

Essays on Teaching Excellence

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What they don't know can hurt them: The role of prior knowledge in learning

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Admit it. You've watched the broadcasts of the Olympics and had your eyes glaze over while Dick Button waxed rhapsodic about the difference between a double axle and a triple lutz. They looked pretty much the same to you, didn't they? You were experiencing what many students face every day in our classrooms, a distressing lack of the prior knowledge necessary to help them understand or appreciate a new experience or content. Current research on learning has offered more and more evidence for the extent to which new learning is determined by what the learner already knows about the topic or related topics. The effect can be either positive or negative, positive if the pre-existing knowledge is correct and consistent with the new information or negative if it is full of misconceptions or conflicts with the new information.

Prior knowledge & current learning.

Prior knowledge affects how the learner perceives new information. This phenomenon is readily demonstrated by a simple experiment. What is the first image that you associate with the word "cardinal"? Some people think immediately of football, some of baseball, birds, Roman Catholic priests, or the color red. In the absence of a context, the association you make will depend on your prior knowledge. Your interpretation of this new information, the word "cardinal," was dependent on what you brought to the situation.

Fortunately, in most learning tasks, words occur in a context to assist in interpretation. If the word "cardinal" had occurred in the context of a discussion about the Inquisition, the number of associations which you could choose from would be dramatically circumscribed. But sometimes the context is no more meaningful than the word itself. If you had never heard of the Inquisition, that context would be no help.

Much the same thing happens in the classroom every day. Instructors use terms and concepts of which students have no prior knowledge to provide an adequate context for interpretation. Used at the rapid pace of the expert, this is what they complain about as "jargon" and its over-use leaves gaps in student ability to process new information. The phenomenon is similar to that experienced by the average computer novice attempting to obtain help from an expert. Half of the words are totally unfamiliar and the other half are used in an entirely new and illogical way. After two or three sentences, the listener is left in the dust and feeling hopelessly ignorant and hostile. This may be the stuff of great comedy routines, but it is disaster in a classroom.

Alternatively, an incorrect bit of prior knowledge which is not corrected could keep the students from understanding an entire lecture. This is frequently the case in science classes, where naive conceptions of natural laws must be unlearned before the correct version can be understood. For example, in chemistry, instructors must somehow convince students that air exists just as liquids and solids exist even though it can't be detected by the senses.

Intellectually students know this, but they often behave as if air was simply the absence of matter. This concept which seems simple, almost automatic, to an expert can be a stumbling block to understanding a whole range of phenomena for a novice.

Prior knowledge affects how a student organizes new information. Remember that a goal of learning is to incorporate new information into the existing organization of memory. A student uses that existing structure to assimilate new information. For example, in the absence of any strong signals to the contrary, a student in a history class is going to organize new historical information chronologically because that is the way history had been organized in earlier classes.

History instructors trying to organize around a different conceptual structure must fight against the students' tendency to see everything as happening in a straight timeline.

Instructors can use this prior knowledge of structure to their advantage when they use analogies or examples. The analogy represents a known organizational structure of information. That organizational structure is what is transferred to the new information. For example, in trying to explain how a gland works, an instructor might say that the gland is like a thermostat. Most students already know that a thermostat controls the temperature by monitoring the presence of heat. They transfer this understanding to the functioning of a gland. It monitors and controls the level of a hormone in the body in the same fashion. If the analogy is a good one, the student can take it from there to intuit all sorts of properties of the gland which parallels the thermostat.

Prior knowledge affects how easily students make connections for new information.

One of the keys to learning and memory is the richness of the connections a bit of information has. The more connections, the easier it is to remember. When new information gets hooked up with a particularly rich and well-organized portion of memory, it inherits all the connections that already exist. This is why it is much easier to learn information that is in one's existing field of expertise than to learn information from a brand new field. There are many more ways to access the system. When a student has nothing to hook new information to, he or she is thrown back on the most basic characteristics of the information such as sound, or form, or straight rote memorization.

Using prior knowledge in instruction To begin, it is helpful to *know what prior knowledge students bring to the learning setting.* Have they had certain common courses? It pays to know what those courses contained. What are their other common experiences? Are they all from similar backgrounds, similar environments? How will that affect the way they interpret the content? Do they have common aspirations and goals? Are they all going in the same direction? What does this information tell you about the prior knowledge they will bring to your class? The use of a pretest of critical concepts and

terms can alert both the instructor and the students to gaps or misconceptions that could prove inconvenient later.

Prior knowledge need not be only knowledge of the content, although that is the most critical type of knowledge to monitor. Knowledge of popular culture or current events can be used to great advantage as well in the same ways, especially in the context of analogies. Some would say that knowledge of popular culture is simply another form of cultural literacy.

Use prior knowledge deliberately in the presentation of new information. Beginning a class with a review of what has gone before helps activate prior knowledge. Presenting new information in its relationship to old not only helps students learn the new information but strengthens the old. Introducing new concepts by contrasting them with some that have already been learned makes use of prior knowledge to aid in the learning of new. Better yet, having the students make those comparisons teaches them something about the way to approach the learning of new material and about the structure of the discipline..

It is also desirable to *get the students to monitor their own prior experiences* and consciously use them in learning new information. Asking students to recall past courses that are related to the present course is an interesting way to encourage this. In a graduate course I ask students to produce a personal bibliography from the readings of their previous courses that relate to the present course. They find this an interesting experience which has never been asked of them before, but it makes the point that what they know is related to what they are learning.

Finally it is always a good idea to *check for faulty prior knowledge regularly* so that it is not allowed to continue to detract from learning. There is a wonderfully apocalyptic story about an astronomy class in which the instructor drew many beautiful orbital diagrams and still the students had trouble understanding celestial motions. Finally, by accident, the instructor discovered that several of the students were interpreting the ovals he drew as being in reality ovals rather than the circles shown in perspective. Until you ask the students what they understand about what is being taught, you will

never really know what is being learned. Structure the learning to bring those misconceptions to the attention of the students. Often they will not realize their confusion until it is too late.

Final thoughts The lesson we take from the research on prior knowledge is simply this: students are not blank slates on which our words are inscribed. The students bring more to the interpretation of the situation than we realize. What they learn is conditioned by what they already know. What they know can be as damaging as what they don't know.