems would be distributed throughout the subsequent practice sets in the textbook.

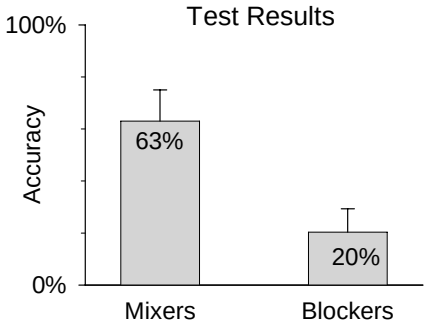
Experiment 1

The first experiment compared the benefits of distributed and massed practice. USF students learned a permutation task and were randomly assigned to one of three different practice schedules: Spacers worked two practice problems in each of two sessions separated by one week; Massers worked the same four practice problems in a single session; and Light Massers worked just two practice problems in one session. All students were tested one week after their final practice problem. Results are shown below.



Experiment 2

This experiment compared the benefits of blocked versus mixed practice *without varying the degree of temporal distribution*. USF students learned to find the volume of four obscure geometric solids. Each student was randomly assigned to either the Mixers or Blockers. Each group worked the same practice problems, but the practice problems were either blocked by type (e.g., four problems for one solid, then four problems for another solid) or randomly mixed. Both groups completed two practice sessions, separated by one week. Students were tested one week later. Results are shown below.



Discussion

Although virtually all mathematics textbooks rely heavily on massed practice and blocked practice, these two strategies proved terribly inefficient in the experiments present here. We therefore suggest that a distributed-mixed practice format deserves further consideration by researchers, teachers, and educators. With this format, the problems relating to a given topic are distributed across practice sets so that each practice set includes a mixture of different problem types.

Incidentally, although the practice session data were not presented in this summary, the learning strategies that provided superior test performance in each experiment did not optimize performance during the *practice* sessions. That is, the temporal distribution of practice had no effect on practice session performance in Experiment 1, and the mixture of problem types sharply impaired practice session performance in Experiment 2.

In brief, these experiments demonstrated that test performance can be dramatically boosted by a mere shuffling of practice problems. Fortunately, the logistical demands and financial costs of adopting a distributed-mixed practice format are relatively small. For example, textbook publishers could simply rearrange the practice problems in the next edition of their textbooks, without altering the lessons.