

Teaching Dossier

Manuela Girotti

Teaching experience at Concordia University (2010–2014)

As a consequence of the scholarships “Exemption MEQ” and “Concordia Merit award” (see résumé), some teaching duties were waived during my Ph.D.

Courses

- **Winter and Fall 2011:** for two consecutive semesters I was appointed as instructor for one of the sections of the (coordinated) course MATH 205 – Differential and Integral Calculus II. MATH 205 is an introductory course to integrals and series; the focus is set on applications, rather than on the theoretical aspect. I was responsible for the preparation of the mid-term exam, while the final was common throughout the sections.

Due to the tight schedule and the big quantity of material that needed to be covered, there was not enough time for engaging the students in discussion and exercises in class, but I was still trying to make the students involved in active participation to classes by asking them stimulating questions and asking their suggestions about ways to solve examples in class.

As a side remark, despite the fact that the topics of power series and Taylor series were placed at the very end of the course syllabus, I do believe that they are important Mathematical tools that a student in a Calculus course should acquire. Therefore, I still tried to allocate a reasonable amount of class hours to clearly explain the material and solve exercises in class.

- **Fall 2013:** during the Fall semester 2013 I conducted exercise sessions (1 hour per week for 13 weeks in total) for the (coordinated) course MATH 201 – Elementary Functions. MATH 201 is a course covering basic mathematical notions (composition of functions, inverse function, polynomials of second order, exponential and logarithmic function) and trigonometry.

In delivering exercise tutorials, I was carefully selecting examples that would highlight the mathematical theory behind and the different situations where the formulæ could be applied. At the beginning of class I would recall the main tools that were taught by the instructor during the week and that would have been used in the exercise session. This way the students could follow more easily the solving process.

Technical assistance

For two academic years (2012–2014) I have been responsible for the management of the online system WeBWorK for the assignments of the service courses MATH 200, 201, 202, 203, 204 and 205.

There were (approximately) bi-weekly meetings with the Undergraduate Program Director and the course coordinators, during which we were discussing a various range of topics about how to improve the learning curve of the students and implement it in the WeBWorK system.

Part of my duties was also to fix possible bugs in the systems and in the exercises (sometimes using the programming language Perl), set up the assignment load for all the courses at the beginning of each term and downloading grades to send to the instructor at the end of each term.

Teaching experience at Université catholique de Louvain (2014–2016)

The post-doc position at UC Louvain was funded through a European research grant (CRaMIS ERC grant) and a teaching activity was not allowed in my contract.

Mentoring and tutoring

Despite the aforementioned limitation, I was involved in mentoring activities: I posted a thesis (“mémoire de maîtrise”) proposal on Soliton theory and Integrable Systems for the master students in Mathematics, I gave my availability for mentoring undergraduate students for their final project and I gave private tutorial lessons in Probability and Statistics.

Teaching experience at Colorado State University (2017–2018)

The postdoc contract at Colorado State University included a teaching load of two courses per academic year (one per semester).

Courses

- **Spring 2017:** in the Spring semester 2017, I was the instructor of the non-coordinated course MATH 369 – Linear Algebra. MATH 369 is a proof-based introduction on the basic notions of Linear Algebra: linear systems, matrices, vector spaces, linear transformations, eigenvalues and eigenvectors.

Along the semester, students were asked to submit homeworks, pass one midterm test and a final exam, all prepared by myself. In order for them to better learn both the Linear Algebra theory and a general mathematical thinking and writing, I was posting detailed solutions of all the homeworks and the midterm, so that, by comparing their production with what was expected to be submitted, students could better understand what was incorrect or incomplete in their papers. This strategy turned out in a great payoff at the end of the semester, when students were capable of writing clear and structured proof in their finals.

I also introduced the practise of giving small quizzes (timed testing) along the semester that the students were asked to solve in class and that I would later grade. Quizzes were a useful tool for giving me an overall understanding of how much the class was following my lectures, but on the other hand they were discouraging students, because the limited time that was allowed (15 minutes) was putting too much pressure on them. Therefore, I decided to abandon this project for the courses in the following semesters.

- **Fall 2017:** during the Fall Semester 2017, I conducted a lecture course on Determinantal Point Processes and Random Matrices (MATH 676 – Topics in Mathematics), basing most of my lectures on research and survey papers.

The class was meeting once a week and the format was similar to an informal working group, where attendees (graduate students, postdocs and some professors) were welcome to ask questions and start active discussions during the lectures.

During the same semester, I was also the instructor of one section of the coordinated course MATH 317 – Advanced Calculus for one variable. MATH 317 is an advanced course mostly aimed at senior students majoring in Mathematics; the goals of the course are to review the main results of Calculus I and II with a deeper and more theoretical perspective: sequences, limits, continuity, derivatives and integrals, series.

The homeworks, two midterm tests and final exam were mostly created jointly with the professor in charge. I set up additional exercise sessions outside the class schedule whenever a midterm test or the final exam were approaching. The students highly benefitted from that and they actively participated in the meetings.

Since the textbook wasn't putting too much emphasis on some important analytical theories, like power series, I complemented the learning material with my own set of notes which were distributed it to the students and posted on Canvas as well as on my website. Some students (mostly students who wanted to continue their academic career in graduate school) gave me positive feedback on this practise.

- **Spring 2018:** in the Spring semester 2018, I was the instructor of the Honors course MATH 345 – Differential Equations (non-coordinated). MATH 345 is an intense course on introduction to Ordinary Differential Equations: it covers first and second order equations (techniques of integration), first order systems of equations, numerical methods, qualitative analysis.

The course testing consisted on two midterms, a set of homeworks and a final exams. Students were again provided with detailed solutions to the homeworks. For the lab sessions, I wrote complementary notes and exercises about numerical integration and the use of MATLAB for the study differential equations that were distributed to the students.

Instead of using the quiz practise as in MATH 369, I decided to dedicate one class per week to have an exercise session. This class was not a frontal lecture, but it was a flipped class: students were given a sheet with exercises (based on the theory explained in the previous days of class and recalled at the beginning of the exercise session) and they were first given a few minutes to think about the problem individually and independently and then asked to try to solve it by actively discussing together about its resolution. One volunteer student would then come to the board and write down the solution with the help of the other students in class. Given the small size of the class (about 12 students), there was no need to divide students into small work groups. Both these exercise sessions and the extra sessions in preparation for the tests were greatly appreciated by students.

- **Fall 2018:** in the Fall semester 2018, I was the instructor of the graduate course MATH 530 – Mathematics for Scientists and Engineers. It is a course aimed at graduate students from the Engineering Department, who are enrolled in the Mathematics Graduate Interdisciplinary Studies Program at Colorado State University. The goal of the course is to teach the students a working knowledge of the fundamental mathematical tools in linear algebra, ordinary differential equations and partial differential equations.

Being a graduate course, the lectures were fast-paced and all the student work was evaluated via weekly homeworks and a final take-home project. The aim was to accustom students to

an academic research environment where they are given time to think about the problem (but still with a submission deadline) and possibly collaborating in groups. In this way, they were able to explore different solving possibilities and research tools (with the use of the textbook and programming softwares) that could be useful to them for tackling the exercises or learning new techniques based on the theory seen in class.

Group collaborations for solving the homeworks was highly encouraged and many students benefitted a lot from that: their comprehension of the material and their exposition skills improved consistently along the semester.

Student supervision

In the Spring semester 2018, I supervised one of my students from the course MATH 345. MATH 345 allows students to conduct an honors project and gain an extra credit in their transcripts.

I gave the student a guided project where he had to analyze the Van Der Pol equation using the techniques seen in class (equilibrium points, phase space) and exploring some slightly more advanced techniques (perturbation methods and Levinson-Smith theorem for the existence of limit cycles). Since the student was majoring in Computer Science and Computational Mathematics, I also tailored the project to his main domain of specialization by adding a part of the project focused on numerical analysis and stability of numerical methods (stiffness).

We had regular meetings along the semester during which the student was reporting on his progresses and I would answer and clarify some doubts, if any. The student performed very well and greatly enjoyed facing and solving the challenges that this project was posing.

Teaching experience at CÉGEP John Abbott (2019)

Courses

- **Winter 2019:** I started teaching at John Abbott College in the middle of the winter semester to substitute a teacher on a parental leave. The courses taught were MATH-015 – Algebra&Trigonometry (one section) and MATH-NYB – Calculus II Science (two sections). During this period I strictly followed the instructions and the teaching style of the teacher in charge, in order to render the instructor transition as smooth as possible to the students.

Both of the courses last 15 weeks and the size of the classes are between 20 and 30 students.

The main goal of the course NYB – Calculus II Science is the introduction of the concept of integration (definite and indefinite integrals) and infinite series involving real-valued functions of one variable (including algebraic, trigonometric, inverse trigonometric, exponential, and logarithmic functions). The focus is exclusively on the applicative side, with emphasis on calculation techniques.

The course 015 – Algebra&Trigonometry is designed for students who need to review or relearn the basic skills in algebra and trigonometry, most notably polynomials, rational and radical functions, exponential and logarithms, trigonometric functions. The scope of the course is to prepare students to other Mathematics courses at the college level (Calculus I and II).

- **Fall 2019:** in the Fall semester 2019, I have been appointed as course instructor and coordinator for the same courses as the previous semester: MATH-015 Algebra&Trigonometry (one section) and MATH-NYB Calculus II (two sections).

I am responsible for the preparation of regular quizzes, weekly homeworks (set up on the WebWork platform) and four midterms for my sections. I am also part of the course committees who are responsible for the preparation of the Final exams, which is common throughout all the sections of the college.

The student of the Calculus course are already acquainted with the pre-university environment and they definitely show independence of study and high motivation to succeed in the course.

All these qualities are lacking in the majority of the students from the Algebra&Trigonometry course. In order to compensate with that, I set up weekly flipped classes session where students are actively engaging in (re)-learning the material explained in class the week before and deepening their understanding by solving a variety of exercises of increasing level of difficulty. I encourage them to discuss with each other and to not be afraid to ask for help from other peers or directly to me.

Additionally, at the beginning of each class I invite one student to come to the board to solve a simple problem related to the material seen in the previous class. This method has a double objective:

- it is a useful review of recently covered topics that will be used in the present class;
- it mildly forces the students to keep up with the material daily, so that they will be better prepared when a midterm exam is approaching.

Clearly, this approach can be implemented in the present situation, thanks to the small size of the class (about 20 students) and the friendly environment that I constantly aim at creating when teaching in class.

A (non-random) selection of students's comments

- Very well taught. Office hours were helpful when I could attend. [...] One of the best Math professors I've had. (MATH369)
- Manuela is a great teacher and is willing to help her students. The content of this class was very challenging but she was able to help me understand during office hours. (MATH369)
- This class is hard! [...] Lectures are educational though, instructor is good and answering questions. Homework is exceptionally challenging and graded harshly, but also educational and rewarding. (MATH369)
- Thanks for challenging us and making the course interesting! (MATH369)
- I enjoyed this class. The only thing I wish I got more from this class is understand the real world applications or why this is useful. But you're an awesome teacher! Thank you (MATH369)
- Thanks for pushing me to become a better mathematician. I can walk away from this class with a solid, basic understanding of Analysis. (MATH317)
- Thanks for improving and showing you care to be here. Thanks for a good semester! (MATH345)
- Dr. Girotti is one of the smartest, coolest professor I've ever had! She really cares that you understand what you are doing with differential equations (as long as you show that you are making the effort). (MATH345)
- Dr. Girotti was extremely helpful outside of class and was thoroughly enjoyable to have as a professor. Dr. Girotti, thank you for a challenging semester! I learned a lot of interesting and crazy things. (MATH345)
- You're a fantastic teacher and despite this being a difficult course you made the material approachable. I appreciate the balance of theory and practise and I definitely felt like I learned much more than I expected. (MATH345)
- I think the instructor did exceptionally well to cover an enormous topic of interest in just one semester of class. Partial differential equations in my opinion should be divided into two semesters in order for the engineering students to be properly adept in the topic. Nonetheless, the instructor did everything in her power to help enable us analyzing the heat and wave equations in a very organized manner. (MATH 530)
- Manuela was an excellent instructor throughout. Easily the best math teacher I've had. (MATH 530)
- Overall, I believe Manuela will be a good instructor, especially for math students. She was always willing to help and answer our questions. Always available for appointments and with much respect even towards our silly questions. (MATH 530)