In my classes, I mix a group-oriented, self-discovery teaching approach with a generous use of real-world examples and visualization techniques. I provide students with the basic tools in lecture, and they discover the deeper implications through crafted worksheets. My job is to help by pointing them in the right direction, sometimes by answering a question with a question, rarely simply giving out answers.

I found this technique to be very effective when I taught, both as a teaching assistant and as an instructor, in the Summer Bridge Transition Program at the University of Illinois. The goal of the program was to bolster basic math skills and foster good study habits to incoming first-generation college students. In this course, a typical day for me consisted of a 10 minute lecture, followed by daily group work. Students would split their time between solving problems from a worksheet and presenting their results to the rest of the class. By having students present solutions at the board, I was better able to identify the gaps in their knowledge and we would discuss, as a group, issues that came up.

I want my students to see the greater consequences and applications of the mathematics I am teaching them. So, before preparing a lecture or activity, I try to think of what applications and examples illustrate the importance of the topics being discussed. As an electrical engineering example, I have given students problems that show how signal processing is tied to Riemann sums. In connection with economics, I have given a Lagrange multiplier problem with a twist. Instead of asking to maximize savings based on a gas consumption constraint, I asked them to show that the price of gas, the multiplier, can influence the consumption constraint.

That is not to say I neglect giving pure math problems in class. One of my favorite problems to use in a Calculus I course is to show there is a line which is simultaneously tangent to $e^x$ and $\ln x$. The question is given as a series of small, incremental problems that lead students to use the Intermediate Value Theorem to show such a line exists, without having to explicitly construct it.

Another concern that seems common among students is the inability to “see” mathematics. To combat the notion that mathematics is a series of operations blindly performed on formulas, I try to design activities that concretely illustrate the lesson. In a Calculus III course, for example, I have experimented with the use of modeling clay to discuss parametrizations of surfaces, surfaces with a discontinuity, and intersections of surfaces. One such activity had students deforming a square in $r\theta$-space into a disc in $xy$-space via a polar transformation. The result was that being able to animate the transformation from one coordinate system to another gave students an insight into how parametrizations work and it set the ground work for double integrals in polar coordinates.

My goals when teaching different courses may depend on the given level of the course,
but my methods for achieving success, whether in a sequence course or a terminal one, are not completely disjoint. Regardless of the level of the class being taught, I put an emphasis on group work with activities centered around three goals: showing applications to topics of interest to the class, extending the consequences of the material learned in lecture, and visualizing mathematical concepts. I strive to guide students to that “Aha!” moment by themselves.