Teaching Statement

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My number one goal when teaching mathematics is to help students shape their own **math intuition**. I believe that planting math intuition into students by demonstrating that math is a **trial-and-error process** is the first step to get students overcome their fear of math. By identifying and correcting their own errors, they will slowly gain confidence, and as their math intuition develops, they will eventually get comfortable with math. As Einstein once said: "The only real valuable thing is intuition."

My college teaching started when I was a junior at Carnegie Mellon University as the instructor of a StuCo (Student Led Course). A StuCo is a credit awarding course of an approved topic taught by an undergraduate under the supervision of a faculty member; my topic was on solving Rubik's Cubes. I would teach the appropriate algorithms and finger tricks to solve a Rubik's Cube during class, and students would practice until the next session. I told my students to always be patient, and practice whenever time permits. When students were finally able to solve a Rubik's Cube without my help, many were eager to get faster. Students naturally started discussions on their own discoveries and how they improved; they were simultaneously teaching and learning from each other. At the end of the semester, students left the class proud of themselves, and thanked me for the course, as they thought they would never solve a Rubik's Cube even once in their lives.

Unfortunately, my first experience with teaching mathematics was quite different. Students were not as active as the students in my StuCo. After contemplating the difference between learning math and learning how to solve a Rubik's Cube, I realized that the crucial difference lies in the *feedback process*; it is visually obvious when an algorithm is applied incorrectly on a Rubik's Cube, yet, in mathematics, it is often unclear if a concept was applied correctly without math intuition. The lack of math intuition is natural, and I believe one has to patiently train to obtain it via a trial-and-error process.

The key of the trial-and-error process is the ability to identify errors. In my opinion, knowing when a formula or theorem does *not* apply is as important as knowing when it does. Thus, as a teacher, I discuss non-examples in addition to illustrative examples, and I occasionally work though an example incorrectly on purpose to obtain a contradiction, and then gradually fix the mistakes. While doing so, I elaborate my trail of thought as much as possible to share my math intuition, as well as to demonstrate that math is indeed a trial-and-error process. In small classes, I will designate a time frame where students can experience the trial-and-error process themselves by handing out worksheets or in-class assignments. This approach worked especially well when I was the primary instructor of a blended format course (MATH 124); students watch lecture videos online and class time is designated for group work. I concentrated on providing as much feedback as possible. Instead of giving out the answers immediately, I would initiate a debate using examples, and would often play Devil's Advocate so that the students can exercise their own math intuition.

I also believe that modern technology such as computer softwares and the internet are extremely useful for math education, when used appropriately. When I was an online teaching assistant for two geometry classes (netMATH 402 and netMATH 403), we used a questioning system embedded in the online lectures to check that the students were creating the right intuition. This system worked very well since these questions were graded based on completeness and not correctness, so students would honestly reveal how much they understood the material. The abstract notion of non-Euclidean geometry was transforming into intuition as the students were actively using the

course software to visualize concepts that were otherwise hard to imagine. Another wonderful advantage of this online course was that besides the mandatory checkpoints, each student was allowed to have a different pace.

I had the pleasure of combining the advantages of both traditional style lectures and online courses, as the primary instructor of a traditional lecture style course (MATH 181). Since the course had no fixed syllabus, it was a great chance to expose students to various areas of math such as game theory, fair division, and even a taste of my own research, graph theory. Teaching this course was a challenge because it was a compact half-semester course designed to cover a full semester's worth of material; the lecture blocks were twice the length of the original to accommodate this. The main difficulty was keeping the students focused throughout the entire class. Yet, I was able to keep them entertained by showing interesting visuals online, carrying out instances of voting theory with students, and playing educational games on graphs. It was a great opportunity to get hands on with the students to aid their math intuition.

As a post-doctorate researcher at KAIST, I have been informally helping graduate students with research. I led several projects and encouraged students to get involved as much as they can. For each project, I provided a general overview of the method to be used, but I focused on assigning small tasks that gradually led to the final result of the project. I was able to coauthor several papers with multiple students, including a paper regarding graph theory with a student who has not even taken a graph theory course yet. This eventually led to the masters thesis of this student. It was an exciting experience to guide one through the process of starting from scratch and obtaining a fruitful result. This experience gave me a taste of advising students, and I hope to continue aiding the next generation of math fanatics.

I believe teaching math is similar to learning math in the sense that teaching math is also a trial-and-error process. From teaching various courses on various subjects in various formats, I not only gained a substantial experience teaching, but also shaped my own teaching intuition. Thanks to this, I teach with confidence, and am able to deal with unpredicted situations in the classroom. As I developed my teaching intuition in my courses, I hope my students will also establish their own math intuition in my courses, and go even further to realize that learning any topic of their choice can be accomplished with sufficient time and practice.