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Key Concepts in Organizing Instruction and Study

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Topic: How to Organize Your Teaching

Highlights

- Research in cognitive psychology can help us understand common problems in teaching and learning, like how to reduce forgetting.
- There are two sets of ideas represented in the practice guide: how to improve memory and retention and how to improve understanding and comprehension.
- Four practices are recommended: Space learning over time with review and quizzes, alternate worked out examples with problem solving, make connections between abstract and concrete representations, and use higher order questions to help students build explanations.

About the Interviewee

Hal Pashler received his Ph.D. in experimental psychology from the University of Pennsylvania in 1985, and is currently a Professor of Psychology at the University of California, San Diego. One main focus of his research has been human multitasking limitations, and the role of attention in visual perception. Since 2002, Pashler has been primarily involved with basic research on human learning and memory, focusing on

questions that have direct implications for instructional practices and potential new learning technologies.

Pashler is the author of *The Psychology of Attention* (MIT Press, 1998) and Editor in Chief of the *Stevens Handbook of Experimental Psychology, Third Edition* (Wiley, 2002). In 1999, he received the Troland Prize from the National Academy of Sciences, which cited his "many experimental breakthroughs in the study of spatial attention and executive control, and his insightful analysis of human cognitive architecture."

Full Transcript

I'm Hal Pashler. I am a professor of Psychology and Cognitive Science at the University of California in San Diego. Research in the fields of memory and cognitive science has some pretty broad implications for the most effective ways to organize study time and instruction time, and we thought it would be useful to produce a guide that distills some of the most concrete recommendations that have a strong research support and provide these to teachers.

One of the premises of our work is that we think a lot of what people believe is educational failure actually results from a failure to retain information. If you look at the studies that show disturbing gaps in what high school graduates know, 30% of them in one study can't find the Pacific Ocean on the map. And it's our belief that in most cases this information was taught, there was a moment in every high schooler's educational career when they could have pointed out where the Pacific Ocean is on a map but they have come—they have lost the information. And the field of memory has some concrete suggestions to offer about how things could be done a little differently so that forgetting would be less of a problem, and that's one of the main focuses in the guide is to try to give some concrete advice that might address the problem of forgetting.

There's really two sets of ideas in the practice guide. So, one set of ideas is about reducing the rate of forgetting and making it so that information is retained better over long term. Another set of information is about improving comprehension for difficult concepts, and here we are emphasizing practical things that the teacher can do to produce better understanding at the time the information is being presented.

One of our recommendations relates to spaced learning with review and quizzing. And the basic idea here is this: that you need to think about material that doesn't automatically get reviewed in the course of the ordinary curriculum. So there's lots of things you learn like in a math course you learn to add, you are going to use that over and over again. But, in something like a history course there is going to be material that's learned, it's never reviewed again, and basically there is catastrophic forgetting of material that isn't reviewed. If you pick out material that's important and you want that to be retained, you need to arrange for it to be reviewed, and here the research shows timing is very critical. A review days or just a few weeks later is probably not enough. It's much more effective if that's delayed by many weeks or ideally months.

This will affect the amount that people remember years later by maybe a factor of two or three.

Another element that we combine in that recommendation is the role of quizzing. So it's natural to think of tests just as assessment, but they directly promote learning. The optimal reviews procedure is to combine a delayed quiz, so that you review material and the student is prompted to actively retrieve it, and this will produce a remarkable increase in the amount of information available years later.

An example of this would be if you've got some basic history facts that you don't want kids to forget, what you need to do is arrange so that a couple of months after they have been covered, they are brought up again in class and ideally in the form of a quiz. The quiz doesn't have to be graded. The important thing is that the student is prompted to retrieve the information and if they miss it, they get some feedback, but it's not important that this be a basis for their grade.

One of our recommendations is to alternate between worked examples—that is examples where the teacher or the book shows the correct solution path and examples that the student has to do themselves, the problem solving exercises. Most classroom and textbooks actually ask students—first of all expose them to some worked examples either in class or in the textbook, and then the student is left on their own to do a set of homework problems. But there is quite a bit of research to show that it's actually more effective to alternate between these. So usually in class the student will watch the teacher go through a bunch of examples, but then in the homework assignment the student's left on their own to solve a series of problem solving exercises. It turns out to be significantly more effective, according to a pretty serious body of research, if you alternate, so the student jumps between seeing a worked out example and having to solve their own example and then having a new worked out example and so forth. This procedure has been found to produce significantly better problem solving on new problems.

Another one of our recommendations relates to making a deliberate effort to connect abstract and concrete presentations of the same principles or course content, and this applies particularly in science or math where you have some abstract principle that can be applied to an infinity of different new problems. And what's important to do here is to connect the abstract and the concrete to provide diverse examples of a principle in different domains and to connect the general principle to the way it's being applied in each of these individual cases. This is—research shows this produced significantly better learning and transfer to new problem solving.

So the idea is to show how the same abstract idea can be realized in many different ways. So if you think about something like the function y=2x, that can be—you can see many examples of that in very diverse domains. You can represent that visually as a function; you can see it as a table. You can represent it concretely thinking about a walkathon where you are paid $2 for every mile that you walk, and these are

all examples of the same underlying abstract idea. So the idea here is that teachers can promote later understanding and transfer of these ideas by showing numerous diverse concrete examples and explaining how the same underlying principle is exemplified by each of them.

Another of our recommendations focuses on deepening students' understanding of course content by posing questions to them and what we recommend here is to pose what we call higher-order questions, and by higher-order questions we mean questions that probe the student to provide explanations, answers, causes, to ask why, why not, questions of this sort that go beyond the descriptive content of the material and ask for a deeper level of organization of the material. And it turns out there is a significant amount of research to suggest that doing this produces better retention and better performance later on new problem solving, basically better understanding and better retention.

Teachers could use a variety of different kinds of support in implementing these recommendations. The recommendations about spacing and testing have strong implications for curriculum materials and textbooks, and current textbooks really promote batching of everything on one topic within a particular part of the course. I think that the changes in that could be very helpful.

Some of our recommendations relating to quizzing and self-quizzing could be facilitated by new kinds of educational technologies. There is also the potential, I think, for helpful professional development work on some of our more—more higher-level recommendations we have such as the use of higher-order questions and the connecting of abstract and concrete materials, and here I think professional development courses that include lots of good examples of these practices can be very helpful.