KAVITA SUTAR **TEACHING PROFILE**

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1 Educational Qualifications

- **Ph.D.(Mathematics)**, Northeastern University, Present
- **Master of Science(Mathematics**), Pune University, 2000-2002
- **Bachelor of Science(Mathematics)**, Pune University, 1997-2000

2 Teaching Experience

- **Chennai Mathematical Institute, Chennai**, Visiting Assistant Professor, August 2012 - Present.
- **Northeastern University, Boston**, Teaching Assistant, Fall 2006 - Spring 2012.
- **Bhaskaracharya Pratishthan, Pune**, Mathematical Olympiad training, 2004 - 2006.
- **Fergusson College, Pune**, Lecturer, 2003 - 2004.

3 Teaching Philosophy

As a student, I had some teachers I liked and some I admired. But I did not grow up dreaming to be a teacher. I discovered my passion for teaching after I started doing it. In the spring of 2003, I taught my first course - group theory - to a class of undergrad students. I was surprised at how much I looked forward to the class every week and the positive response I received from the students. By the end of the semester I was convinced I wanted to continue teaching.

The best student-teacher interaction I have had is when I was teaching at Bhaskaracharya Pratishthan in Pune, India. I was successful in converting a batch of students who came in with the humble expectation of being able to pass their exams with good scores and ended up being a bunch of the most motivated and hard-working students. I think this could be achieved because I could make them believe that math is fun and that there is more to it that they have usually seen at school. I still remember their enthusiasm and the gleam in their eyes when they understood a concept or things 'clicked' in their mind. I would have out-of-class discussions and even suggestions from them about how I could make my class more interesting. This is the kind of interaction I continue to strive for in all my classes.

Assigning projects, inviting students to come forward and lead, recognizing and rewarding their achievements in different ways (could be as simple as an applause or a candy in class), providing positive feedback about their strengths and shortcomings, scheduling one-on-one meetings during the semester, arranging group problem-solving sessions and small in-class competitions are examples of strategies I have used to get my class involved in learning. For example, in my Calculus 2 class at Northeastern, I had a half-hour competition session every two weeks where the class formed groups of four and competed in solving some difficult homework problems. The winner group was applauded, asked to explain the solutions to the class and earned cookies. The class had fun and everybody was actively involved in the problem-solving process.

I think it is not sufficient to lecture a class, assign homework and grade quizzes; it is equally important to come up with ideas and devise methods that will make the students get more involved into what they are learning. I have observed that adding a personal touch to dealings with students makes them more open, confiding and involved in the course. For example, I make sure I know the names of all my students by the end of the first week of classes. Students

appreciate my efforts and the fact that I care about their identity. This process also helps as an ice-breaker. When I grade homeworks or quizzes, I write remarks/suggestion such as 'this was better expressed than last time', 'this is very well written', 'please see me about this matter', 'please do not repeat so-and-so' etc. The students perceive this as a personal check and stay alert as well as make efforts to honour my suggestions.

Another important thing I learned from my teaching experience is the following: most students are confused about how things work in math but that is not enough reason to deny them the logic/proof of why things work. In fact, telling them the logic behind the methods makes them more confident about the stuff they are learning. In their initial confusion, most students don't get past the methods. This makes teachers feel that the utmost priority should be given to 'how' and not to 'why'. Hence the lack of proofs in our texts. I feel that though it is important to know 'how', teaching only that is bound to take away the spirit of the subject and reduce it to a mere set of algorithms for solving problems. I believe that it is part of a teacher's responsibility after having taught how things work, to interest the class in considering why they work that way. If the students are sufficiently interested, one may go on and provide actual proofs. But it is important to have students realize that they ought to be really thinking about the 'why' question. I first realized this fact when I was teaching Euclidean geometry to 9th grade students. They did not study proofs of theorems as part of their school curricula. But I introduced them to proofs and I was surprised that once this feeling of 'need for proof' was invoked, the students themselves insisted on working out the proof. They developed a keen sense of logical deduction which helped them quickly gain access to more difficult topics in combinatorics and number theory at such a young age.

While teaching at Northeastern, I found that students were even more unprepared, afraid and reluctant to learn mathematics than their counterparts in India. This surprised me and was a major hurdle for me when I started my teaching assistantship. I should also mention that the learning culture in India is very different from that in the USA and this cultural difference posed a challenge for me. As semesters passed, I learned from my mistakes and also from my students and colleagues about how to teach in this new cultural environment. I found that being open about my shortcomings and ready to accept criticism helped me connect with my students better. I tell my students where I come from, that if they have problems with my accent or my methods of explaining they can comment on it. Every three weeks I pass out 1-minute evaluations for them to fill out asking them for their comments/suggestions. I have benefited immensely from these continuous feedbacks. They have not only helped me in improving my teaching methods for those particular courses but also in developing my teaching style.

My way of doing mathematics is to first look at examples, pick out the ideas and gradually move towards the general setting. This gives a strong foundation for the ideas to be based on and the examples provide a good reference point. All the same, it is important from time-to-time to stand back and take stock of the big picture. This technique has worked for me and my students have appreciated it. Even so, as a student and as a teacher, I think that there is certainly scope for improvement here. In general, I am open-minded towards experimenting with other ideas and techniques of teaching. In this sense I think that teaching is in itself a lifelong process of learning.

4 Courses taught

4.1 Chennai Mathematical Institute

Semester	Course
January - April 2014	Representation theory of the symmetric group
August - November 2013	Numerical linear algebra
August - November 2012	Numerical linear algebra

4.2 Undergraduate teaching at Northeastern University

Semester	Course	Description
Spring 2011 and Fall 2011	Mathematical Thinking	Symbolic logic, counting principles, probability and distributions
Spring 2010	Calculus 3 for Science and Engineering	Differential and Integral calculus of several variables, Green's theorem, Stokes' theorem with applications
Fall 2009	Calculus 2 for Science and Engineering	Integral calculus, sequences and series, differential equations, vector calculus
Fall 2008 and Spring 2009	Calculus for Business and Economics	Differential and Integral calculus, Marginal Analysis, modeling for economics
Spring 2008 and Summer 2008	Calculus 1	Differential and Integral calculus, Optimization and applications
Spring 2007 and Fall 2007	Calculus and Differential Equations 2 for Biology and Life Sciences	Differential and Integral calculus, numerical methods, systems of linear differential equations, linear algebra, biological kinetics

4.3 Mathematical Olympiad training

The description of topics listed here is not exhaustive. The idea was to train students in 8th grade onwards to compete at the regional and national level Mathematical Olympiads.

1. **Euclidean Geometry:** including Euler's line, nine-point-circle, Simson line, Ptolemy's inequality, Ceva and Menelaus theorems etc.
2. **Number Theory:** including Fundamental Theorems on Arithmetic, Linear and quadratic Diophantine equations, Pell's equation, Arithmetic of residues modulo n, Fermat's and Euler's theorems.
3. **Combinatorics:** including graph theory.
4. **Algebra:** including Fundamental Theorems on Algebra, algebraic inequalities, factorization of a polynomial into a product of irreducible polynomials, symmetric polynomials of several variables, Vieta's theorem.

4.4 Undergraduate teaching at Fergusson College

- Operations Research for T.Y.B.Sc.
- Group theory for T.Y.B.Sc.
- Differential Equations for S.Y.B.Sc.

- Analytical Geometry for F.Y.B.Sc. and F.Y.B.Sc.(Computer Science)
- Algebra for F.Y.B.Sc. and F.Y.B.Sc.(Computer Science)
- C-programming practicals for F.Y.B.Sc.(Computer Science) and S.Y.B.Sc.(Computer Science)

5 Teaching strategies

In the past 8 years, I have had the chance to teach different levels of mathematics courses to a wide spectrum of students ranging from 8th graders to graduate students. From this experience I have learned things that have moulded my attitude towards teaching and learning. During these years I experimented with different teaching methods and strategies to make my class more interactive and inclusive. I will briefly describe a few of those here.

When I was training students for the mathematical olympiads, my class consisted of 8th and 9th grade students who were used to viewing mathematics with some awe and fear. I took efforts to reduce this feeling and make them more comfortable with the subject. For this I introduced them to the art of 'proof'. I found that teaching Euclidean geometry a very good way to do this. When the reasoning became clear, the students found that they could remember results and formulae more easily than before. Also, the proofs helped them understand how they could apply different concepts. Not only did they gain a level of comfort but also started losing the fear of mathematics.

During the training I noticed that the energy level of my students was very high. I made use of this by challenging them to try and understand some concepts on their own during their holidays. They took up the challenge and formed groups to come and work at the institute every afternoon. This was exciting and unexpected since the students voluntarily came in to do math during their free time. I worked with them in groups letting them learn at their own pace. This experiment was very successful and I had groups coming in all summer.

In the years that I taught at Northeastern, I tried a variety of class activities to increase the involvement of students. One idea was to give them a problem set to solve in the last 15 mintues of class, based on the material covered in class that day. This helped them test their understanding right away. I assigned a small credit to these problem sets, so it was an incentive for the students to pay attention in class and take interest in what was being taught. Another idea was to have them work in groups on some assigned problems. This method helped as an ice-breaker among students. They would discuss the problem among themselves and in the process they could compare what they had understood in relation to their classmates. Some students could identify their problem areas better by discussing with their peers. Some smarter students could increase their understanding by explaining the solutions to the weaker students. This activity was always useful since it served many such purposes and suited students with different learning styles.

I have found that adapting myself to the class I am teaching has given me very good results. When I taught Mathematical Thinking at Northeastern, my class consisted of students who had little or no exposure to undergraduate mathematics. This made them reluctant to learn any math. I took efforts to understand their point of view and adapt my methods to suit them. My class appreciated this and they ended up having fun as well as learning math in the process.

I found the experience of teaching at CMI quite interesting. The students undergo a selection process and are better equipped to take on difficult concepts in mathematics. As a result, I could experiment with introducing new components to the course such as scilab, LaTeXing, projects etc. The students responded well and were glad to have learned these techniques.

In the August-November semester of 2012, I taught a course in Numerical Linear Algebra to students of the M.Sc.(Applied Mathematics) program. This was my first time teaching a course which concentrated on the numerical and algorithmic aspects of linear algebra. I looked upon it as a challenge and a chance to learn about those aspects of linear algebra. To make the learning more interactive, I introduced a component of Scilab to it. This was new to the students and they enjoyed the experience. To encourage students to work more proactively and to give them a feel for research, I asked them to work on a course project. The class was divided into groups and each group was asked to study the literature and come up with project ideas that related to their course. This forced them to browse through and read even about aspects of numerical linear algebra which were not being covered in the syllabus. The students got a good feel for the varied applications of the course and gained practical insight into the problems that occur. I encouraged the students to start typesetting in LaTeX and to make their presentations in beamer. All groups responded to this and as a result the entire class learnt to use these techniques.

I like it when the students can perceive me as their friend rather than an aloof teacher. This is important because it makes them comfortable and opens their minds, which makes it easier for me to convey to them the enthusiasm I feel for mathematics. I think this is more than a strategy, it is the spirit of my teaching.

5.1 Course projects

This component of the courses I taught at CMI was introduced by me with the aim of encouraging students to work on their own. The students would either choose a topic or I would assign a topic to them. I would meet them twice during the semester to discuss their progress on the project work. At the end of the semester, the students submitted a project report and gave a class presentation explaining their work.

I first experimented with this course component in my numerical linear algebra course in 2012. The response I received from the students was so positive that I decided to try doing this in every course I taught. The students were always glad for the experience of writing an article/project report and presenting in class.

5.1.1 Representation theory of the symmetric group (January - April 2014)

There were 7 projects, most of them done individually:

1. Sliding (Jeu de Taquin)
2. Viennot's algorithm
3. R-S-K correspondence
4. Symmetric functions
5. Hook formula
6. Littlewood-Richardson rule
7. Murnaghan-Nakayama rule

5.1.2 Numerical linear algebra (August - November 2013)

Four projects, in groups of two or three:

1. Study of population growth and intrinsic growth rate.
2. Iterative methods for the eigenvalue problem.
3. Image compression.
4. Analysis of price fluctuations of financial stocks and construction of stock portfolios.

5.1.3 Numerical linear algebra (August - November 2012)

Four projects, in groups of two or three:

1. Google PageRank with stochastic matrix.
2. Cutting plane method of concave quadratic optimization.
3. Application of Least Squares Method in Regression Analysis
4. Integer programming explained through Gomory's cutting plane algorithm and column generation.

All the project reports can be found on the corresponding course webpages at `http://www.cmi.ac.in/~ksutar/teach.html`.

6 Teaching Feedback

6.1 Student comments

This is a sampling of student comments I received on the evaluations-

- "Enthusiatic, friendly, willing to help"
- "She was extremely helpful and very patient."
- "Thoroughly explains subject material...always on time.."
- "She was an excellent teacher who explained thoroughly and paced the course well."
- "She understands the material well and has no problem answering questions."
- "Willing to help, very organized class notes."
- "I really enjoyed the class. It was challenging, but because of the teacher's notes it was easier to understand."
- "One of my best math teachers. Really helpful when working one-on-one."
- "Clear notes on the board, willing to do multiple practice problems."
- "She provides lots of examples for every topic."
- "Very detailed and thorough."

6.2 Course evaluations

Here is a summary of the departmental teaching evaluations. The official copies of teaching evaluations are available upon request.

Course Name	*Semester*	*Overall*	*Preparation*	*Enthusiasm*	*Clarity*	*Methods*	*Examples*	*Answers*
MATHEMATICAL THINKING	Spring 2011	7.2	8.5	7.1	6.4	7.5	8.8	8.3
CALCULUS 3 FOR SCI/ENGR	Spring 2010	8.1	8.8	9.0	7.9	8.3	8.1	9.4
CALCULUS 2 FOR SCI/ENGR	Fall 2009	7.1	8.3	7.7	5.8	7.3	8.7	8.5
CALCULUS FOR BUSINESS/ECON	Spring 2009	7.1	8.3	7.5	7.3	7.4	8.5	8.9
CALCULUS FOR BUSINESS/ECON	Fall 2008	6.1	7.8	6.0	4.4	5.4	7.6	6.6
CALCULUS / DIFF EQNS FOR BIOLOGY 2	Fall 2007	5.2	6.3	5.3	5.1	5.8	7.4	6.2
CALCULUS / DIFF EQNS FOR BIOLOGY 2	Spring 2007	5.4	6.4	4.8	5.2	6.0	7.2	6.0
	Overall Avg.	6.6						