GENERALIZING
Helping Learners Make the Shift from *Doing* to THINKING

In many disciplines, learners are required to do a lot of homework in order to produce the ability to apply the concepts, processes, and principles of the discipline to a variety of contexts. Even with all these homework problems, many students still complain when they encounter a problem in a new or unfamiliar context on the test. What does this mean? That they haven't truly generalized the knowledge. What are the ramifications of this? Faculty members teaching the next or follow-on course recognize that students are unable to transfer knowledge from the previous course to the current course.
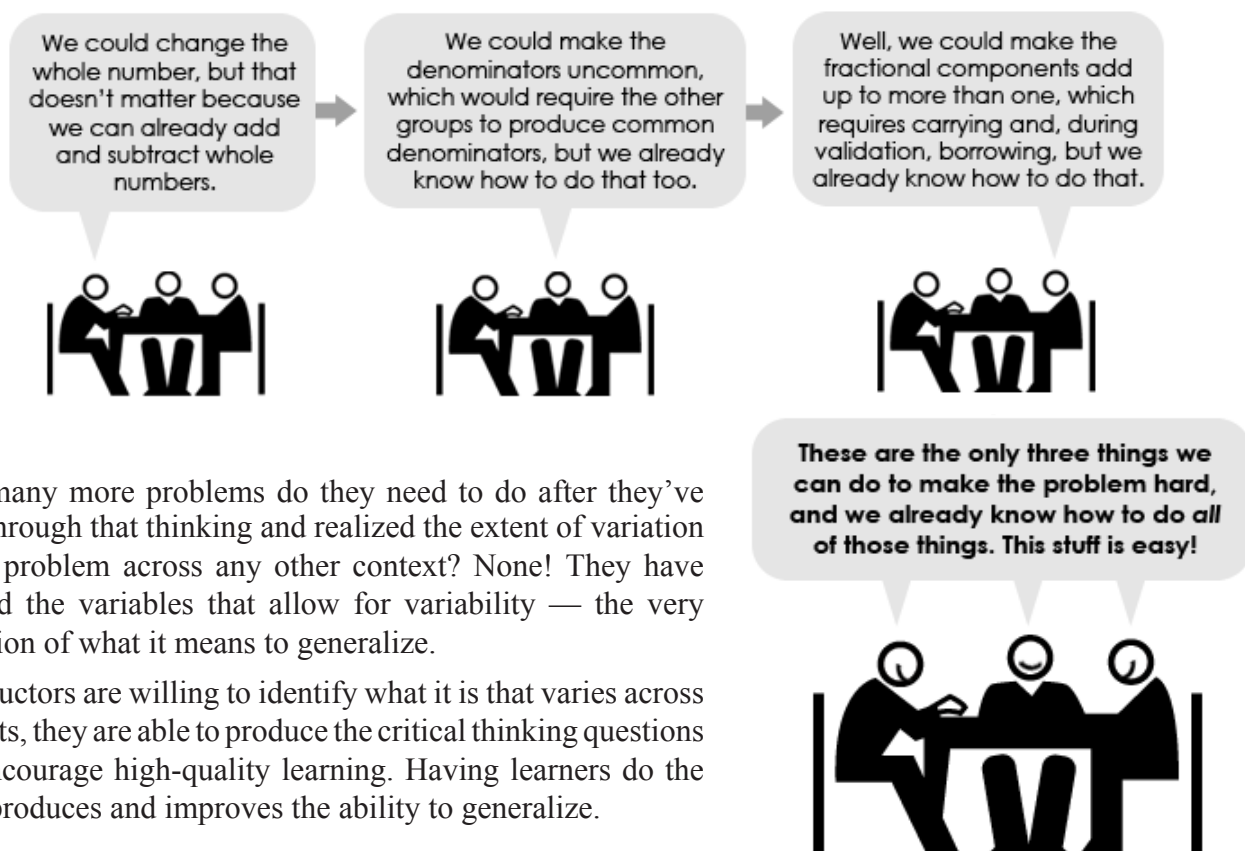
As a way to help students build the skills necessary for generalizing and transferring knowledge, one of the best practices is called **Generalization after Four Problems**. The approach is to have students become increasingly able to generalize concepts, processes, and principles by:

1. Solving a problem in a familiar context
2. Solving a problem in a similar context
3. Solving a problem in a more difficult (less similar, less familiar) context
4. Solving a problem in a very difficult (least similar, least familiar) context

This is a very useful practice and will help students increase their ability to generalize.

But there is a technique that may be even more promising: **Having students create their own "hard problem."**

In a recent basic math course an instructor was asked to observe, groups of students were working on adding and subtracting mixed numbers. One group had just finished a problem and said that they found it was a "really hard" problem. The instructor intervened with a challenge, asking them to create another "hard problem" that would stump the other student groups. The thinking they exhibited was interesting:

> We could change the whole number, but that doesn't matter because we can already add and subtract whole numbers.

> We could make the denominators uncommon, which would require the other groups to produce common denominators, but we already know how to do that too.

> Well, we could make the fractional components add up to more than one, which requires carrying and, during validation, borrowing, but we already know how to do that.

> These are the only three things we can do to make the problem hard, and we already know how to do *all* of those things. This stuff is easy!

How many more problems do they need to do after they've gone through that thinking and realized the extent of variation of the problem across any other context? None! They have grasped the variables that allow for variability — the very definition of what it means to generalize.

If instructors are willing to identify what it is that varies across contexts, they are able to produce the critical thinking questions that encourage high-quality learning. Having learners do the same produces and improves the ability to generalize.