

# Bootcamp: Daily Practice Problems

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**Context:** CME 100 - Vector Calculus for Engineers; CME 200: Linear Algebra with Application to Engineering Computations

**Keywords:** practice problems

**Student Activity Time:** 30-60 minutes each day

*After the midterm, students self-selected to work a math problem each day above and beyond course assignments.*

## Introducing the Reflection Activity

In a vector calculus class for engineers, first and second year students often approach math with a study-for-the-test approach and a fixed mindset. A fixed mindset, as opposed to a growth mindset is the idea that one has a fixed amount of knowledge rather than the perspective that they can obtain additional knowledge.<sup>1</sup> To encourage students to transition to a growth mindset, the educator incorporates a range of reflective activities in the classroom including minute reflections, think/pair/share, and connecting concepts to the broader context. In one particular reflection activity—bootcamp—students self-selected to complete additional math problems six days a week above and beyond course assignments. The purpose of bootcamp was to engage students in practicing more math problems and to help build students' confidence in their math abilities.

After the midterm in week five or six of the ten week quarter, the educator invited students to sign-up and participate in a class-related bootcamp. In this invitation, she described to students how the bootcamp worked, expectations for students participating, previous students' outcomes from participating in bootcamp, and how to sign-up. For those students who self-selected to be a part of bootcamp, the educator posted the bootcamp problem on the course learning management system each day. Students completed and submitted these bootcamp problems daily. The educator checked students' answers to bootcamp problems each day and provided personal feedback where needed.

While bootcamp participation was not a part of one's overall grade or even offered for extra credit, it still had the opportunity to impact students' overall class grade because the educator graded on growth, rather than pure performance. For example, if a student didn't do very well in the first half of the quarter, they would not be penalized at the end of the quarter for the poor grades early on. Because students' participation in bootcamp has the potential to positively impact their performance on course material, there is potential for students' grades to be higher.

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<sup>1</sup> Dweck, Carol. *Mindset: The new psychology of success*. Random House, 2006.

In terms of outcomes, students may realize the importance of moving beyond just studying for a test and understand the importance of, and positive outcomes of daily practice. By working a little bit on math each day, rather than intermittently, students may transition from a fixed mindset to a growth mindset—they think and believe in their math abilities and see their future related to math change, they start believing in their own ability to grow.

### Recreating the Reflection Activity

	Description
1	Describe bootcamp to students and invite them to participate.
2	Post daily problems on the course learning management system.
3	Look over students' solutions to get a sense of how students are doing.
4	Hold weekly bootcamp office hours, and in these office hours be prepared to highlight high-level themes from students' solutions.

### In the words of the Educator: Tips and Inspiration

*Recognize the difference between fixed mindset and growth mindset.* The main challenge I see is that the students come into mathematics with a preconceived notion of how good they are at mathematics. Most of them see little room for personal growth related to math. I believe it is important to help students realize their potential for a growth mindset and transition from a fixed mindset to a growth mindset.

*Believe in the growth mindset.* It is important that you, as the educator, strongly believe in this growth mindset and you have to make sure the students frequently practice problems related to the course content. While this may sound like holding their hand, this approach works at all levels. In my teaching, I insist that they actively engage in classroom, I expect they come to class, I make the homework sufficiently regular and hard, and I have regular quizzes in class.

Believe that most people can become apt in math by practicing. It is important to have a strong belief that most people can become apt in math by practicing regularly (preferably daily), rather than cramming once a week (which is the mode of operation of many students). In other words: neuron connections can be created, but this won't happen if students do not practice daily, hence the bootcamp. It is not only confidence building, but literally connection building.

*Check in with students.* I think it is important to individually checking with each student in the class. In these emails, I highlight what the student is doing well in and where the student could improve, including strategies for improvement (e.g., participating in bootcamp, attending office hours, going to the study center, learning new studying techniques).

*Recognize the time and energy this type of teaching requires.* You do have to put in a lot of energy in these classes. So you have to be super, super energetic and I don't mean hyper, you just need to be on the ball.

*Check students' answers bootcamp problems.* Daily, I checked the students' answers to bootcamp problems and where needed provided personal feedback. This personal touch is what keeps students committed. Attrition in bootcamp is low despite the high workload.

*What was the inspiration for this activity?* Sometimes learning is quite a lonely experience, so what I try to do is not make it so lonely for them. The bootcamp is really helpful. I started this because I used to do similar bootcamps for personal training and I thought, why not for math? I see it as a confidence building exercise. They start believing in their own ability to grow, and they start seeing that regular training pays off, just like with everything else in life. Most of them do practice regular training in other aspects of their life, it may be sports, a diet, learning a language but they just haven't seen that for science.