Statement of Teaching Philosophy

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1 Teaching experience

With a teaching load of (in average) 3 courses per semester over the past 7 years, I have now accumulated some teaching experience. In total I have taught 40 regular university undergraduate courses, incl. two courses as a part-time lecturer in ICU/KAIST. These are fundamental courses like calculus and algebra (and some elementary number theory). Before, I had given some more advanced short-term courses (of about 1/2 semester) on various topics, like specialized semi1ars on research (of others) in my field and writing papers in English. I have also, at numerous occasions, given personal advice to students regarding their research.

The following contains some words about my ideas concerning teaching, evaluation, and relations to students.

2 Teaching style

I try in my teaching style to mostly follow classical methods. In particular, I certainly use a blackboard instead of electr(on)ic devices that display pre-prepared material. For me it is important students to follow the lecture and it to be adequately organized, so that they can take notes and these notes to be of much use to them later. (It this is still too difficult from my blackboard writing, I consider writing/typing some handout notes.) From my own experience as audience I was often overwhelmed with the speed in which slides have been exchanged, and so much of the essence of the presentation goes amiss. While for research talks this may be tolerable, I hardly imagine it appropriate for university courses. It does not mean that rigorous proofs must be provided anywhere. Sometimes the use and easiness to understand a statement stand in no comparison to the effort of its proof. But I prefer students to develop a good understanding of less material rather than a vague understanding or more. Examples often are far more useful than detailed arguments. In any case, for me the most important thing about teaching is that the students understand the lecture; without this teaching loses its meaning.

I try to keep an informal atmosphere in the belief that this stimulates students to learn. Thus I try to have the class entertain*ing*, but it should not be misconceived as entertain*ment* – the students must keep the purpose of the whole process in mind.

I assume an institution I am expected to teach at has its own particular rules about teaching programs, literature to use as a basis for a course etc. I would follow such rules as far as I see that it does not influence negatively the clarity of my presentation.

3 Course organization and exams

Much of the course is organized with particular orientation toward the exams. For some time, I have adopted to carrying out midterm and final exams in two separate parts: solution part and multiple choice part. This structure has several reasons, and advantages (although certainly also some disadvantages; see below). Apart from this, they are quizzes (usually 3-4 per course).

Course organization depends somewhat on the subject. Mathematics English courses have a slightly different style, in that oral presentations are given (in the second half of the course), and students are examined also about the contents of others' presentations. Moreover, there are writing assignments, which I redistribute to be evaluated by other students (some sort of peer review). Final exam is written only in one (multiple choice) part, as a compensation for the oral presentations.

The following explains my guidelines for how to evaluate and how to organize teaching with focus on that evaluation. (These apply for Mathematics English courses with slight modifications.)

Developing an examfull of exercises can cost nearly a month. Many factors play here.

- First, the topics must be properly selected.
  - On the one hand, I try to organize exams so that all taught material is uniformly covered. Only in this way I believe I can obtain a realistic picture of a student's capabilities. Also, students should be discouraged from learning selectively (based on guesses about particular topics chosen in the exam).
  - On the other hand, several issues of overlap must be payed attention to.
    - Overlap of problems within an exam. Clearly it is not reasonable that two solution exercises demand mutually disjoint skills. But, for example, the answer to a multiple choice question should not too easily lead to the solution of another. That is, it is not helpful to ask variations on the same fact. (At some point, the capacity of an exam is exhausted, and making it longer does not make it better.)
    - Overlap of problems with previous exams. One mistake I made in my very first course was to use without (essential) altering my colleague's sheets of the previous year. I was not prepared for things like students being bargained with (possibly even for money) about old sheets, in the quality of a prophecy for what comes (in the next test).
      Of course, when the same topic is taught several times, questions about it cannot be fundamentally different. Thus past exam sheets can be helpful in exam preparation. But obviously one must avoid students to consider them as entities of negotiable value, and as a manual for transcribing (or learning at heart) solutions. Ultimately, mathematics is not a recitation project.
    - Overlap of problems in non-simultaneous exams. Sometimes there are reasons (incl. such not lying on students) that exams or quizzes cannot be taken entirely simultaneously. In such a case, students should not assume that exam sheets are identical, or similar to whatever degree. Since grades are comparative, advising fellows about exam problems, students can end up compromising on their own grade. On the opposite end, they take every burden of being misinformed (or misled) in queries about exam contents. In the bottom line, it is necessary to make spying on problem sheets (even beyond one's capacity to monitor such activities) unattractive to students as a way of exam preparation.
- The degree of difficulty must be chosen well. Clearly no students will like an unsolvably hard exam. But making the exam too easy for everyone does not bring it

either: good students have no opportunity to show their class - why shouldn't they? In either way, performance spectrum will narrow, which will augment the influence of random factors on final evaluation. In the end, one should want enough evidence that someone with a better grade has really done better.

Quizzes, exams, and assignments are returned corrected as quickly as possible. Students should not be bluntly penalized for doing something wrong, but rather explained what they did wrong and why, and how to make it better the next time. They should also have the right to inquire (and object) to my grading. After quizzes and midterm (but, of course, not final) exam, I usually invest some time to discuss solutions (at least of problems which have generally created more difficulties). This is also the purpose of the solution sheets I prepare.

3.1 Solution exercises

A general mathematics course aims at developing a student's skill to deal with a certain type of calculation problems, and thus it is not realistic to evaluate performance without solution exercises.

The solution exercise exam usually has 80 points, divided (not evenly, but indicatedly) among 6-7 problems. The preparation of solution exercises requires further specific steps.

- That I solve the exercise in advance (I also type a solution sheet) is a minimum requirement, but this is often not enough.
- Numerical parameters must be adjusted. Most exercises should focus on a particular type of solving procedure taught in class, rather than arithmetic mastership. Of course, occasionally arithmetic skills can and should be demanded, but ultimately they should not become a continuous challenge over the entire exam.
- I think about possible fallacies. An expert with enough time to prepare is rather different from a student sitting in an exam to solve. Of course, one cannot predict where who how will err, and no exercise is safe against all possible ways it can be made wrong. But an exercise should be designed so that at least minor numerical blunders still do not obstruct arriving at some result (or at least going a large part along the way).

In a similar spirit, grading of solution exercises is done mainly with respect to solving skill rather than final result. A proof or solution is deemed complete (only) if it includes enough detail so that I or a fellow-student can understand it without solving the problem (or doing any steps in its solution) by him/herself. That is, I can (and will) only evaluate what is on the exam sheet, and not what is in a student's head. A correct answer with no solution often brings few points. A(n otherwise correct) solution with one calculational mistake and incorrect answer can bring maximal points minus one.

In general I allow in solution exam the use of student's own notes (in extreme cases, also of the book). This has, in my opinion, more advantages than disadvantages.

- First, it encourages students to take own notes (and therefore also to attend). I always stress that neither the book, nor the class website material is a definitive reference; it's the material of the class that decides the scope of quizzes and exams. My attitude is suggestive: the reason why a university pays an instructor to stand in front of students is not that they stay home and study the book by themselves. Thus taking notes is (for my courses) an important part of exam preparation.
- As my experience has shown, absolute (and even less so comparative) performance of students is hardly altered by permitting these materials. This is not surprising, since solving skills can only be gradually acquired over the entire course, rather than read off somewhere during exam time. Thus students should realize that without understanding the subject, materials will be of little use to them.

- On the other hand, this freedom seems to make students less nervous. Ultimately, it also provides to them overwhelming evidence that their failure to deal with some particular problem lies on them, and not on me.

- There are also certain drawbacks. In some cases students have believed to do well by finding a similar exercise in their notes (or homework) and reciting its solution onto the answer sheet. Still, such practices are transparent: I know class content well, and students skilled enough to unrecognizably cover up reproduction would have enough ideas to try solving the problems by themselves.

So far it was not necessary to introduce calculators in exams. In pure mathematics courses, which I have taught, many topics can be covered (or better, one should strive to cover them) without calculators. Numerical bulk is seldom essential in conveying concepts or explaining solving methods, and beyond this calculators have tended rather to cripple than to spur a student's working skills. Certain subjects do require beyond-paper-and-pencil calculations. In such case I have presented the outcome in examples in class, and left similar exercises to homework (where electronic access is no problem). At least for the time being it was possible to get along in exams without these devices.

This may change in certain courses in the future. At some later stage I could encourage students to learn using a computer (as I do in most of my research), but not before they learn the principles behind what they would ask a computer to do for them.

3.2 Multiple choice problems

The multiple choice exam has some unpopular, but compelling reasons. On the one hand, as explained, I try to have material uniformly covered. On the other hand, it is not physically possible (in particular at the absence of TAs) to evaluate an all-spanning exam program in entirety for partial credits.

The multiple choice part consists of (usually) 20 multiple choice problems (1 out of 4), total 100 points. The evaluation is 5 points for right answer, 0 points for no answer, -1 point for wrong answer. This penalty point scheme is introduced, because otherwise students are both compelled and abetted to guessing, rather than thinking about the answers.

Multiple choice problems should refer to some theoretical knowledge and/or the capability (based on such knowledge) to observe certain facts without much calculation. There are multiple choice problems where one can see the correct answer directly, and such where one arrives at it restrictively (by seeing that the other 3 are wrong). At least a part of the problems should be designed so that there are alternative ways to arrive at (or at least get closer to) the solution.

A good multiple choice problem is not to match among several possible answers of a long calculation (after seeking all one's blunders in it). Of course in certain cases a long (and correct) calculation can lead to an answer, but one enters into it only because one fails to see a more direct way in which the problem is meant to be solved. One general principle in mathematics, which is true from undergraduate classes to top-level research, is that when one knows or sees some things, one can save oneself a whole lot of unnecessary calculation.

In a multiple choice exam, a student uses only a pencil and eraser. There are simply enough answers here which can be read off (or convincingly suggested) by things one can find in the book or one's notes.

My experience is that the lack of partial credits makes the multiple choice exam somewhat harder. On the other hand, it is not a writing marathon, and students can easily grab a number of points by paying enough attention. In certain cases, students with severe writing weaknesses have pushed themselves this way over the survival bar.

4 Homework and Quiz

There is some disagreement as to the role of homework in classes.

The fundamental issue with homework is copying, and, in my opinion, this issue will persist as long as homework is given. For this reason, many instructors generally avoid homework, but have the content written as tests in class.

I still do give homework, and here are some reasons.

- Students need the opportunity for cheap credits. The subject is notoriously hard. Many students enroll in mathematics classes not because of their direct interest in the topic (and underenrollment has been a painful plague at some stages). One cannot expect all students to be by nature well-disposed toward the material. Depriving them of opportunity to securely earn a minimal credit polarizes performance (i.e., widens the gap between those who can and those who can not), and deteriorates class atmosphere. In my opinion, the reasons for poor evaluation (and failing) should not be as much the incapability of students to adapt to the particular material, but rather, at the presence of such difficulties, their lack of discipline to do an appropriate minimal amount of work. (This attitude may not apply to top-level education standards, but I have so far not worked there.)

- Homework is a part of exam preparation. Exam problems often lean on (but, of course, are not identical with) homework problems. Here the issue of copying comes in. Even if I see the same mistakes repeating over half a class' assignments, I cannot of course investigate who copied what from whom. In fact, I do not object homework to be solved collectively, as long as students think about what they write. But I do advise students that every point of thoughtlessly copied homework credit is a point lost in the exam (where it matters much more).

- One can use homework for a certain number of more difficult problems, which one cannot reasonably assume a student to deliver on *ad hoc* in class.

- In-class tests not only put immense pressure on students, but also eat up teaching time.

Quizzes usually consist of 6 multiple choice problems (30 points) and one solution exercise (10 points). No materials are allowed. Quizzes serve several purposes.

- Provide additional credits. As for homework, they can be a resort of relief from (or in-advance compensation of) poor exam results.

- They prepare for the multiple choice exams (in contrast to homework, which focuses on preparing for the solution exams). More generally,

- they keep the students adapted to exam atmosphere (and pressure), and so keep up learning discipline. A common trend I've observed is that students' performance gradually declines over test-free periods: the longer the break, the worse the result after it. This trend is further enhanced (and thus additional attention to it warranted) by the fact that not only the volume, but also the difficulty of the material increases as the course progresses. I do not remember students who have skyrocketed in their final exam, but there were some who have crashed.

- They provide a more continuous reflection of a student's comprehension and performance progress. It is also free from the bias of interaction inavoidably occurring with homework. This gives hints to me how to adjust teaching level, etc.

5 Point lists

Point lists are updated on the course website and include score in exams, homework, quizzes, and attendance. I offer this service to students to see how they progress over the course, and how they fare compared to others. The lists are anonymous; students can identify themselves using their student number. (The reason is suggestive: while I can appraise some good student in front of others, few students will like being openly exposed doing poorly.)

6 Final grades

Division of final grades is decided by largest gaps in final score ranking.

The grades are decided comparatively, i.e., by overall class performance. I do not fix percentages in advance. (E.g., I've had a class with the bar for A+ being at 62%, and another with 89%.) Two main reasons are:

- Performance is unpredictable. I cannot know in advance what students enroll into the class. I do guest-lecturing at other departments, and so most students, by experience, enroll into my class for the first time. Even for those I have taught previously performance has changed somewhat depending on the courses.
- Students' interaction is desired. That performance is evaluated (mostly) individually does not mean that taking courses should be an individual process. There is nothing wrong with (and, in my opinion, one should be) asking for help when there are many good students. It is thus suggestive that the same performance could earn one a worse grade if more fellows do better.

Just one rule of thumb: $> 90\%$ is almost certainly an A+, while $< 10\%$ is almost certainly an F.

In marginal cases, secondary criteria play a role: the tendence (final as compared to midterm, and here I weigh the solution part heavier than the multiple choice part), attendance, and my personal impression (e.g., whether I see the student trying hard or being lazy).

Grades are usually undebatable. I must evaluate the performance in class, and not negotiation skills after class. In particular, if I assign an F, I am convinced that the student has failed to offer even an absolute minimum to achieve the glass goal. (A exemplary series of such cases is below.)

Exceptions may occur if I have misevaluated an exam (e.g., forgot to grade some exercise). Serious reasons for a grade change are not that a student believes to deserve a better grade than someone else (even if he/she has a slightly better score: one can put divisions somewhere, but not everywhere), or that he/she wants to apply for a scholarship or to enroll into some program.

I do not mean this in an adversary spirit. My duties toward students do not end with the class room, and so I am certainly not indifferent about their campus life, study/career plans, etc. What I say, though, is that these issues should not be reflected in, and hence should not (at least directly) influence, learning evaluation. In fact, knowing students over the course, I find it often painful to write bad grades. But indications of a weak performance are usually visible early and continuously (one main reason I decided to provide point lists). A student should keep in mind that others are trying their best as well, and also that, even although I see him/her heading for a disappointing result, prodding him/her to work harder is neither my duty nor my pleasure.

As an extreme case of intolerable grade appeal by students, I was repeatedly put in a situation I need to mention explicitly. Certain senior students enrolling into my classes at the math dept. tell me that they work outside the university. Then they never attend, they know no material in exams (sometimes they miss exams), not even class rules. Yet they want to correct their "F" grade; the argument is that they need passing credit for their coming graduation. Thus some students hope to *beg* together missing class credits the last semester (or year). I do not deliver mercy in such a situation.

7 Relationship to students

I would always try to help students and treat them respectfully, but informally. From previous experience, in particular in Germany, it became apparent, that elsewhere professors consider students as inferior class individuals who fill classrooms, and such professors try to keep their distance from students as a sign of their self-perceived authority. Such attitude inavoidably creates an unpleasant academical climate.

In fact, I am convinced that a vast majority of students are honest, integer, and uncomplicated individuals. This is, unfortunately, far less to be said about superior circuits of academic hierarchy. To me this is the reason that, despite the work I have done, I have met so considerable difficulties in pursuing my own mathematical career. For the time being I had not much influence to support students in their career. It seems a sad reality that someone's mathematical development depends more on other mathematicians' interests and agenda rather than his/her own skills. Now, most students I teach have no (strong) ambitions inside academia. I cannot advise in detail about other branches of society, both because I live in foreign countries and because it is academia that I insisted staying in. But when advising students about their future in academia, they need to be also made aware of the range of ethical problems it is plagued with. In turn, I hope that students can carry their positive spirit into academia helping not to debase, but at least to maintain, or better to improve standards of conduct there.