Teaching Statement

Jianqiang Zhao

I always think that love of students and love of mathematics are the most crucial factors in becoming a good mathematics teacher. With love, teachers can offer genuine help to both the advanced students and those who struggle with math. Teachers' love of math can become contagious only if they show their care for the students. Nonetheless, there are many other factors which can also affect the effectiveness of one's teaching. In what follows I'll try to summarize my experience and understanding on this important part of the college life.

1. Teaching experiences (see http://home.eckerd.edu/~zhaoj/teach.htm)

Before coming to the US in 1994, I had had four years of college teaching experience from freshman calculus to senior graduate courses in China, three years as teaching assistant and one year as instructor. I was able to nurture an informal relation with my students because I was about their ages. One of them, Yi Ouyang, is now a Professor of Mathematics of the University of Science and Technology of China after receiving PhD from University of Minnesota in 2000 and then his postdoctoral study at the University of Toronto.

The training at Brown University as graduate teaching assistant and then teaching fellow turned out to be pivotal in my academic life later. I have learned a lot of very useful ideas and teaching techniques from my professors there, such as Prof. Thomas Banchoff, Prof. Michael Rosen and Prof. Joseph Silverman, to name just a few. To me, the most important influence of all is their love of students and their enthusiasm when teaching mathematics.

Four years of postdoctoral studies at the University of Pennsylvania provided the ideal opportunity for me to nurture and gradually improve my teaching style. I was able to teach both undergraduate and graduate courses, ranging from *Calculus* classes of more than 60 students to *Number Theory and Cryptography* class of less than ten students. I had a wonderful time at the UPenn and received the Good Teaching Award from the Mathematics Department in 2003 (see http://home.eckerd.edu/~zhaoj/teach/certificates.htm for the copy of the certificate).

Partly because of my love of teaching, in 2003 I accepted a tenure-track position at Eckerd College, a four-year library arts college. During the past six years I have taught a full range of undergraduate courses, from *Introduction to Statistics* and remedial *Pre-Calculus* to *Real Analysis* and *Abstract Algebra*. My performance gradually caught up with other long time faculty members at my college. Moreover, I have been able to stay above average in the recent past few years (see Appendix A). In 2007, I was granted tenure at Eckerd College.

Besides teaching I've been a mentor for about twenty students at Eckerd College most of whom are majors in natural sciences. My primary responsibility is to provide help and guidance to them in their academic life such as deciding which courses to take and what direction of study they can pursue according to their preference and strength. One of my mentees, Samantha

Combs, took part in the NSF Physics REU program at U. Nevada in 2008. Another student, Hilary Browning, was named one of the Hollings Scholars in 2009 (122 total nationwide).

2. Teaching strategies.

There are often many abstract concepts in a math course. They are the main obstacles to a large number of students. Before introducing a new definition, I often provide a couple of simple and conceptual examples to prepare my students. Also, I always look for creative ways to bring these abstract concepts down to earth; for instance, to compare the sphere coordinate system to the coordinate system on a map of the Earth, the real "Globe". Sometimes, the definitions in the book are quite involved in order to be precise. I will then rephrase them in several ways in plain language, pointing out what will happen in special cases when some of the conditions are trivial.

It is my belief that to excel in math, one must do a lot of exercises. Therefore homework is indispensable for students to understand fully the content of the text book; as I tell them, they cannot become good at math simply by watching me solving problem the same as they cannot speak good French simply by listening. Furthermore, I often emphasize the importance of reading and understanding the examples in the textbook before doing their homework.

Concerning the content of the assignments, while it should mostly consist of straightforward problems, I think it should include a couple of sophisticated ones, too. The later problems not only deepen the understanding of the concepts involved, but also lure some the more advanced students into math more likely. This is particularly true in advance math courses. Even if most of the students cannot answer the harder problems, they provide an excellent excuse for them to visit me during my office hours, which I consider to be an integral part of learning and which give me another chance to evaluate my lecture by talking to the students in a more relaxed and informal way. I also believe short quizzes are helpful. Especially carefully graded quizzes will provide students valuable chances for them to check their own understandings.

In my teaching I always pay more attention to the way the students think and solve problems than to the problems themselves. Usually I try to arouse students' interest by instilling in them a curiosity about mathematics, encouraging them to do the actual problems by themselves after giving them detailed solutions of some similar and simple examples. A number of my students continue their academic careers by going to some very prestigious institutions. For example, one of the students, Lauren Yeager, was in my *Introduction to Statistics* course. She was always very curious so I tried to use more examples in real life than what were given in the textbook to cater to her curiosity. Later on she became a double major in Marine Science and Spanish and received the prestigious Fulbright grant to study in Thailand and Mexico in 2006. Alexis Hurst, a student in my Abstract Algebra class, the 2009 recipient of the Meacham Mathematics Memorial (M^3) award as the outstanding math graduate, is now enrolled in the math graduate program at Clemson University.

 Teaching needs devotion.

Of course, good teaching involves much more than lecturing gregariously. The first semester of my teaching as an instructor at Eckerd College was not very successful because of lack of experience with students of different culture. Thereafter I tried to improve my teaching style by learning from the books about teaching and from other good teachers. Good preparation is essential. So I always start with a carefully prepared syllabus, taking into account as many factors as possible. Before the semester even begins I've already looked through all the chapters I need to cover and designed all the homework. As the semester progresses, I constantly keep the overall structure and the mathematical goals of the course in mind, knowing that cohesion both within a single lecture and between lectures is important. For each lecture I prepare my presentations thoroughly, finding good stopping points and paying special attention to illustrative examples. I always begin with a lecture by summarizing the content I taught in the proceeding lecture.

The office hours are especially helpful to those students who have trouble keeping up with course work but really want to learn well. To encourage such students to come to see me during my office hours I have found out that a little reward often works beautifully, for example, awarding homework deadline extensions, allowing re-taking quizzes, etc. Although the more students come to seek help, the more time I need to spend, I feel this is the time well worth spending. I was particularly encouraged when students gave me some positive feedbacks (see Appendix B). One of the students who often come to see me during my office hours is Patrick Crotty. We often discuss problems together late into the night. He is now in the graduate program at the University of Florida.

In order to have a better understanding of the math education in our high schools I took part in the AP reading organized by the College Board in 2007 and 2008. Unexpectedly, I learned some very efficient ideas of designing and grading exams which will be invaluable in my future teachings. I also actively participated volunteer teaching in my kid's elementary school.

3. Teaching and research.

I believe research and teaching should go hand in hand in our higher education institutions. I often use my solution of the BBB-conjecture in [2] as an example in my *Abstract Algebra* class to show that the non-commutative structure may arise naturally even when we deal with commutative objects. I also like to use the analytical continuation of multiple zeta functions [3] in my *Real* and *Complex Analysis* classes to show the differences and relations between two concepts: 1-dimensional (complex) singularities and higher dimensional indeterminacies. Once, a physics major asked me about the Dirac delta function in the *Complex Analysis* class. To help him to understand this important concept I spent an extra class talking about generalized functions and distribution which was used in [3].

The primary road block for more of the students to major in mathematics is their lack of experience in mathematical research. With my previous NSF funding I was able to attract some

advanced students to help with my research projects. One of the students, Christiaan Mantz, helped me with by writing a very sophisticated Java program to test some conjectures of mine. In the process he became very interested in computer modeling. Combined with his interest in physics he later decided to study cosmology. He is currently an associate professor of cosmology at the Utrecht University.

4. Teaching with technology.

I like to apply advanced technologies in classrooms. I have learned some computer algebra systems and used them in my research as well as my regular courses such as calculus and number theory. At both UPenn and Eckerd College I taught a course/seminar called *Number Theory and Cryptography*. After I showed the students the basic skills of Maple programming I assigned several projects to the students which required large amount of computer aided computation. I believe that the students will be inclined to love modern technology if the teachers have set good examples for them. They probably also will like to try and use advanced technologies in the future after they leave college.

At Eckerd College I have used WebCT to complement my classroom teaching. It offers a marvelous platform to keep me and my students connected even when I am away from campus. The chat-room function provides my students the opportunity to get instantaneous help when they need. This is a very handy backup tool in case of emergency, too.

5. Coda.

With over 15 years of teaching experience, I find that love of students and love of math are the most important for a math teacher to succeed. It is now also clear to me that to teach students how to think is more crucial than some specific tricks and formulas. I like to say this to my students: “Memorizing is important, but critical thinking is more important. You know how to integrate to find areas and volumes, but if your answers are negative then something must be wrong." By making conceptual questions the focus of my efforts to improve the interactive environment I felt that I would also improve the overall learning and retention of material. As a matter of fact, students often forget how to “plug and chug” through a problem a year after completing a course, but conceptual knowledge, i.e., the “philosophy” we teach them, may remain with them for many years to come.

References

[1]. S. Akiyama, S. Egami and Y. Tanigawa, Analytic continuation of multiple zeta-functions and their values at non-positive integers, *Acta Arithmetica* **98** (2001), 107—116.

[2]. J. Zhao, On a conjecture of Borwein, Bradley and Broadhurst, in press: *J. reine angew. Math*.

[3]. J. Zhao, Analytic continuation of multiple zeta functions. *Proc. Amer.Math. Soc*. **128**(1999), 1275—1283.

Appendix A. Teaching Evaluations (at Eckerd College)

(see http://home.eckerd.edu/~zhaoj/teach/eval.pdf for original evaluation forms)

Effectiveness of faculty		Level of difficulty		Total hours per week
Quality of course		1=Very elementary		1=3-5 hours
1=Very good/Execellent		2=Somewhat elementary		2=6-8 hours
2=Generally good		3=About right		3=9-11 hours
3=Adequate		4=Somewhat difficult		4=12-14 hours
4=Mediocre		5=Very difficult		5=15 hours or more

Course		Section Mean	Course Mean	Discipline Mean	Collegial Mean	Program Mean
	Effectiveness of faculty	1.33		2.12	1.69	1.57
2008 Fall	Quality of course	1.33	only one	2.27	1.85	1.75
Abstract Algebra I	Level of difficulty	4.67	section	3.67	3.54	3.36
	Total hours per week	3.00		2.74	2.66	2.54
	Effectiveness of faculty	1.20		2.12	1.69	1.57
2008 Fall	Quality of course	1.20	only one	2.27	1.85	1.75
Linear Algebra	Level of difficulty	4.00	section	3.67	3.54	3.36
	Total hours per week	3.40		2.74	2.66	2.54
	Effectiveness of faculty	1.50	3.00	2.12	1.69	1.57
2008 Fall	Quality of course	1.75	3.12	2.27	1.85	1.75
Calculus II	Level of difficulty	4.25	4.33	3.67	3.54	3.36
	Total hours per week	3.83	3.11	2.74	2.66	2.54
	Effectiveness of faculty	1.50		2.06	1.74	1.54
2008 Spring	Quality of course	1.60	only one	2.17	1.91	1.70
Discrete Math.	Level of difficulty	3.80	section	3.93	3.52	3.37
	Total hours per week	3.60		2.82	2.64	2.59
	Effectiveness of faculty	1.57	1.37	2.06	1.74	1.54
2008 Spring	Quality of course	1.57	1.81	2.17	1.91	1.70
Calculus II	Level of difficulty	4.29	4.41	3.93	3.52	3.37
	Total hours per week	4.14	3.56	2.82	2.64	2.59
	Effectiveness of faculty	1.25	2.48	2.06	1.74	1.54
2008 Spring	Quality of course	1.35	2.53	2.17	1.91	1.70
Calculus I	Level of difficulty	4.63	4.39	3.93	3.52	3.37
	Total hours per week	4.16	3.35	2.82	2.64	2.59

		Section	Course	Discipline	Collegial	Program
Course		Mean	Mean	Mean	Mean	Mean
	Effectiveness of faculty	1.14		1.87	1.69	1.57
2007 Fall	Quality of course	1.29	only one	2.07	1.85	1.80
Calculus III	Level of difficulty	3.86	section	3.97	3.57	3.37
	Total hours per week	3.57		2.85	2.68	2.57
	Effectiveness of faculty	1.22	2.09	1.87	1.69	1.57
2007 Fall	Quality of course	1.44	2.34	2.07	1.85	1.80
Calculus II	Level of difficulty	4.11	4.22	3.97	3.57	3.37
	Total hours per week	3.72	3.31	2.85	2.68	2.57
	Effectiveness of faculty	1.25	1.56	1.87	1.69	1.57
2007 Fall	Quality of course	1.36	1.86	2.07	1.85	1.80
Calculus I	Level of difficulty	4.19	3.92	3.97	3.57	3.37
	Total hours per week	3.56	2.93	2.85	2.68	2.57
2007 Spring						
Abstract Algebra II	Enrollment < 4					
	Effectiveness of faculty	1.80	3.04	2.75	1.73	1.58
2007 Spring	Quality of course	1.80	2.96	2.93	1.94	1.77
Calculus II	Level of difficulty	3.80	4.36	4.01	3.58	3.36
	Total hours per week	2.60	2.71	2.47	2.61	2.53
	Effectiveness of faculty	1.64	3.08	2.75	1.73	1.58
2007 Spring	Quality of course	1.92	3.39	2.93	1.94	1.77
Calculus I	Level of difficulty	3.86	4.25	4.01	3.58	3.36
	Total hours per week	3.00	2.65	2.47	2.61	2.53
2006 Fall						
Abstract Algebra I	Enrollment < 4					
	Effectiveness of faculty	1.45		1.87	1.67	1.61
2006 Fall	Quality of course	1.45	only one	1.96	1.84	1.81
Calculus II	Level of difficulty	4.00	section	3.56	3.61	3.36
	Total hours per week	3.27		2.33	2.57	2.46
	Effectiveness of faculty	1.29	1.64	1.87	1.67	1.61
2006 Fall	Quality of course	1.36	1.85	1.96	1.84	1.81
Calculus I	Level of difficulty	3.86	4.05	3.56	3.61	3.36
	Total hours per week	3.86	3.03	2.33	2.57	2.46

Course		Section Mean	Course Mean	Discipline Mean	Collegial Mean	Program Mean
	Effectiveness of faculty	1.50		2.00	1.66	1.55
2006 Spring	Quality of course	1.50	only one	2.14	1.83	1.73
Real Analysis II	Level of difficulty	4.75	section	3.83	3.61	3.38
	Total hours per week	3.50		2.43	2.70	2.59
	Effectiveness of faculty	1.44		2.00	1.66	1.55
2006 Spring	Quality of course	1.78	only one	2.14	1.83	1.73
Survey of Math.	Level of difficulty	4.22	section	3.83	3.61	3.38
	Total hours per week	3.28		2.43	2.70	2.59
2006 Spring						
Western Heritage	This is a year-long general education non-math course.					
	Effectiveness of faculty	1.20		2.02	1.68	1.62
2005 Fall	Quality of course	1.20	only one	2.24	1.83	1.81
Real Analysis I	Level of difficulty	4.80	section	3.93	3.50	3.33
	Total hours per week	3.80		2.66	2.60	2.51
	Effectiveness of faculty	1.75		2.02	1.68	1.62
2005 Fall	Quality of course	1.83	only one	2.24	1.83	1.81
Statistics	Level of difficulty	3.96	section	3.93	3.50	3.33
	Total hours per week	3.00		2.66	2.60	2.51
2005 Autumn Term:	Effectiveness of faculty	1.80		1.43	1.43	1.43
How to play games	Quality of course	2.20	only one	1.63	1.63	1.63
mathematically?	Level of difficulty	3.50	section	3.35	3.35	3.35
	Total hours per week	2.30		3.00	3.00	3.00
2005 Spring						
Abstract Algebra II	Enrollment < 4					
	Effectiveness of faculty	1.68	1.63	1.90	1.80	1.59
2005 Spring	Quality of course	1.68	1.81	1.98	1.92	1.72
Calculus I	Level of difficulty	4.05	4.00	8.73	3.56	3.32
	Total hours per week	3.16	3.00	2.53	2.77	2.69
2004 Fall	Effectiveness of faculty	1.00		1.81	1.82	1.64
Math Seminar 2nd	Quality of course	1.00	only one	1.99	1.93	1.75
Number Theory	Level of difficulty	2.67	section	3.77	3.49	3.31
and Cryptography	Total hours per week	3.00		2.62	2.68	2.63

		Section	Course	Discipline	Collegial	Program
Course		Mean	Mean	Mean	Mean	Mean
2004 Fall						
Abstract Algebra I	Enrollment < 4					
	Effectiveness of faculty	1.33	1.55	1.72	1.73	1.59
2004 Fall	Quality of course	1.43	1.64	1.64	1.64	1.75
Calculus I	Level of difficulty	3.76	3.96	3.80	3.54	3.32
	Total hours per week	3.19	3.09	2.63	2.70	2.60
2004 Spring	Effectiveness of faculty	1.00		1.81	1.82	1.64
Math Seminar	Quality of course	1.00	only one	1.99	1.93	1.75
Number Theory	Level of difficulty	3.00	section	3.77	3.49	3.31
and Cryptography	Total hours per week	1.00		2.62	2.68	2.63
2004 Spring	Effectiveness of faculty	1.00		1.81	1.82	1.64
Partial	Quality of course	1.00	only one	1.99	1.93	1.75
Differential	Level of difficulty	3.67	section	3.77	3.49	3.31
EQuations	Total hours per week	3.00		2.62	2.68	2.63
	Effectiveness of faculty	2.00	1.57	1.81	1.82	1.64
2004 Spring	Quality of course	3.00	1.94	1.99	1.93	1.75
Calculus I	Level of difficulty	4.40	4.08	3.77	3.49	3.31
	Total hours per week	2.80	2.78	2.62	2.68	2.63
	Effectiveness of faculty	1.22		1.81	1.82	1.64
2004 Spring	Quality of course	1.44	only one	1.99	1.93	1.75
Survey Math	Level of difficulty	3.67	section	3.77	3.49	3.31
	Total hours per week	3.00		2.62	2.68	2.63
2003 Fall						
Complex Analysis	Enrollment < 4					
	Effectiveness of faculty	2.93	2.21	2.25	1.91	1.69
2003 Fall	Quality of course	3.00	2.33	2.39	2.03	1.87
Calculus I	Level of difficulty	3.93	3.88	3.84	3.58	3.33
	Total hours per week	2.71	2.50	2.36	2.58	2.55
	Effectiveness of faculty	2.88		2.25	1.91	1.69
2003 Fall	Quality of course	3.19	only one	2.39	2.03	1.87
Precalculus	Level of difficulty	3.65	section	3.84	3.58	3.33
	Total hours per week	2.11		2.36	2.58	2.55

Appendix B. Samples of Students' Feedbacks

1. *From a mentee*: Very friendly and open to conversation. Takes into consideration what I want to do after graduation and not just my major. Very polite and asked about my classes, sports, and family. Seems to be curious and intrigued. He does very well to my taste. Isn't always on my back about things but does show concern when I am struggling. He's a nice guy and a good mentor all around.

2. *From a mentee*: As a mentor, Professor Zhao has assisted me in every way that I have requested. I have had absolutely no problems or concerns with him as my mentor. He's been really beneficial with helping me to decide which classes to take.

3. *From a student's email to our Dean of Faculty at Eckerd College*: (for more feedbacks please see http://home.eckerd.edu/~zhaoj/teach/suppLetter.htm)

   I am writing on behalf of Dr. Zhao, whom I believe deserves tenure. Dr. Zhao was my professor for two semesters of Real Analysis and I am currently in his Abstract Algebra class. I have had other classes with Dr. …, and of the math faculty I have found Dr. Zhao to be the most approachable for help. While I was in his Real Analysis class I was amazed by Dr. Zhao's level of commitment to teaching. I can remember numerous instances when I would visit his office for help long after his scheduled office hours and he was always happy to assist me. During second semester of Real Analysis he set up a weekly extra help session in his office which was immensely helpful. Near the end of the year I actually stayed in his office working until 2 am and he was happy to help the entire time. I've never had a professor who was as willing to put in so much extra effort to help me learn. I tutor mathematics for the department three nights a week, and so I am familiar with Dr. Zhao's assignments in many of his lower level classes, and I must say that he is very demanding teacher. However, the problems he chooses are similar to the problems one encounters in higher level math classes; for instance, in his Calculus section he regularly assigns the questions that require proofs rather than the more common computational problems. I feel that the students who bring Dr. Zhao's questions to me are forced to think about aspects of mathematics which I did not get much experience with in the Calculus class I took at St. Petersburg College. I feel that this gives them a more thorough understanding of the subject than I received from the more computationally oriented class I took. …

Question: **Was this course intellectually stimulating? Did it stretch your thinking? Why or why not? Please explain…**

1. This course was very challenging and I feel as though I understand so much more now.
2. This is an incredibly difficult course. It definitely stretched my thinking.
3. Yes, very difficult but made me change my way of thinking about math.
4. Yes, I learned a lot and expanded my mathematical ability.

Question: **What aspects of this course contributed most to your leaning?**

1. Calculus tutoring and extra help with Dr. Zhao. One on one time really helped me grasp the materials that I was struggling with.
2. Doing the homework problems.
3. Book & quizzes.
4. The calc tutors and Dr Zhao's help.
5. The quotient rule song.

Question: **What aspects of this course, if any, inhibited your leaning?**

1. It was simply difficulty.
2. It was difficult to understand some of the concepts.
3. Way too fast.

Question: **What suggestion do you have for improving the course?**

1. Students just need to take the time to go in and ask for extra help.
2. Slow down. Review. Easier HW.
3. More class time.