

# Applying Active Learning Strategies to Advanced Mathematics Courses

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In the fall semester, we discussed to bring the active learning strategies to college class teaching. Traditionally mathematics courses were taught in lecturing format: Teachers presented course materials on blackboard; Students take notes in class and do their assignments after class. This is referred as the passive teaching style. **Mathematics is an exact science.** Gauss referred to mathematics as “*the Queen of the Sciences*”. Albert Einstein stated that “*as far as the laws of mathematics refer to reality, they are not certain; and as far as they are certain, they do not refer to reality*”.

The passive teaching approach had been the only way in mathematics teaching because it is really difficult for students to understand by self-studying in a short time. Unlike other sciences, mathematics are not driven by hypotheses and experiments. We should always learn the correct definition, statements, and justifications. The teachers can make the learning process easier and faster for students.

However, active learning strategies can be applied to mathematics teaching, particularly in advanced mathematics courses. For example, I am teaching Math 674, Computations in Linear Algebra. There are eight graduate students enrolled for this course, seven from Math Department and one from engineering. The class meets twice weekly with a computer lab biweekly. For most of lectures, I bring the definitions, motivations, and main statement as the core materials for this course. In this class, students are not passively leaning from me only. I tried several complementary strategies as active learning process.

1. Each student is free to choose an assignment, each covering a topic discussed in this class. They do their own research individually about the project I assigned to them. At the end of semester, they will present what they learned/discovered. Students can get help from me or other students. Through this project, students not only learn in broadness but also in depth. In this way, students can help me learn something I was not aware of before.

2. Taking exams are very important to assess students' learning in mathematics. I replaced the examinations as opportunities for students to learn and share the learning in this course from each other. Students write an essay about what they thought the most important they have learned from this class. Each student will have a basic judgement about what they learning and what the difference between they learned and the other students learned. Surprisingly, they all wrote in different perspectives even for different topics. It suggested that they come to this class with different expectations and different outcomes. I read and corrected each articles carefully making sure there is no error. I feel that students learned a lot by doing this.

Overall, I think that introducing active learning strategies help students learn in my Math 647 classe.