

## Active Teaching and Learning Versus Traditional Lecturing in Electrical and Computer Engineering Courses

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**Abstract** –Colleges and universities are developing all kinds of innovative instructional technologies into the various aspects of their teaching environment. Sometimes, it is hard to distinguish the effectiveness of these innovative technologies from traditional ones. This paper compares student test scores and evaluation feedback using traditional instructional technology alone with those who received active teaching and learning on the same course. Detailed method of active teaching and learning is introduced. A study was carried out to prove the effectiveness of the active teaching and learning approach.

### 1. Introduction

Many academic institutions are utilizing innovational technologies as one means for material delivering. The technology presented in this paper consists two kinds of behaviors: The behavior of instructor and the behavior of the student. The instructor's behavior is active teaching. Regular teaching is to deliver lectures, give out assignment, labs and prepare midterm and final exam, etc. In active teaching, the instructor will have additional behaviors to facilitate the teaching. Most of these additional behaviors are to motivate the students. If we can keep students intrinsically motivated, provide meaningful feedback, and encourage the development of realistic, valuable and achievable goals that students expect to achieve, their engagement in learning should be enhanced<sup>1-4</sup>. On the other hand, learning is the behavior of students, who are to come to the class, handle assignment, survive the midterm and final and finally successfully pass a course. Also additional behaviors will be added to have an active leaning behavior. In active learning, students are not only involved in listening, they are also involved in higher-level thinking (analysis, synthesis and evaluation) and are engaged in activities (discussion, writing, etc). This paper investigates the effectiveness of active teaching and learning technology, which evaluates the student learning style; measures their satisfaction with technology and correlates student performance with the innovative instructional technology. This paper is organized as follows:

A prediction is given in section 2 about the effectiveness of the active teaching and learning methods. The detailed active teaching and learning methods are given in section 3. Section 4 describes the way of using active teaching and learning methods. Results are given in section 5 and the last section concludes this paper.

### 2. Prediction

Various methods are used to teach electronic subjects. Traditional lecturing in electronics subject includes lecture notes, assignment, labs, midterm and final exam. For some students with personal goals, they have their drive to learn and they can motivate themselves. For many other students, motivational pump is

unprimed. Students' degree often require certain courses, students may be not interested in the material, since they did not choose the course themselves, or perhaps they consider its content irrelevant to their personal goals<sup>2</sup>. Students identified eight characteristics of class in which they have high motivation. They are enthusiasm, relevance, organization, appropriate difficulty level, active involvement, variety, rapport, and use of appropriate examples. Incorporating some of these characteristics into classes will help to increase student's motivation.

In order to maximize the achievement, student should be active while they are learning. One-way to get students more actively involved in this process is to structure interaction into class so that students can interact with the instructor. It is vital for students to have support from their fellow classmates and instructor to be active learners. Students get to know their classmates and instructors, and the instructors get to know the students and this will build a sense of class climate that centers on the academic side of the school.

It is predicted that outcome of the active teaching and learning are but not limited to the following:

- a) Tend to get high score and complete better project
- b) Tend to have good friendship with the instructor and among the classmates
- c) Greater psychological health, social competence

### 3. Active Teaching and Learning Technology

#### A) Active teaching strategies: motivating the students

What can instructors do to increase the motivation of the students to learn? Survey shows that there are eight characteristics of the class in which students will have high motivation. They are described as follows<sup>2</sup>:

1. *Enthusiasm*: Teachers in these classes have high energy levels, and their interest in and enjoyment of the subject matter are obvious. As the students often put it "how can teachers expect us to be interested in a topic if they don't seem interested in it"
2. *Relevance*: The students see course material as relevant, applicable, and important. They can relate it to their experiences and career goals. Teachers often make this relevance explicit to students through explanation and examples.
3. *Organization*: Teachers of these classes do not "wing it". Their classes are organized, and their preparation is obvious. To put it in the student's words, "we can see that they've done their homework, which makes us feel more of a responsibility to do ours"
4. *Appropriate difficulty level*. Most students see the class as challenging but "doable".
5. *Active involvement*: Students are actively engaged in classroom learning, which may involve group discussion or other hands-on activities.
6. *Variety*: The same instructional techniques are not used in every class.
7. *Rapport*: The teachers are perceived as approachable and friendly. They appear interested in the students and their learning. They talk to students before and after the class, know at least some of their names, and create a comfortable class climate.
8. *Use of appropriate examples*: Course material is made real, concrete, and understandable through the use of appropriate examples and related anecdotes.

#### B) Active learning strategies

Active learning means the students are actively interact to each other, work together and communicate between each other while they are learning. There are lots of technologies that can facilitate the active learning environment in classroom setting. Here are some yet not exhaustive lists of the active learning approaches:

9. *Quick writing*<sup>8</sup>: Quick writing is writing as you think until the time is up. This method can be used at the beginning of class or during lecture breaks, or when there is no response to a question, or when you want a variety of response, to help slow thinkers. After quick writing, you can collect and read them yourself, ask for comments in discussion, student pair and read responses to each other.
10. *Anonymous Quiz*<sup>6</sup>: Give out a quiz in the class and collect the solution from the students. The students are not required to submit their names. This method will improve the communication and enhance outcomes from students—more learning, better grades, and higher overall satisfaction with the course.
11. *Think/Pair/share*: Students are asked to digest the concept and share his/her thought with his /her neighbor. This method will improve the interaction among the students.
12. *One-minute papers*: With books and note books closed students summarize the “most important” or “most useful” points they learned from a particular lecture, reading assignment, laboratory, or discussion”<sup>7</sup>. The use of one-minute paper is to help entice student away from passive copying of information toward a more active learning focus.
13. *The JIGSAW*: To provide an opportunity for students to be responsible for learning and share part of the information needed to complete a task. It is an ideal method when you wish the students to learn a significant amount of information in a designated period time<sup>9</sup>.

Directions:

- a) Divide the content of class into parts
- b) Divide the class into groups of learning teams
- c) Assign each group a topic to discuss and learn
- d) The group needs to work together to acquire enough knowledge about the topic to teach others
- e) Regroup the students so that new group has a representative from each of the previous groups. Students are required to teach each other in the newly formed groups, the topic their group studied.

Outcomes:

- a) Each student is actively involved in the class
- b) Students acquire ownership of the learning
- c) A significant amount of information can be covered in a class
- d) Students are accountable to each other for covering the content.

#### 4. The Study

Approximately 60 third year and 20 fourth year Electrical and Computer Engineering students from Dalhousie University took part in this study in the fall of 2001 and 2002. ECED3201 is a core course for Electrical and Computer Engineering students. All the students are required to take this course as a requirement for graduation. ECED4260 is an elective course for electrical stream student. Computer engineering stream students are not allowed to take this course. However, since this course covers very popular topics, about 20 plus students take it each year.

#### 5. Results of the Study

Four groups of students were studied who were enrolled in Electrical and Computer Engineering. First two groups were enrolled in 2001 courses, which are ECED3201, “Introduction to Electronics” and ECED4260, “IC Design and Fabrication”. Second two groups were enrolled in the same course in 2002. Traditional methods were used in 2001-year courses and active teaching and learning methods were used in 2002 courses.

The mean and stand deviation of course scores for each instructional format over the two years of study are shown in figure 1 and figure 2. As assumed, the data strongly matches the prediction.

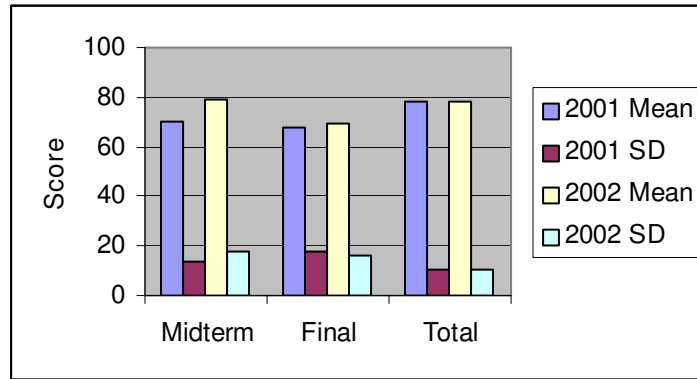


Figure 1. Means, Standard deviations for ECEd3201

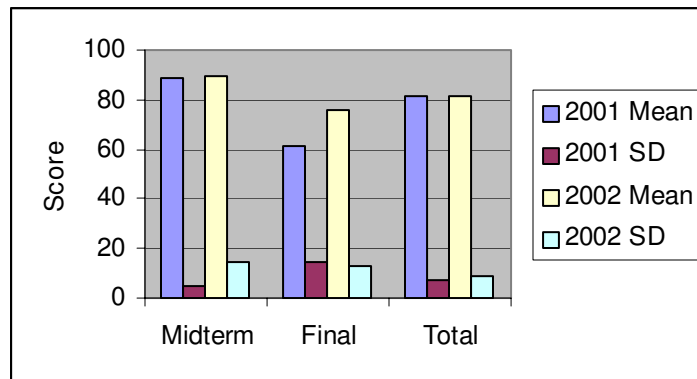


Figure 2. Means, Standard Deviations for ECED4260

Final evaluation was taken for each section of students, corresponding to each instructional technology. The survey for each section contained question common to all sections, and questions specific to instructional technology being used for that section. Student used a 1-5 scale to respond survey questions. A response of “1” indicated strong disagreement, “3” was neutral; and “5” indicated strong agreement. Figure 3 shows the summary of student response to different teaching format. Students have higher satisfaction with the active teaching and learning technology.

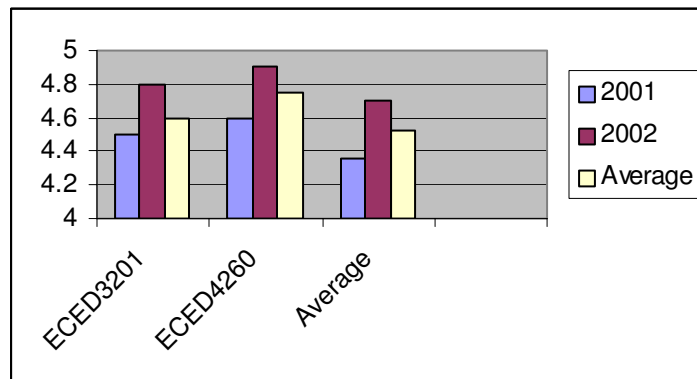


Figure 3. Student evaluation and average for ECEd3201 & ECED4260

## 6. Conclusion

Today, more and more active teaching and learning technology are used in the teaching environment. It is the trend that active teaching and learning technology can be combined with traditional teaching method on Electrical and Computer Engineering subjects.

Motivation is a basic quality of each learner. However, if the instructors can successfully keep the students intrinsically motivated, provide meaningful feedback and develop achievable goals that students expect to achieve, the engagement of the students learning will be greatly enhanced.

Based on final grade in the various section of the course, it is hard to determine that the use of active teaching and learning instructional technologies improved student performance compared with the traditional approach. However, if we consider the GPA of the students before they come to the course. We find out that the proposed instructional technology was effective. From the course evaluation, we found out that the students are more satisfied with the proposed instructional technology. Overall, the results of this research agree that active teaching and learning method can effectively motivate the student, and facilitate the learning process.

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## Biography

Dr. JASON GU earned his Ph.D. degree in the Department of Electrical and Computer Engineering at University of Alberta in Canada. He is currently an assistant professor in the Department of Electrical and Computer Engineering at Dalhousie University. He offers core and elective electrical and computer engineering courses and graduate courses. His research interests include Biomedical Engineering, Rehabilitation, Mobile and Tele-operated Robotics, Control Systems and Intelligent Systems.