

## FORMAL EDUCATIONAL TRAINING

2023 SDU course "MCQ – Construction and quality control of multiple choice items"  
2023 participation in TAL2023 (Teaching for Active Learning) conference  
2023 SDU course "Use student response systems in your teaching (PollEverywhere)"  
2023 SDU course "How to design, produce and use videos for teaching and learning"  
2022/23 SDU Lecturer Training Programme (planned completion January 2024)  
2022 SDU PhD Supervision Course  
2015 Harvard University New Faculty Institute

## ADMINISTRATIVE TASKS RELATING TO EDUCATION

2023-current course head for Mathematics for Biology, Mathematics and Statistics for Pharmacy, and Introduction to Category Theory at SDU  
2022-current course head for Introduction to Algebraic Topology at SDU  
2015-2018 course head for eight courses (Introduction to Algebraic Geometry II, Linear Algebra and Applications, Introduction to Algebraic Geometry I, Introductory Real Analysis, Lie Groups, Analysis II: Measure, Integration, and Banach Spaces, Dynamical Systems, Dynamics, Stability, and Noncommutative Algebra) at Harvard University

## EXPERIENCE OF STUDY PROGRAMMES, SUPERVISION AND EXAMINATIONS

At the University of Southern Denmark, Department of Mathematics and Computer Science (2022-current):  
Course organizer and lecturer: Algebraic Topology (5ECTS), Category Theory (5ECTS), Mathematics and Biology/Pharmacy (5ECTS each)  
Co-supervisor for 1 PhD student (finished in 2023)  
At University of Oxford, Mathematical Institute (2019-2022):  
Tutor at Exeter College: Prelims Dynamics, Prelims Geometry (fortnightly meetings with students, 1-on-2)  
Tutor at St. Peter's College: Revision classes, Part A Rings and Modules, Prelims Geometry, Part A Differential Equations (fortnightly meetings with students, 1-on-2)  
Assistant: Lie groups consultation sessions  
Class head: Computational algebraic topology classes  
Co-supervisor for 1 PhD student (expected to finish 2024)  
Supervisor for 3 master students  
At Harvard University, Department of Mathematics (2015-2018):  
Course designer, organizer, and lecturer: Introduction to Algebraic Geometry II, Linear Algebra and Applications, Introduction to Algebraic Geometry I, Introductory Real Analysis, Lie Groups, Analysis II: Measure, Integration, and Banach Spaces, Dynamical Systems, Dynamics, Stability, and Noncommutative Algebra (72 hours of lectures for each course, about 10 ECTS)  
Section head (lecturer): Linear Algebra and Differential Equations (72 hours of lectures, about 10 ECTS)

## METHODS, MATERIALS AND TOOLS

Experience with e-learning tools:

- Canvas
- Itslearning
- PollEverywhere
- Desmos

Experience with assessment forms:

- Written assignment (in-class and take-home)
- Multiple choice
- Oral exam

Types of course materials produced:

- Lecture notes
- Slides
- Videos

## Educational development and applied research into teaching at university, including educational awards

2023 Lecture Training Programme (LTP) Development Project: Microquizzing to Encourage Active Learning in Math Classes conducted during Mathematics for Biology/Mathematics and Statistics for Pharmacy, fall 2023 term

## Reflection on teaching practice and future development including student evaluations

I have taught at universities in various different countries and academic cultures and systems. My goal throughout has been to create engaging lectures and to ensure the success of my students. The more I improve my lecturing style and

interactions with students, the more rewarding teaching has become for me. Here, I will attempt to convey some of the most important lessons I have learned, illustrated with concrete examples from my courses.

Of all the qualities a good teacher should have, I think the following three are most essential:

1. Deep understanding of the material
2. Generates enthusiasm
3. Awareness of students' struggles

From the student's point of view, each of these corresponds to a service the teacher provides that cannot be replaced by reading through a textbook or watching a recorded lecture.

Why are we here?

My goal at the beginning of any course is to convince students that what they will be learning is extremely useful to know, that the subject has an intrinsic beauty and intriguing problems, and that working with it will be fun and engaging — in short to provide motivation for the course. For example, in fall 2016 I taught Math 114, an upper level undergraduate course on measure theory, integration, and the beginnings of functional analysis. Measure theory is often regarded as a very dry and technical subject. A lot of theory needs to be developed before one can define the integral of a function, something students think they know how to do already anyways. As a remedy, I decided to start with the Banach–Tarski paradox, a striking theorem which nicely illustrates that the volume of an arbitrary set cannot be defined and thus the need to introduce measurable sets. Several students told me that this is what got them excited for the course. On the more practical side, in fall 2017 I taught Math 121: Linear algebra and applications. One of my primary goals for the course was that students learn how to apply theoretical/conceptual knowledge about the subject to solve real world problems. In my first lecture I described the problem of developing an error-correcting code in very concrete terms for a 4 bit message. Finding a solution to this problem involves understanding vector spaces over the field with two elements, and how linear maps are characterized by their image and kernel.

Interactivity and fun

It is tempting to ask questions which test how well the students recall previous lectures or their general knowledge. If the goal is to create engaging lectures and classroom discussion however, it is better to ask something that the student is not expected to know the correct answer to from the beginning, or better even has multiple correct answers. Multiple choice or true/false questions work very well in particular. Actually coming up with good questions requires quite a bit of creativity though, and can be particularly challenging in math which is more removed from everyday experience than other subjects. For example in a course on real analysis, I would from time to time ask questions of the type "is there a function on  $[a, b]$  with such and such properties". Finding a counterexample involves creativity and geometric intuition on the student's part. Another strategy is to ask students in the beginning to make a guess and show of hands who thinks that a certain statement is true or false. That way they feel more invested and motivated to figure out the answer. Props are also a fun tool and useful for students who have trouble visualizing static blackboard drawings. When discussing ribbon graphs in a graduate topics class, I passed around a paper construction and asked about the genus of the corresponding surface. Computers can serve as a particularly versatile kind of prop in more numerically oriented subjects. It is amazing to see, for example, how well the Babylonian algorithm approximates  $\sqrt{2}$ , or looking at a dozen random walks to see the arcsine laws in action. Both of these were demonstrations in my dynamical systems class.

Education is a social activity

Being approachable is not optional. At the beginning of the course I strongly encourage students to visit me during office hours, even if it is just to introduce themselves, and always stay after class until everyone has had a chance to talk to me. During class, I also like to share personal experiences and stories if they are somehow relevant.

There is a great debate as to whether a teacher should be a "sage on a stage" or a "guide by the side". The (non-)answer is: Both, and how much depends on the context. Office hours are great for an individualized learning experience, particularly for those students who need more help. When students ask a question it is tempting to choose the shortest path and just give them the answer. Of course the better way is to lead them to the correct conclusion via a string of simple questions, or even allow them to go down the wrong path from time to time and see why it does not work.

Becoming a better teacher

I continuously try to find weaknesses in my teaching and ways to improve based on feedback from students and others. I have been inspired by other great teachers both at the math department and outside. Math can be tedious and opaque or fun and inspiring — students deserve the latter.