Abstract Examples in Learning Math

Why Is This Strategy Useful?

For some math topics, it is advantageous to use concrete examples of the to-be-learned concept to promote students’ math learning. Concrete examples may include physical manipulatives that might be used by elementary students as well as contextualized, real-world examples that might be encountered by more advanced learners. Recent research shows that for some higher-order thinking skills, the use of generic or abstract examples leads to better results. Abstract examples minimize extraneous detail, such as traditional symbolic notation. In addition, abstract examples are less likely to compete for attention with deep to-be-learned structure than concrete examples. Thus, transfer of conceptual knowledge is more likely to occur after learning a generic instantiation than after learning a concrete one. This strategy is applicable for high school students practicing higher-order thinking skills in mathematics.

Description of Strategy

Abstract examples replace the real-world examples used in concrete examples (e.g., slices of pizza or measuring cups filled with liquid) with arbitrary symbols such as geometric shapes. For example, instead of teaching students that combining two cups filled with a certain amount of liquid would result in a cup with another certain amount of liquid, teachers instructed students that combining two specific symbols (e.g., two squares) would result in a certain different symbol (e.g., diamond) under the newly learned mathematical rule. Using symbols rather than real-life examples is considered generic because the symbols are not meaningful, the storyline or context is novel, and the rules of the language are arbitrary. Using symbols rather than a real-world example may, in some instances help students focus on the rule rather than the instantiation of the rule.

Research Evidence

One article reporting on a series of small randomized controlled trials with college students provides support for this strategy. Students taught a set of mathematical concepts using abstract symbols were compared to students taught using one, two, or three concrete examples. Students taught the mathematical concepts using abstract symbols were better able to apply this knowledge to a new example than college students taught using concrete examples. Furthermore, those taught with concrete examples scored roughly the same as they would have if they had answered questions randomly.

Sample Studies Supporting this Strategy


The article discusses one successful approach in introducing abstract knowledge to students. The authors suggest that a promising strategy is to present students with multiple concrete as well as highly familiar examples of the concept that is being introduced in class. For example, one common approach when teaching probability is for a teacher to select red marble from a bag containing red and blue marbles. This example represents the concept of probability and may assist learning by connecting the learner’s existing knowledge with new knowledge. However, concrete information may not always be the most effective strategy for transmitting information to students, and the concrete examples may in fact compete for students’ attention.
An alternate approach is to provide students with abstract, symbolic representation rather than multiple concrete examples.

Additional Resources