Teaching Statement
Collin Bleak

The mind is not a vessel to be filled but a fire to be kindled.
- Plutarch

Over the course of my ten years of teaching, I have been involved in teaching projects spanning from summer remedial courses for disadvantaged inner city youth, through teaching mathematics at community colleges and various universities as well as teaching graduate courses, to supporting advanced undergraduate research and my own Ph.D. student's graduate research. I have also supported infrastructure by participating in activities such as grading Mathematics AP exams, creating my own mathematics courses at the sophomore/junior undergraduate level, and directing the summer Mathematics Program for Binghamton University.

In this teaching statement, I will not attempt the impossible (give a full description of my teaching beliefs and practices), but rather, I will condense my teaching philosophy down to its core, and then explain loosely how this philosophy is reflected in my practice. My core teaching philosophy is simple; I am a pragmatic, with a sense of aesthetics.

I wholly subscribe to Plutarch's opinion; I believe that if one wants to be an effective teacher, one cannot simply present material at the board, or tell a student (at any level) to go and read something, without some willingness to discuss the ideas. It is not enough to lead the horse to water, one must also describe how crisp and cool the water is, and how refreshing it will be to drink. One has to work to get the student interested in the material, for his or her own ends.

A separate, but very important challenge, is that one cannot allow oneself to calcify in one's habits; the day a teacher becomes unable to adapt to his or her students is the day the teacher is no longer properly teaching. For instance, one has to be very flexible to address the differences in culture in the audience, and a working habit from one year might not work the next. In particular, not only do we get students who differ from each other in a classroom, we have the subtler differences that come with the passing of years and the changing of the basic culture of the students (this is less subtle as we see the huge impact the web is making). Once one understands student context, it is much easier to make the water look inviting (or at least, for a vast majority of the students).

We can also speak of peer review, active learning, manipulatives, and the various other catch phrases of our industry; providing mechanisms for the students to engage in the material and with each other helps in the process of assimilation. To some extent, one can use these technical methods to carry one across cultural differences and other issues. However, in the end, I have found that in order to create an atmosphere where the students really relax and interact with the material, the teacher has to understand the students points-of-view ahead of time; the teacher must make the shy student feel safe, and must engage the more vocal students actively in the process of bringing the other students 1 into the discussion. Thus, a purely mechanical approach tends to fail.

Another issue is that the classes we teach vary widely in many different parameters; size, social/cultural balances, and core material being just three such. Various combinations of these factors require different strategies. Once, in teaching a small calculus class, I assigned four-page writing projects describing one of three Calculus ideas, according to student preferences. Groups were formed according to projects, and each group as a team graded all the work of the individual students in another group, according mostly with a rubric I had laid out. Such a project could not work with a large lecture of 140 students.

Thus, my essential method is that I try dynamically to create an atmosphere where students feel that they can safely become ENGAGED in the material, instead of just hearing it or seeing it. As each class and each situation is different, finding the path to this atmosphere becomes one of the bigger challenges for me in any particular course I teach. Sometimes, I fail to find it, but generally, I have been able to succeed. I find that students are generally perceptive enough to realize when a teacher is trying to understand their point of view, and they try to assist in that process. True student engagement, when it can be achieved, lights the fire that leads them to success in their learning endeavor. Since curiosity is a hard habit to break, once it has taken root, I always hope that my own students success with me will translate to future successes for them elsewhere.

While the struggle to achieve the correct social dynamic in a classroom is very important, so too are the standard methods we employ to insure a proper transfer of information. Here is a short list of some of the methods I commonly employ in my lecture/classroom teaching to assist in knowledge transfer (I include short descriptions of some of the impacts these methods have on the learning environment). This list does not capture my in-class style, or represent the totality of the craft I try to employ, but it does provide a baseline of a practical sort, which indicates some of the regular structure and methods one could expect from me in my classes.

- Repeating student questions/statements before answering them.

  Often, students cannot hear each others questions. When a professor simply answers a question, without giving it context, the students who did not hear the initial question are spending some portion of their thinking trying to figure out the original question, instead of digesting the answer. This also creates a dynamic of supporting students, by showing that you take their questions seriously and by indicating that you think the questions are representative of what other students are thinking about (it somtimes pays to make a comment such as Yes, this is a common question at this point... in your answer).

- Polling Students for understanding.

  I regularly ask, after describing something (possibly complex), for a quick show of hands, representing student comfort with the material just cov- ered. There are some tricks associated with this. Firstly, students will not respond accurately in general, but particularly if the question is phrased negatively (one should not request Raise your hands if you do not un- derstand. when of course almost no students would raise their hands!). Instead, by making positive statements (e.g., Raise your hand if my de- scription of X made sense to you.), and with practice with a particular class, one can come to accurately judge student response.

- Inciting discussion.

  Once one has a feel for the students and social dynamics in a classroom, it becomes fairly easy to engage the class in a discussion. One can usually start with an outspoken student, and engage in debate which spreads to other students, eventually including even the very shy (one method for this is to move questions from the less shy to the more shy, another method that can be used in smaller classes is to move questions around the room in accord with seat location in a regular way; no student feels singled out when their seat just happens to come up, and they usually have more time to prepare themselves to answer a question.) This should always be done with a light touch; gentle or undirected humor goes a long way in supporting this technique.

- Special attention to the blackboard.

  The best lecturer I have ever seen, in terms of use of the blackboard, was Peter Hilton. His print looked like large, careful typesetting, he almost never had to erase, and his blackboards always contained the core argu- ments, very clearly marked, by the end of a proof. He steadily worked left-to-right and top-to-bottom, and he always used up all of the easily visible boards before going back to the beginning and erasing his first board. He had clearly given, before each lecture, careful thought as to what should be written down. After seeing a Peter Hilton lecture, one never had to ask oneself What is the most important thing I learned today?, as Peter had done such a marvelous job of laying out the material, and emphasizing the key points and ideas. I am not Peter Hilton, but I certainly try to be when it comes to my blackboard use.

  One obstacle for me is that my classes tend to be a bit more dynamic in topic, so it is essentially impossible to plan out my blackboards ahead of time; I am never completely certain what I will cover by the end of a class session. I fight this in ways, and I do try to Steer my classes to cover the core material which I had originally planned on covering, but I cannot always succeed in this. In any case, I do try to keep my boards neat and organized, with minimal use of the eraser. I also try to keep the presentation balanced, so that no portion of reasonable board space is excluded regularly.

  Sadly, my handwriting is not as good as Peter's!

- Incorporating practice into a lecture.

  In undergraduate classes, I always try to have my students exercise some of what they have just learned during that lecture. I do this by having 3 them work through easy examples after I have done one or two myself and presented a theorem or lemma. This is informal work; the students are encouraged to ask me or other students for help. I have found that this is also a good time to circulate through the class and interact less formally with the students (in classes with less than fifty students). By watching the students work, I also get immediate feedback on where I am failing to connect with them.

Finally, some mention should be made of the differences I have found between teaching at the undergraduate level in a course environment, and teaching in support of research. Over the last three summers, I have been involved in leading projects for the Cornell University Mathematics Summer Research Experience for Undergraduates (REU). In these projects, I take a small collection of talented undergraduates from around the country, and I prepare them, and then collaborate with them, to carry out advanced research. This work has lead to the solution of open questions in the theory base loosely associated with R. Thompsons groups $F < T < V$ and a nice result about restrictions on faithful gorup actions in the piecewise-linear category on higher dimensional manifolds. The work has alread produced one paper (to appear) in Geometria Dedicata, and I expect three more papers to eventually be submitted by my students, relating to work we have carried out at these REU's.

What is the difference here, between teaching in an undergraduate classroom, and leading a research REU? In my experience, it is a question of focus. Classroom teaching supporting an REU is almost totally supportive of the students absorbing the material they will need to carry out research in an area. This teaching tends to be focussed on only what the students really need to get to work, and they know it. Also, there is no question of a grade; the students are there to learn for their own purpose. I may write recommendation letters for them, but everyone understands that this activity will mostly be driven by the research they carry out, not their classroom learning. The shift in focus is to working together creatively and dynamically to answer open questions. The students are highly motivated, and they understand they are exploring; going where no human has gone before. This creates an entirely different learning dynamic, and my goal here is to point in directions that look promising, and to support the students answering questions in any direction, without stepping on their creativity. I have found this to be a particularly satisfying teaching activity, and I hope to do it, or something like it, for years to come.

Finally, there is another sort of teaching involved with my first Ph.D. student. Here, I aspire to see him achieve substantial core knowledge of two general research areas; profinite methods in semigroups and groups, and topological dynamics/symbolic dynamical systems, particularly in relation to the theory of group actions. He also needs to attain a high level of sophistication in the region of his precise chosen research. Supporting these aspirations, I have given him two projects to think about; a concrete problem in the theory of Thompson's group V, which is naturally approached using the theory of groups actions and symbolic dynamics, and selecting and working on an open problem from (the list of 84 such) inside Rhodes and Steinberg's book on the q-theory of finite semigroups (which book uses the profinite approach to analysis in many places). My hope is that the problems Nathan works on will fuel him in his general learning. We meet regularly to discuss his work, and at this juncture (since he appears interested and happy with his present course), my biggest challenge is in staying out of his way while still suggesting occasional minor course corrections; allowing him the time required to gain the mastery and confidence required to produce his Ph.D. When he attains a higher level, it will also become important to make sure he goes to conferences regularly to develop further knowledge and social ties from within his research area.

In summary, I believe it is essential to address students' mental perspectives while teaching. Motivated students learn faster and deeper, and they retain their knowledge longer. I believe in making students feel safe in their learning environment, and then challenging them (slightly) beyond the limits of what they thought they could do. My methods of teaching do not generally require tremendous time expenditure outside of the classroom environment, but they do require great focus and attention in the classroom. I hope to help students acquire a habit of thought supporting avid curiousity, and the confidence to pursue their questions beyond simple memorization of material. I am proud that my students feel I am a tough teacher, but that they also enjoy my classes and feel that they learn much in them.