Teaching Engineering Courses: A Teaching Assistant’s Perspective to Help Students Learn More Effectively

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Abstract

In this paper, we draw on our experiences as teaching/graduate assistants for engineering courses, at the University of Louisiana at Lafayette. We will discuss the teaching methodologies, with which we have worked, and put forward the teaching assistants’ point of view on how engineering students can maximize their learning experience within the purview of these teaching methodologies. A graduate student's education is traditionally focused on research and training within his academic area of concentration. Teaching assistants frequently provide a large portion of undergraduate student contact hours, particularly in introductory courses at large universities. This affords the teaching assistant many opportunities to both receive student feedback and to formulate their own points of view about the prevalent teaching methodologies. Familiarity with the tools of today's technologically sophisticated systems is essential in order to be ready for real-world success, which is integral to many of the courses in the engineering curriculum. The goal of the teaching assistant is to guide the student through the steps of setting up, recording, analyzing, and reporting the behavior of a system using these tools, so that he can complete a proper laboratory experiment and can establish the level of its success.

Introduction

A graduate student's education is traditionally focused on research and training within his chosen academic area of concentration. As teaching assistants, graduate students frequently provide a large portion of undergraduate student contact hours, particularly in introductory courses at large universities. This provides them with many opportunities to both receive student feedback and to formulate their own points of view about the prevalent teaching methodologies. Within the study of science and engineering, we can say that a good teaching assistant seeks to help an undergraduate student optimize an educational experience, ease the students indoctrination into a disciplinary culture, and to help the Faculty in all aspects of the teaching process.

Traditionally any engineering course would be divided into lectures, laboratory/project work, home assignments, quizzes and examinations. As a teaching assistant, one gets to interact with
and observe a broad spectrum of student personalities, all very individual and unique in their own way. Despite this uniqueness, it comes to fore that most people tend to make the same mistakes and follow the similar paths to successful completion of the courses. In this paper we aim to present a learning methodology for students, as well as, a teaching strategy for the teaching staff, especially the teaching assistants.

The lectures, tutorials, home assignments, laboratory and project work associated with an engineering course are only the visible elements of the teaching and learning process. In addition, the students need to spend at least as much time in individual study as they do in lectures, tutorials, and laboratories if they are to master the engineering concepts and their application. One of the important objectives of any course is to develop the ability to learn in students; so mastering the techniques for learning is vital if the student is to be successful in their studies and professional career. In the following sections we will try to address each part of an engineering course individually and try to address an effective methodology for the students to apply in their pursuit of knowledge, based on our observations as a teaching assistant [1].

Lecture

Classroom lectures are the backbone of any course and constitute a major portion of the coursework. Lectures may be presented using blackboard and chalk, overhead transparencies, computer slide shows or other media, but they should be treated only as a guide to the important concepts and their application. They are not simply a replication of the textbook, but rather a view, based on the instructor's experience, of the importance of the various topics and how they relate to one another. Lectures aim to establish the learning objectives and how the flow of topics, analysis, and results relate to these [2].

To take advantage of what goes on during a lecture, it is critical to listen and follow what is being said (which may not appear on the board or in the printed notes). Coordinating this with taking notes is a difficult task and requires practice and concentration. Therefore, any distractions should be avoided, as there is a need to achieve total involvement with the lecture. For many students a good way to achieve this involvement is by

- Sitting as close to the front of the lecture room as possible. By doing so, there will arise the inclination, as well as the opportunity, to ask pertinent questions and clarify conceptual doubts if you sit nearer the lecturer.
- Correspondingly instructors should also make provision for time in their lecture plan for students to take notes.
- If a student feels that the style of the lecture makes it difficult for him to make good use of the time spent. For example, if it is a challenge for him to just take accurate notes, let alone understand what is being said, he should discuss the matter with the instructor as early in the course as possible. This will help the instructor make the required adjustments in his teaching plan/strategy.
Assignments

Contrary to popular belief, solving problems, such as those at the end of each chapter in the textbook, is not by itself an effective learning technique [1,2]. Rather, it should be used as a test of whether the student has assimilated the material well enough to apply it in a variety of ways and as a way to get involved with the course material. The problem solving process involves starting, encountering difficulty, reviewing the relevant concepts, restarting, and iterating toward a completion. This is very important to understand because it means that if the student is experiencing difficulty with a particular problem, beyond a certain point, it is a waste of time to continue to struggle with it. Rather, he should review the underlying concepts and then try to proceed. If he still has difficulty, then it is advisable at this time to see the instructor or teaching assistant who will help clarify the concepts and show how to apply them to the problem in question. It is also a waste of time to blast a solution from a classmate since the student will have still not passed the test of his own understanding, although he may think he has. As a matter of fact it is very beneficial to get to know your peers/classmates and try and form study circles/groups, not only does it drive away the drudgery at times of studying alone, but would add another perspective on the problems at hand. As the saying goes "Two heads are better than one".

Laboratories/Projects

Laboratory and project work are the most important aspects of an engineering technology course. They serve as the ultimate aim and objective of the course, i.e., to translate theoretical concepts into a physical reality, giving the student a chance to really appreciate the meaning, as well as, have the real feel of what he is studying. However, it is important that the teaching assistants and Faculty take care that the students also get to learn other things in the laboratories including

- Hands on experience with the various equipment to be used in the laboratory whilst performing experiments.
- Safety aspects of working in a laboratory.
- Importance of accuracy.
- Attention to detail, and preparation in making reliable engineering measurements and observations.
- Techniques for reporting and documenting experimental work.
- Management of group activities.

This is the time to interact one-on-one with the instructor and teaching assistants and really get involved with the subject. Instructors and teaching faculty can use the laboratory as a platform to really fire up young students' imaginations and come up with some really interesting and useful ideas that can be translated into Project work.
Self Study

Self-study is a very important but oft-neglected part of coursework. Despite best efforts to take advantage of the lectures, labs, assignments, and tutorials, students, in order to really learn, need to do a great deal of self-study. If an effective self-study strategy is not developed, a great deal of time will be spent with little benefit. Following, are some ideas, which may act as direction for formulating individual methods. One should not be afraid to try new ways of working; sometimes simply changing a study location may prove to be amazingly effective.

- Need to have at least one private, quiet space for study.
- Need to have a plan, which includes attention to all courses on a regular basis. If the student is really interested in learning, cramming at exam time is not effective.
- There are four primary resources to aid in learning the material in a course: the class notes, textbook, instructor, and teaching assistants. Class notes should act as a guide to the important topics and how they are related and provide illustrative examples of how to apply basic ideas to solving problems. One can start by reviewing notes taken earlier in the day (they may not make much sense later) and make note of all the points that are not clear and review the corresponding textbook coverage.
- Use some form of summary or condensation of the important topics and results. Eventually, a course will boil down to the essential concepts, techniques, and results, and it will be a surprise to the student as to how few there are, once it is really understood what is going on.
- Use textbook worked examples effectively.
- Lastly, try the home/problem assignments or other problems from the textbook. If you have difficulty, it means you do not yet understand the material well enough. This is a good time to ask for some help from the instructor.

Examinations

Examinations are the logical culmination of any course. They serve as the prize at the end of the race, as the measure by which one can judge how well the concepts have been understood. Each instructor has his individual approach towards testing of students. On one hand an instructor might like to take a number of small tests and quizzes all through the semester and on the other hand he might like to stick with a few but bigger sized tests [3]. Whichever the case, if a student does well in the examination it brings joy not only to him but to the instructor as well, on a job well done. Examinations need a strategic approach, keeping the amount of coursework and time available in mind. If the student studies properly during the term, then there would not be a need to cram for examinations. That is the payoff. If one starts reading notes and attempting problems for the first time the night before the exam, then there is little hope of overcoming any conceptual difficulties leaving a lot to be desired in the preparation for any exam.
Giving examinations well is as important as preparing for them. It would serve no purpose if after a huge effort in preparation a student were to go and spoil an exam. Most exams are designed by instructors keeping the degree of difficulty, time required as well as the coursework covered in class, and are quite balanced. Often students run out of time whilst giving exams, this is more due to an unplanned approach than any other reason. It is very important to allocate time for reading, understanding and answering questions at the start itself. Also important is the method to build an answer to any question. Writing down in a sequential, concise and clear manner indicates your grasp of the subject and helps the grader to grade your answer more efficiently.

**Conclusion**

Every student as mentioned earlier, is a unique individual and thus the learning strategies brought out in this paper may have varying impact on the myriad of student personalities involved. Thus it is ultimately the student’s decision as to what suits him best and the kind of learning strategy that he would wish to adopt.

Our experiences as teaching assistants turned out to be really rewarding. During the course of our assignment as teaching assistants, we realized that the best way to get to know any subject is by imparting that knowledge to another person. All the aspects of being a teaching assistant had a different flavor to it: the setting up of laboratory equipment before any lab class, the grading of home assignments and lab work, the tabulation of grades, as well as numerous one-to-one consultations with students to address doubts in concepts. The aim of this paper was to highlight our observations on the approach that most students take when taking any course, in our case, an engineering course. We have taken the liberty to put forward our ideas for realizing a successful learning strategy based on the prevalent teaching methodologies. We also are in the process of dissemination of these ideas to our respective students for the current semester in ITEC and hope to be able to publish results in the near future.

**Acknowledgements**

We wish to take this opportunity to thank Dr. G.H. Massiha, ITEC, University of Louisiana, Lafayette for having given us the opportunity, as well as the responsibility, to be his teaching assistants. He has been a wonderful guide in our development towards handling a student body. As a matter of fact it was his idea that we put down on paper, our perspective on teaching engineering courses.
References


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