

Enhancement of Students' Learning in Large Classes

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Abstract

For the past five years, the authors of this paper have been teaching an engineering course - *IMSE 250 Introduction to Manufacturing Processes & Systems* - in large classes at Kansas State University. The average enrollment of IMSE 250 was 115 in spring 2005 and it is taught twice a year. In order to enhance students' learning, six techniques have been used for lecture preparation and class organization. This paper presents the authors' experiences and the effects on students' learning when these techniques are applied.

Keywords

Active learning; Engineering education; Large-class teaching.

1. Introduction

At Kansas State University, *IMSE 250 - Introduction to Manufacturing Processes and Systems* - is a required course for students majoring in industrial engineering, manufacturing systems engineering, and mechanical engineering. This course is also taken by students in other engineering disciplines, humanities and sciences. It is intended to not only provide engineering students with technical knowledge for further study in their disciplines, but also expose humanities and social sciences students to manufacturing engineering. *IMSE 250* is a large engineering class (115 students in spring 2005). To teach such a large class, the instructors faced several challenges ¹:

- Students from diverse backgrounds with different prior knowledge of manufacturing
- Vast scope of information the course intends to cover
- Delivery of engineering knowledge in an interesting way

In order to deal with these challenges, the instructors of *IMSE 250* have tried to set up an active learning environment in the classroom. A series of active learning strategies were designed to encourage the students' participation in learning. These strategies are categorized as:

- Application of advanced technologies
 - K-State online learning tool
 - Multimedia presentations by the instructors
- Motivation of students' active learning
 - TTYP (Turn-To-Your-Partner) in-class discussion

- Daily quizzes
- Extra credit activities
- Interaction with outside resources
 - Guest speakers from industry
 - Plant tours
 - Interaction with the IMSE 251 (*Manufacturing Processes Lab*)

To ensure the effective implementations of the above strategies, the instructors adopted many techniques. In the next section, the authors will outline six techniques that were often used to enhance the active-learning environment in IMSE 250.

2. Six techniques to improve students' learning

Technique 1: learn how to teach

In order to prevent the class from becoming boring to students, the instructors of IMSE 250 made great efforts to learn:

- 1) What is active-learning and how to create such an environment?
- 2) What are the features of the large class and how to teach a large class?

For this purpose, there are abundant resources on the internet, including:

- Teach Large Class (University of Western Ontario, <http://www.uwo.ca/tsc/tlc/index.html>)
- Teaching Resources (University of Georgia, http://www.isd.uga.edu/teaching_resources/)
- CDTL Brief (National University of Singapore, <http://www.cdtl.nus.edu.sg/brief/>)

In addition, participation of ASEE conferences, on-campus teaching workshops and on-campus teacher development programs (e.g. K-State LEA/RN program) were also helpful for the instructors to learn.

Technique 2: prepare PowerPoint slides

To improve the students' learning in a large class, the PowerPoint presentation is a practical tool. A well-prepared slide can attract the students' attention and convey the information to them effectively. To prepare slides, two things should be emphasized:

- Write important things only - It will be very boring if too many words are written in one slide. A good slide should contain large letters that the students in the last row of the lecture hall can see clearly.
- Make the slides colorful and animated - The key points of the slide should be written in bright colors. Proper animation (such as video clips, flying effect, flash effect, etc.) will make the lecture more interesting and easier to understand.

Technique 3: ask teaching assistant(s) to help class preparation

At Kansas State University, large classrooms (capacity more than 200 with movable chairs and movable tables) are heavily used during the semester. The time interval between two large sessions is normally 10 minutes. In this case, a teaching assistant (TA), before and after the class, can help the instructors get the following tasks done in a timely manner:

- Before class – set up the projector, video and audio equipment, clean the blackboard, distribute the graded quiz and homework, hand out the in-class quiz for current lecture
- After class – collect the homework and in-class quiz, close all multimedia applications used during the class

Also, the TA should know the topic to be taught for the day in case that the students may put forward a question.

Technique 4: manage time for group activities

In IMSE 250, students often had TTYP (Turn-To-Your-Partner) discussions with his or her neighbors. TTYP is an efficient way of learning. Yet, as observed by the instructors, any discussion that exceeded 5 minutes was likely to make the students deviate from the topic. Therefore, the instructors needed to control the time of TTYP closely. Normally, the discussion that ranged from 2 – 3 minutes worked the best. The questions for TTYP needed to be selected so that they would not be too hard to be answered within the required time. Some typical questions for a TTYP discussion are as follows:

- 1) Write down at least one item for each of the sand, investment & die casting process.
- 2) Write down some features of plastic blow molding.
- 3) Write down the most important things you have learnt from this class so far.

Technique 5: interact with students frequently and concisely

A lecture-centered large-class session tends to minimize the student participation, leaving little opportunity for effective learning². To prevent the “lecture-centered” situation from happening in IMSE 250, Q & A interactions between the instructors and students took place quite often. These questions called forth the students’ attention, helped them better understand the lecture, and provided a good feedback through which the instructors could know how well the students had learnt in class.

However, these interactions need to be concise. As observed by the instructors, it seemed better if each Q & A could be finished in one minute. If the interaction was longer than that, then the class was likely to lose the interests in the topic. If the question needed longer time to answer, the instructors would invite the students for individual discussion after class instead of lingering on it in class.

Technique 6: give “bonus” to students

Bonus points served as a very effective stimulus to motivate the students' learning interests. In each class session, the instructors would put forward a couple of bonus questions. All the students were encouraged to raise their hands. After a student got the correct answer, other students were still encouraged to give their confirmation or their comments. And all these students would receive bonus points.

Besides the bonus points, other types of encouragement (e.g. a chocolate bar, a big applause from the class, some encouraging words from the instructors) were also worthwhile trying.

The above techniques effectively improved the learning environment in IMSE 250. Some of the students' anonymous comments on the class are listed as follows:

- "PowerPoint presentations are better for this class in particular; this is not the case for all classes."
- "TTYP, Quizzes for Extra Credit → Enhance mutual learning and teamwork skills."
- "Good class. Learning more than what I thought I would."
- "Good teaching style."
- "I think you have a class that you can learn a lot even you aren't trying hard. You do have to put in some effort to get a good grade. I like it."

3. Conclusions

The instructors of IMSE 250 introduced six techniques to improve the classroom environment by active learning. These techniques included:

- Learn teaching skills to make lectures interesting;
- Use PowerPoint slides to make presentation effective for learning;
- Ask TA(s) to help so that the class can start and finish punctually;
- Manage the time for group discussions to make the class learning more efficient;
- Get the students actively involved in learning by interacting with them often, both in class and outside class;
- Give "bonus" points to stimulate the students' learning interests.

The implementation and improvement of the possible teaching skills in engineering education need creativity, time and efforts. There is no single technique that optimizes students' learning in large engineering classes. The instructors will seek and try more techniques to help the students to learn.

References

1. Pei, Z.J., Deines, T., Hanna, S. and Lei, S., 2002, "Experience in a technology-based instruction and active learning for a manufacturing course," Transactions of the Committee of Manufacturing Engineering

Chairs/Coordinators (COMEC), Vol. 1, pp. 38-45; also SME Technical Paper, ED02-259, Society of Manufacturing Engineers, Dearborn, MI.

2. Acharya, C., 2001, "Enhancing learning in a large-class session: some issues," Large-Group Teaching, Vol. 4, No. 5, retrieved from: <http://www.cdtl.nus.edu.sg/brief/v4n5/sec3.htm>

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