Achim Schroll
Department of Mathematics and Computer Science (IMADA)
Applied Mathematics
Postal address:
Campusvej 55
5230
Odense M
Denmark
Email: achim@imada.sdu.dk
Mobile: 24984090
Phone: 65503553

Pedagogical portfolio

An updated list of courses is available on request.

Personal background and experience

Already as a high school scholar, during my last year at gymnasium, I started to teach beginners in 5th grade in mathematics in what was called "Förderstunde". As we shall see below, a fresh memory of my own learning resulting in a good understanding of the pupils' learning process are important advantages that help a teacher to succeed. As a teaching assistant at Konstanz University I gave exercise courses. During post graduate studies at ETH-Zürich I held an assistant position with 50% teaching duties. Also the assistant professor position at RWTH-Aachen included half time teaching obligations. Over the years I had the chance to educate several thousand students at seven universities in five European countries. On average I have been teaching 10 ECTS/year during 1986 to 1998 and 20 ECTS/year since 1999. I taught all kinds of courses from first year introductions for huge classes of approximately 1000 students, to research based seminars for "a handful". All of the PhD students for whom I was responsible, defended their thesis on time and had several offers for employment to choose from.

Maintain enthusiasm and support activity!

Practice and conditions for university education vary with the environment. Courses for several hundreds of engineering students work entirely different than advanced courses in mathematics or PhD seminars. Teaching periods of 14, or alternatively 7 weeks do affect the course concept. However, one basic principle is universal:

The students –die Studierenden– are the active part in the process of learning and the teacher's role is to support this activity and enthusiasm.

"The problem was whether or not we could make a course which would save the more advanced and excited student by maintaining his enthusiasm." (Richard Feynman: The Feynman Lecture on Physics, 1963)

Statistical data documents, that first year students are highly motivated (Demografisk enkät inför studiestart, LTH, 2008). Interest and challenge are the two driving factors for students – ideal preconditions for successful studies! But do we succeed to maintain and excel this enthusiasm?

Pintrich (Paul R. Pintrich: Multiple Goals, Multiple Pathways: The Role of Goal Orientation in Learning and Achievement. Journal of Educational Psychology, 2000, Vol. 92, No. 3, 544-555) collected data from 150 pupils in 8th and 9th grade in their math class using both self report questionnaires and actual math grades. The general observation is that initial enthusiasm drastically decays over a period of 1,5 years. The real challenge is to save the exited student!

Following educational psychology, goals of learning are key factors influencing student's intrinsic motivation. One distinguishes mastery and performance goals. Mastery orientation is described as a student's wish to become proficient in a topic to the best of his or her ability. Mastery orientation is associated with deeper engagement with the task and greater perseverance in the face of setbacks. Mastery orientation is thought to increase a student's intrinsic motivation. In contrast, performance orientation is described as a student's wish to achieve highly on external indicators of success, such as grades. The students' sense of satisfaction is highly influenced by their grades, and so it is associated with discouragement in the face of low marks. Performance orientation is also associated with higher states of anxiety. Performance orientation is thought to increase a student's intrinsic motivation if they perform well, but to decrease motivation when they perform badly.

Pintrich observes that despite the general negative trend, adaptive outcomes like efficacy, interest, effort, persistence and performance are significantly better preserved in a multiple goal approach when both mastery and performance goals are combined.

My experience, mainly based on the work with PhD students, is the following: Initially, the subject is in focus creating a mastery orientation and driving the student's engagement. Over time, when continued efforts have been made, the

mastery approach asks for some confirmation of success and performance orientation is being build up.

To “save” the enthusiastic student, multiple goals are a necessity and mastery orientation cannot be separated from performance goals. A continued effort without supporting feedback simply leads to frustration, for students and teachers alike.

To provide support, we have to understand how learning actually takes place. According to constructivism (Jean Piaget, Swiss philosopher, 1896 – 1980), individuals construct new knowledge from their experiences. For example, they incorporate the new experience into an already existing framework. This may occur when individuals' experiences are aligned with their internal representations of the world. In contrast, when individuals' experiences contradict their internal representations, they may change their perceptions of the experiences to fit their internal representations. According to the theory, accommodation is the process of reframing one's mental representation of the external world to fit new experiences.

Learning by experience, or discovery-learning, is an active, social process.

The teacher’s role is to help the student to experience insufficiencies in his/her perception. This requires communication skills and a good understanding of the student’s knowledge.

Teaching principles

A university teacher must have the competence to form a course by identifying a few core topics, which any student has to understand in order to pass the course: Define clear goals! Dare to focus and provide support to make sure that students master the essentials: “Fordern und fördern!” When efforts are rewarded, according to goal theory, students will develop higher persistence and continued engagement.

Some general principles are the following: Support student’s activity – it is the student who is learning! Provide time for individual learning and help the individual to experience insufficiency. Be very clear and focused. Don’t try to impress by long lists of contents – it is not impressing! Show the global picture behind all the details. Understanding of abstract structures is much more impressing. Mathematics is all about conceptual understanding. Knowledge consists of facts consistently embedded in theoretical concepts (Diana Laurillard: Rethinking University Teaching, Ch. 3, The complexity of coming to know, RoutledgeFalmer, 2004). At several technical universities I observed a tendency to over exemplify things. But remember: Abstraction helps to understand complex matters. It helps especially the weaker student who does not discover the structure behind all the examples by him- or herself. Meaning is given by structure. Students that understand the concepts can also apply, and extend, their knowledge in varying contexts. They will be better prepared for their future.

Maintain enthusiasm and support activity! Define goals, sketch activities to reach the goals and provide meaningful feedback! Help the student to discover the world!

What is the students’ perspective on these teaching principles? Investigation of ca 2500 course evaluations at LTH shows, that there are four key factors which are highly correlated to overall satisfaction with a course: Clear goals, the teacher’s enthusiasm, his ability to motivate and the relevance of the course’ topic within the educational program.

“I cannot learn for you, but I can help you to learn!”, Achim Schroll.

Students perception

"the teacher who always wears a smile in his face"
"an excellent teacher who really understands to motivate and give support"
"the best course in mathematics I have ever had"
"Achim rocks!"
"Achims undervisning i numerisk analyse var eksemplarisk god og inspirerende."

Curriculum developement

Our student's laptops would have been the worlds fastest computer in year 2007. Can we still teach classical curricula in the style of the 1980's? Today integrals are solved by computer algebra and adaptive numerical methods. Mathematics is needed to understand the duality argument in the error estimation. PDEs are solved by Galerkin methods based on Lax-Milgram theory and the Riesz representation theorem, which in turn rely on integration theory, Hilbert spaces and the fixed point theorem. SDUs bachelor students of Applied Mathematics "solve" the 1M$ millennium problem during their third year of studies: Navier-Stokes equations with heat transfer in complex, multidimensional geometry. And they are proud of their abilities and competences:

"Det giver faglig stolthed, nar det man lærer kan bruges til noget."

Lecture notes

2019	Numerical Analysis of Conservation Laws (90 pages), SDU
2003	Numerical Analysis - An Introduction, 5th. edition (125 pages), Lund University (with Claus Fuehrer)
2002	Hyperbolic Systems with Relaxation and Applications to Reservoir Simulation (122 pages), KFS Lund, ISBN: 91-974362-0-8
1995	Differenzenverfahren und Finite Elemente fuer partielle Differentialgleichungen (72 pages), RWTH-Aachen (with Jens Lorenz)

Outreach activities

2017	Science and education for life: the virtual heart, workshop biotechnology and mathematics, SDU
2015	Do points define a function?, Nyborg Gymnasium
2015	Computational Mathematics - the (he)art of modern science, Nyborg Gymnasium
2012-2013	Natural Science Distinguished Lecture Series
2012	SDU Days of Scientific Computing
2012	Mathematik mit Perspektive: Das virtuelle Herz, A.P. Møller Schule, Schleswig
2011	Animations of Complex Flows, Odense Math Film Festival
2010	Matematikkens ligninger på lægens bord, Folkeuniversitetet
2010	Scientific Computing - the (he)art of modern sciences, Forskningens Døgn
2009	Mathematical modeling, Science Day, SDU

Conferences

2016	New teaching methods in mathematics, Nyborg, Denmark
2012	IT tools in education, Naturama, Svendborg, Denmark
2012	MaP – Mathematik mit Perspektive/Matematik med Perspektiv, Kiel, Germany
2002	Ämneskonferens i datavetenskap/datalogi/numerisk analys, Linköping, Sweden

Formal pedagogical training

2008-2009	Workshop "the pedagogic portfolio" (1.5 ECTS), Centre for University Education, Lund University
2008-2009	Pedagogic inspiration (4.5 ECTS), Centre for University Education, Lund University
2008	Communicating Research in Science (1 ECTS) by Michael Alley, Penn State University
2001	"docent" in numerical analysis from Lund University
1999-2000	Pedagogical education program for university teachers (4 ECTS), NTNU-Trondheim
1999	"venia legendi" from RWTH-Aachen

Educational services

2013-	Director of studies in applied mathematics, SDU
2013-	Member of the teaching committee at IMADA
2012-	State approved censor in engineering mathematics and physics
2011-2012	Chairman of the committee and main contributor to the new SDU programm in Computational and Applied Mathematics
2010-2013	State approved censor in pure and applied mathematics in science and engineering
2006-2009	Member of the teaching committee "engineering physics" at Lund University
2002-2007	Director of studies in numerical analysis, Lund University