

# Teaching Large Classes of Engineering Students

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## ABSTRACT

*The face-to-face lecture is the conventional means of teaching large groups of students. However, it the large class is a great challenge to student learning and instructor teaching. Asian students are relatively passive compared with Western students due to cultural differences. Hence, teaching passive Asian students in a large-class setting adds to the challenge of delivering effective lectures. To cope with this challenge, the authors developed a 7-MUSTs teaching approach for large engineering classes in Asian countries that includes: (1) have a heart for students; (2) spend time preparing for lectures; (3) present well in lectures; (4) always make students think in lectures; (5) have two-way communication/interaction in lectures; (6) get feedback from students; and (7) always think of ways to improve. The authors have been using the 7-MUSTs teaching approach and obtaining good teaching evaluations from students in Hong Kong and Singapore. This proves that the 7-MUSTs teaching approach is both useful and successful.*

## Keywords

Engineering education, instructor, large class teaching, passive student

## INTRODUCTION

In most universities, it is common for the general introductory engineering courses to be taken by several hundred first-year students. Teaching large classes with conventional face-to-face lectures and tutorials requires special teaching skills. It is a challenge to teach large classes with hundreds of students. Furthermore, it is an even bigger challenge to teach large classes with a group of passive students.

Asian students from Hong Kong, Taiwan and Singapore are more passive and are less willing to answer questions during lectures than are students from North America and Australia. Most Asian students are quite shy in public settings and thus they normally would not answer questions in a lecture even if they knew the answers. Similarly, they rarely dare to ask questions even if they do not understand the lecture material. It is not uncommon for some students to approach the instructor after a lecture and ask

questions outside the classroom for 15 to 30 minutes. Soh and Gupta (2000) mentioned that students from a large class of over 1600 come with diverse backgrounds with different levels of understanding. The tutors would normally find students queuing outside their office when it is close to examination time. One of the reasons these students do not ask questions in class is that they do not want to disturb the lecture. However, other reasons are: (1) they are afraid of losing face if they ask stupid questions; (2) they do not feel comfortable communicating in English; and (3) they are too shy to ask questions in front of a large class. These reasons are perhaps due to cultural differences between Western and Asian students. Communication skills are an important part of engineering degree courses and it has been suggested that they be integrated into engineering subject matter (Collins et al., 2000). A good teacher relies on two-way communication (Ferguson, 2001). For this reason, special teaching approaches should be developed for large classes as well as for groups of passive Asian engineering students.

It is not an easy task for most instructors to teach large classes. The main objective of this paper is to share the authors' experience in large class teaching. A special teaching approach for large classes called the '7-MUSTs' has been developed by the authors. The authors are able to manage classes well by using the 7-MUSTs teaching approach and, according to teaching evaluations and student feedback, this approach has been proven to be effective.

## **BACKGROUND**

The authors have extensive teaching experience in both Asian and Western countries for over 10 years. The first author was a teaching assistant during his PhD study at the University of Sydney, Australia. He was an assistant professor in the School of Civil and Environmental Engineering, Nanyang Technological University (NTU), Singapore. Since large class teaching is quite common in NTU, he often taught classes of 300 students in a large lecture theatre. After working in NTU for a few years, he joined the Department of Civil Engineering at the Hong Kong University of Science and Technology (HKUST) in 2001. He has taught Australian, Singaporean and Hong Kong students in Civil Engineering. The second author was a teaching assistant during her study at the National Taiwan University and the University of Texas at Austin, USA. She joined the HKUST in 1992 and is currently an associate professor in the Department of Civil Engineering. She has been teaching both engineering and non-engineering students with a class size of 120 students, and has taught Taiwanese, American and Hong Kong students.

## **TEACHING APPROACHES**

With over 10 years of experience in teaching large classes in Hong Kong, Taiwan, Singapore, North America and Australia, the authors found that the learning mentality of Asian students is quite different from that of Western students. This is mainly due to the passiveness of Asian students and to other possible reasons which have already been mentioned in the introduction to this paper.

In addition to the aforementioned problems faced by the students, when teaching large classes in Asian countries, instructors also face difficulties such as:

- Difficult to attract the attention of students
- Difficult to interact with students
- Not easy to make eye contact with every single student
- Unlikely to recognize students' names

Since there are difficulties in both teaching and learning in a large class, the authors have implemented a '7-MUSTs' teaching approach to overcome the above problems. The 7-MUSTs teaching approach is shown in Figure 1. This teaching approach includes the following:

- (1) Must have a heart for students
- (2) Must spend time preparing for lectures
- (3) Must present well in lectures
- (4) Must always make students think in lectures
- (5) Must have two-way communication/interaction in lectures
- (6) Must get feedback from students
- (7) Must always think of ways to improve

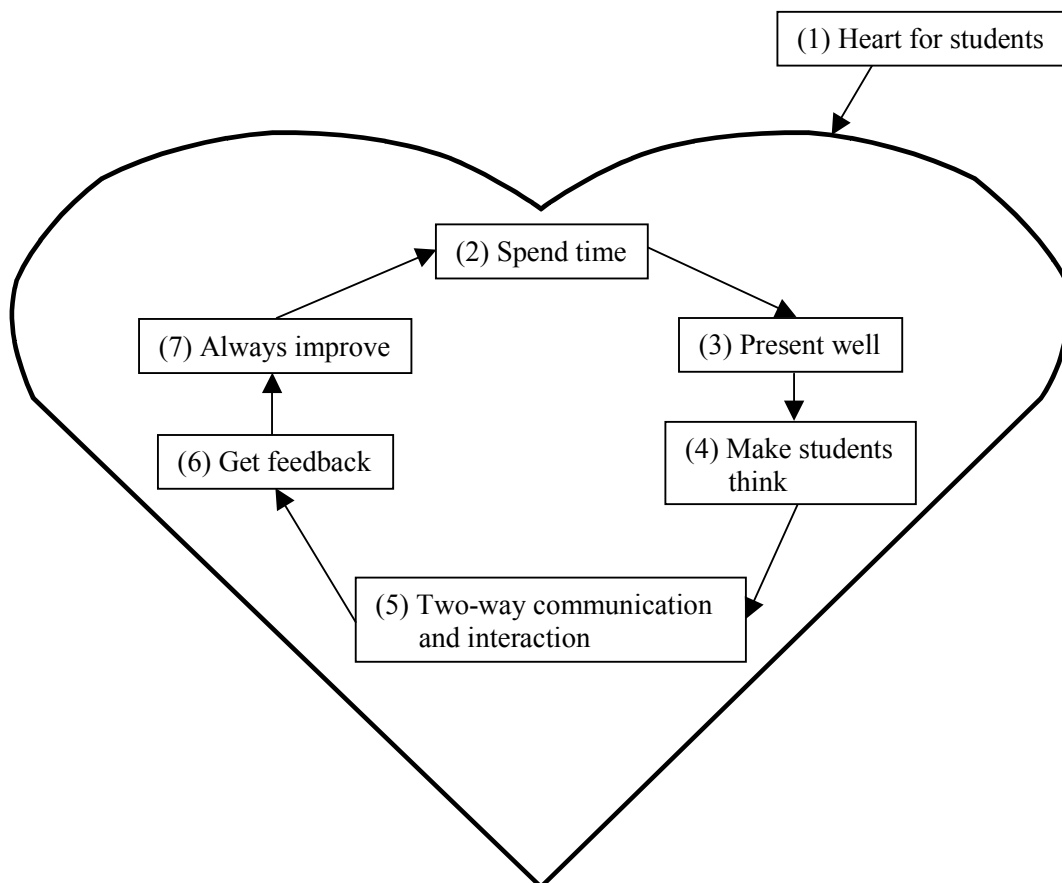


Figure 1. The 7-MUSTs teaching approach

## **IMPLEMENTATION OF THE 7-MUSTS APPROACH**

### **(1) Must have a heart for students**

It is believed that a good instructor must have a heart of understanding, enthusiasm, patience, and kindness for students. Extra patience must be given to students because different levels of student ability varying from mediocre to top-notch may exist in a large class. The instructor must put himself/herself in the students' position, try to understand how they think, and be able to teach according to their level of understanding. Some instructors might teach from their high level of knowledge, which is beyond the level of students' learning abilities. The instructor must also have patience with the less competent and more passive students by explaining concepts repeatedly in different ways and through different methods. Other than teaching technical materials, it is also important to care for the welfare of students.

### **(2) Must spend time preparing for lectures**

A good instructor must be willing to spend time preparing lectures. It is important to prepare a good set of lecture notes and other reading materials for mediocre and passive students. This is because the mediocre students may not be able to follow the lecture. In preparing a new set of lecture notes, the authors normally spend 10 to 14 hours per hour of lecture. In addition, the authors spend at least 45 to 60 minutes reviewing the lecture material before each lecture. Lots of time is spent on setting good tutorial questions to help students understand the lecture material. Lastly, it is important to revise lecture notes and tutorial questions from time to time to include up-to-date engineering technology. Therefore, lecture preparation is a continuous process.

### **(3) Must present well in lectures**

There is a significant difference between an instructor with good presentation skills and the one who delivers materials in a straightforward manner. The authors personally think that use of a good voice and eye contact are powerful tools for attracting students' attention and to control the atmosphere in the class. The lecture materials must be presented clearly and must be to the point. In presenting abstract theories, it is necessary to use diagrams and models to illustrate the key components of the concepts. A student from Singapore once remarked: 'A diagram explains a thousand words and a model explains a million words.' To arouse students' interest, the authors often use illustrations with student involvement and practical worked examples for explaining the teaching materials. Other useful teaching tools that the authors also use in lectures are detailed in Lo and Young (2004). The teaching tools integrate theory with real-life examples and stimulate students' interest in the subject matter. The teaching tools can also enhance the engineering sense of the students.

### **(4) Must always make students think in lectures**

In large classes, students are often like signal receivers minus the data processing (i.e., students receive the lecture material without thinking). It is important to make students think in lectures. The following activities can stimulate students' thinking:

- Help students to think about the fundamental concepts rather than simply solving the problem. The authors often ask basic questions related to the concept prior to moving into more difficult materials.
- Get the students to note down some lecture materials during the lecture to keep their minds active.
- Give some apparently correct but wrong examples after teaching a concept and a theory. Ask the students to identify the mistakes in the example.

#### **(5) Must have two-way communication/interaction in lectures**

A good lecture must include two-way dialogue between the instructor and students. Thus, students should always be encouraged to participate in the class to enhance the learning process. The way to ask questions in a large class is to state the questions so that they have a simple 'yes' or 'no' answer. The students respond by raising their hands. The authors believe that even if there is no response from the students, asking questions in the class is not meaningless because students might have already answered the questions in their heads. The purpose of two-way communication/interaction can then be achieved. The authors also encourage students to answer questions by telling them 'people do learn from their mistakes'. If they give a wrong answer, the authors simply say 'good try'. As a result, they do not feel embarrassed for trying to answer a question.

#### **(6) Must get feedback from students**

The authors normally seek feedback on their lectures from students at the beginning of the semester, especially after the first few lectures, rather than waiting until the end of the semester. The feedback can be gathered by talking to the students in person. With this feedback, the authors then make necessary adjustments to their subsequent lectures. It is important to gather feedback from both the top and poor academic students. In addition to listening to verbal feedback, the authors also treat the student evaluations conducted by the university at the end of each semester very seriously. The main purpose of getting feedback is to improve teaching quality.

#### **(7) Must always think of ways to improve**

Teaching a large class of students is not an easy task. Improvements in teaching are always necessary. A good instructor must always have a positive attitude to improve his/her teaching. If the instructor thinks that his/her teaching is good, he/she will never improve. After each lecture, the authors would review and revise their teaching materials to improve the clarity of their lecture notes, the pace of the class and the use of illustrations to explain difficult concepts.

### **CONCLUSIONS**

Conventional face-to-face lectures in large classes require special teaching skills. Asian students are comparatively more passive than Western students due to cultural

differences. The authors have developed the 7-MUSTs teaching approach for large engineering classes in Asian countries. It has been proven a success by the good teaching evaluations from students at Hong Kong University of Science and Technology as well as Nanyang Technological University, Singapore. Teaching is considered as equally important as research. As responsible instructors, it is our obligation to do the very best to teach students because the students of today will be the engineers of tomorrow.

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