

An Efficient Teaching Technique for Engineering

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Abstract

Almost every professor has experimented with various teaching techniques in order to find an effective way to reach their students. As a new instructor to engineering trying to find my own preferred teaching style, I found a particular technique to be extremely effective in terms its benefits and the positive feedback I receive from my students. According to numerous education experts, just purely lecturing each and every lesson is not the ideal method of instruction. As I discovered, engineering is perfectly suited for reflection pauses during the lesson in order to give students time to analyze and absorb the new material as they work on in-class problems related to the lesson material.

Introduction

Last fall was my first semester as a college engineering educator, and I certainly learned more about teaching than I ever expected. After studying various teaching literature and experimenting in the classroom, I quickly discovered that there are many variables that contribute to effective teaching and student learning. After experimenting with various methods of instruction in the classroom, I found a particular teaching technique to be very effective, and it merits the attention of all educators of engineering because of its benefit to the instructor and the students.

Most engineering experts would agree that engineering is a problem-solving science that must be practiced in order become effective at solving complex problems. Undoubtedly, engineering students across the country are getting plenty of practice solving problems outside the classroom in the form of homework, but for most engineering programs, the only time professors get to observe their students solving engineering problems might be during laboratory hours or while advising on a design project. By observing our students, we gain invaluable feedback about their knowledge and problem solving abilities. Therefore, why not observe our students working on problem in the classroom as part of the weekly lecture time? Besides just receiving feedback from our students about their understanding and gauging our effectiveness in teaching, problem solving in the classroom is an active form of learning which is generally agreed upon to be the best form of learning.

Description of the Teaching Method

I am absolutely convinced there are several benefits gained by dedicating time during the classroom lecture period for the students to practice on problems related to that particular day's lesson. Before I discuss these benefits, allow me to explain the flow of a typical lesson in my

classroom. During my lesson planning before class, I organize my lesson's learning objectives in a logic and linear fashion and determine the best way to present the material. Besides just pondering on the best way to present the material, I draft several engineering problems related to that day's lesson. Typically, I have two to four problems that I prepare for each lesson, and place these in a word document with enough white space so that the students can work directly beneath the problem statement and schematic on the sheet I provided them. At the beginning of class, I provide every student with a hardcopy of the problems we will be reviewing for the day. At the beginning of class, I usually start by conceptually explaining the concepts behind the lesson objectives and discussing their importance and application. Then, I transition to the board to derive and provide the theoretical background needed to solve that lesson's engineering problems. Once I feel like I explained how to solve a particular problem, I stop lecturing and then ask the students to attempt the first problem on their handout which I provided them beginning of class. However, sometimes, I work through the first problem on their handout at the board if I feel like the students will struggle too long without first seeing a similar example worked by me on the board. Therefore, I often work the first problem on the board for the entire class, and then ask them to attempt the next problem on their handout which is similar yet different. If I have similar problems, I usually make the subsequent problem slightly more difficult. Also, I ensure that I have a least one problem related to each lesson objective for that day; therefore, some problems might require different approaches and techniques to solve.

Regardless, I ensure that I offer time for my students to attempt at least one problem on their handout either by working alone at their desk or with a partner next to them. During my lesson planning prior to class, I strategically outline in my mind which problems I will personally review in class on the board and which problem(s) I will have the students attempt on their own during the lesson period in class. Typically, I do not allocate more than 15 minutes of class time to student reflection on a particular because I need the remaining lesson time review the problem and introduce the other problems on the handout. While the students are working on their problem, I walk around the classroom and observe their work. During this time, I collect feedback from the students by observing those who seem to completely understand the material and others who seem to be struggling with particular concepts. Also, I make myself readily available to answer any of their questions and work with them one-on-one in clearing up any confusion. Therefore, I get to know each of my students better by having another form of feedback from my students, and I get more personally connected to my students by getting the opportunity to teach and assist them on a more personal level than if I was teaching them up at the board. If I happen to see the majority of my students struggling to complete a particular problem, then I know they either did not prepare properly for today's lesson or I did not effectively introduce the material at the beginning of class. Therefore, I stop their reflection time and return to the board and work through the problem for the entire group. As I will discuss next, providing time for the students actually think about and attempt a problem during class time has several benefits that definitely outweigh the cost of sacrificing class time.

Ideal for Active and Reflective Learners

Many professors might feel reluctant to sacrifice valuable lesson time in order to allow their students to practice working on problems in the classroom. They might argue that their students

will have the chance to practice solving problems on their own during the homework assignment or later during the laboratory exercise; in addition, some professors might think that they have to cover too much material and there is not enough time. However, I argue that there is much more to gain than there is to lose when you provide time during the lesson's lecture for student reflection. First of all, I am certain that students leave the classroom with a better understanding of the material after they practiced on a problem than if I lectured the entire period and did not afford them the opportunity to work a problem on their own. Many studies clearly indicate that active learning is one of the best forms of learning; therefore, why have our students completely in the passive mode of learning for the entire lesson? By getting hands-on practice in the classroom, the students must actively participate in the lesson by thinking about a problem and trying to solve it. Not every learner is an active learner; there are some who are reflective learners². Besides targeting active learners using this method instruction, reflective learners are also ideal students for this style of teaching. Reflective learners have an opportunity to think about the new concepts I just presented when I pause my lecture; I do not require my students to actively go to the board and work on problems. Instead, I allow everyone the opportunity to sit in their own desk and reflect on the material at their own pace by working through an example problem. As a student, I remember plenty of occasions in the classroom where I could barely keep up copying notes from the professor's board work, let alone have a moment to actually think about the material I was copying.

Real-time Feedback

Gathering and analyzing feedback about your students is critically important as a professor. It is important not only for grading purposes and determining student learning, but it is also vital for self-assessment of your own teaching performance. In an engineering classroom that is strictly taught by lecture, the professor has little or no opportunity to collect feedback from their students during the class period. Using this teaching style, the professor usually only gets feedback after a graded event. Then, it might be too late to make course adjustments or emphasize a particular point in the lesson. However, if the professor allows for time in the classroom for the students to reflect and work on a problem, then he or she can gather real-time feedback about their students and their teaching style. For example, when I turn it over to the students to work on an in-class exercise, I walk around the room and observe my students. By looking at their work, assisting them with the problem and asking questions, I can quickly gather information about their level of understanding. When I discover several students struggling on a particular problem, I know that I need to dedicate more time reviewing that concept. On numerous occasions when I think my students are following my lecture and understanding the material, I quickly discover they are struggling with some particular concepts after I transition to an in-class problem. If I would not have stopped the lecture and had them apply the lesson material to a problem, I would have never known about their difficulties in understanding the material. By gaining this real-time feedback in the classroom, I can tailor my lesson material and devote the appropriate amount of time to fit my students' needs. Besides just myself gathering feedback, my students also perform a self-assessment on their level of understanding while working on a problem. Some students might think they are following me perfectly until they are presented with a problem and then discover they failed to understand the key concepts. Therefore, they quickly realize they need to study harder and ask questions before they are lost. Naturally, this teaching method typically sparks more questions than a purely lecture-style classroom.

Other Benefits Gained

Besides being well-suited for various student learning styles and gathering feedback, this particular teaching method has several other benefits. According to Lowman³, building positive interpersonal relationships with your students and showing compassion in the classroom contributes to the learning experience. This particular teaching tactic provides the opportunity for the instructor to have one-on-one conversations with his or her students while assisting them during in-class problems. When students see you devoting your time to individually help them, it shows that you genuinely care about them and their education; it shows them that they are no longer just a nameless body in your classroom that you are just lecturing to. Besides showing compassion and improving interpersonal relations, strategically placed reflection pauses in the lesson also changes the pace of the classroom which assists in maintaining the attention of the students. Certainly every professor at some point has witnessed a student lose focus during their lecture; therefore, why not turn the classroom over to them for part of the lesson? By doing so, it also reinforces the goal of having the students take responsibility for their own learning. As a professor, when you sacrifice lesson time for in-class problem solving, naturally you cannot discuss everything in as much detail as you would like; however, you are now placing ownership of that burden to the students instead of the professor having the complete responsibility for explaining every detail. When students actively participate in the lesson, it also helps improve their self-motivation¹. Students that know that will be expected to participate in the lesson will probably come more prepared for class by doing their reading and study problems prior to class than a student who knows they can just sit there, copy notes, and not have to answer any questions.

Conclusion

There are various ways to teach engineering; some are more appropriate than others for particular lessons. The teaching technique I described in this paper might not be the right fit for some classrooms or occasions. However, if you think this technique might be appropriate for your class, then I highly recommend giving it a try. Once you experiment with this technique, I am certain that you will find it to be a very efficient teaching technique where the benefits certainly outweigh the costs.

Bibliography

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