Some reasons to invest in teaching

Oliver Knill

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Research is probably the most important parameter in the job market for a graduate student. A brilliant theses can guarantee a job. With a poor theses, it can be difficult, even after doing a good job teaching. But this observation assumes that research and teaching are independent. They are not. Things are more complex: Here are some reasons why it is wise to invest into teaching even if the primary goal is to become a research mathematician. Here are some points based on my own experience of teaching and from watching many of graduate students at various institutions struggle through the problem to balance research and teaching.

Fill intervals

When doing serious research, there are times when things are stuck. This is typical for mathematics, "being stuck" is a common situation in research. Especially if an unsolved problem is tackled. In a research lab, even the unsuccessful experiments can be published. In mathematics, an incomplete proof can be worthless. Being stuck in research can be a bummer. Teaching can help to overcome such times. Teaching is fun, investing time in teaching is appreciated. It can fill intervals.

Recharge

A successful lecture with students appreciating the subject can motivate also the work in research. Positive experiences ask for more positive experiences. On the other hand, a bad teaching experience with an unprepared lecture and disappointed students can have a negative effect on research.

Aim high and relax

Whether a lecture succeeds or not can also depend on parameters you are not in control with. The student composition and the class psychology is different in every class. Sometimes, you succeed better, sometimes it is difficult. The actual success is an interval around a target point, which you can determine. By positioning this target point high, you assure, that even with some difficult students and on a bad day, you have an ok lecture. Aiming high assures that you are fine and that you can relax.

Avoiding the abyss

Teachers falling below a certain threshold of teaching are "flagged". You are watched more closely, the reputation can harm teaching experience. It can cost much more time in the end and affect the time allocated for research. In the same way, a positive feedback produces more positive experiences, negative feedback can produce a "circulus virtuosus". Even more time needs to be spent to regain ground.

Motivate research

Teaching can motivate research. Even simple calculus or high school mathematics can be close to actual research mathematics. Here are some examples: while teaching calculus as a course assistant and learning ergodic theory, I wondered whether Green, Stokes and Gauss theorems can make sense in dynamics. They have and the corresponding de Rham cohomology is group cohomology. Indeed, calculus can be done without actually doing limits. An other example: a logician teaching single variable calculus can secretly investigate, which statements are actually provable with less axioms. A student interested in number theory can draw from varieties or elliptic curves to build examples in calculus. This can also enhance the pedagogy. Of course, these kind of thoughts must be shielded from the students but it can help to be more immersed into the problems and to stay excited about the subject even after teaching the same things over and over again.

Tapping research

Research can motivate teaching. Some problems in algebraic geometry for example might involve functions which lead to interesting calculus problems. It is amazing how much research has "shadows" which make sense in a calculus lecture. A number theorist for example can use the concept of linearization to solve Diophantine equations. There are many Diophantine equations which are unsolved and some of these problems are accessible for first year calculus students. Like for example the problem whether there are perfect Euler cubes, cubes with integer sides, for which all side diagonals and room diagonals have integer length.

Advertise the field

Research is a lot about politics and public relations, especially early in the career. Convincing the advisor, peers or friends that what you are doing is interesting and exciting. If research wants to be read, then you have to give talks which excite people. Producing clarity in a research seminar is similar to clarity in the classroom. And the track record of research talks is not so good from the didactic point of view. A good teacher is likely also able to advertise its own field.

Future grants

Students taught by you today might affect your research tomorrow. Not necessarily as mathematicians in your field, but as politicians who decide about NSF money. Doing a good job as a teacher is likely to sparks excitement in some of your students who will express this view at home, when talking to their friends etc. Your work in the classroom can have a snowball effect will likely affect you in the future. It certainly affects directly hundreds of people but indirectly thousands of people. Sharing teaching experiences on the web might reach even hundreds of thousands of people. Several thousand unique visitors visit a typical department server every day. Communicating mathematics well will assure that the subject will remain funded also, when you are a senior mathematician.