

First Year Mathematics Repository Workshop

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1 Overview

In the workshop attendance were 24 participants, representing 12 Canadian universities: University of Alberta, University of Calgary, University of Victoria, University of Fraser Valley, Simon Fraser University, University of Regina, Mount Royal University, University of Manitoba, Queen’s University, University of Toronto Mississauga, University of Waterloo, and McMaster University.

The workshop was an important event within an ongoing National dialogue on the present and future of teaching first-year mathematics at Canadian universities. The dialogue, initiated by the workshop organizers [2], takes different forms: from informal meetings of colleagues from the same department to discussions and exchanges of ideas over social media; and from conducting surveys and writing academic papers to regional and national workshops and conferences. The workshop was built on, and informed by, the outcomes of the CMS Winter Meeting Education session in Waterloo, Ontario (9 December 2017) and the First Year University Mathematics Across Canada: Facts, Community and Vision conference at the Fields Institute in Toronto, Ontario (27-29 April 2018). The follow-up events are planned at the University of Alberta (3-5 May 2019) and the University of Toronto Mississauga (22-24 May 2020). For the summary of the conference at the Fields Institute please see [1].

The themes that were addressed in the plenary sessions, working groups and other activities related to the so-called “service courses,” perhaps best described as (often massive) courses offered by mathematics departments that serve students other than mathematics or statistics majors. ‘How do different institutions and different instructors find the balance between introducing a relatively complex math content and meeting the needs of the specific program that the course “services”?’ was the guiding question. More specifically, the workshop participants addressed the following questions:

1. What makes a math/stats service course program specific, and what are the challenges?
2. To what extent (if at all) are the service courses outcomes of the collaborations between the department of mathematics and/or statistics and another academic unit?
3. How do we address the diversity of the student populations within service courses?
4. What are the available learning resources for service courses?

The BIRS workshop also served as a crucial step in further promotion and development of The First Year Mathematics and Statistics Courses Repository, a resource supporting an ongoing national dialogue about

teaching first-year mathematics and statistics at Canadian universities.[3] This shareable dynamic online database contains extensive data, collected from mathematics instructors across the country, including course content, resource and technology used, learning outcomes, modes of delivery, connections with other courses, as well as informal descriptions of various practices in teaching these courses.

We were able to achieve our main goal to bring together a group of the university mathematics teaching practitioners from across Canada that shared their experiences, views, and approaches to teaching mathematics among themselves, but also with the broader community by critically reviewing data already contained in the repository, providing feedback on the content and functionality of the database, and contributing new content.

2 Workshop Activities and Discussion

The Banff workshop started on Friday, 8 February, in the afternoon. Although no formal activities were planned, the time was used for introductions and much needed socializing and informal conversations. As is well known (and thus was built into the workshop), many important discussions, exchanges of views and ideas, and building of foundations for future collaborations take place outside of the formal workshop/conference activities. The lounge in Corbett Hall, the fireplace area in particular, proved to be an ideal facilitator for this. Moreover, this informality encouraged openness and the depths of critique that were definitely embraced by the participants, who are weary of daily feeds of statements, documents, and views (mis)guided by university branding proclamations, public relations departments, and political correctness.

The workshop was built on the idea that each participant gets the opportunity to voice their opinion about any of the discussion topics and/or initiate discussion about any relevant new topic. This was achieved by structuring the workshop rather as an *experience* equally owned by each attendee than as a rigid schedule driven sequence of events. For us, as the organizers, it was particularly important to establish the atmosphere of the collegiality, mutual respect, and trust from the very beginning of our meeting. In our view, only in that kind of environment a group of the workshop participants as diverse as our group was could have an honest in depth discussion about the complex issue of teaching first year math courses. For example, the group included some of the leading Canadian post-secondary educators, but also some of the young faculty that are just at the beginning of their teaching careers. We are very proud of the fact that in the attendance we had the same number of the female and male colleagues. We represented Canadian post-secondary institutions *A Mari usque ad Mare*, and occasionally shared unflattering facts about some of our institutions' practices.

The true unifying factor for the group was our shared commitment to support our students in achieving their academic goals and to, by transferring our knowledge of and passion for mathematics to our students, meet our share of responsibility in ensuring that the next generation of scholars holds the torch of mathematics high.

The workshop activities were roughly divided in five categories:

- Plenary talks (3 hours)
- Plenary discussions (4 hours)
- Working groups' discussions (3 hours)
- Math showcase (1.5 hours)
- Social events including meals (10 hours)

The four working groups were as follows:

- Service courses for physical sciences and engineering students;
- Service courses for arts, humanities, social sciences, and business students;
- Service courses for mathematics education students;

- Service math and stats courses for life sciences students.

Each group had one or two *captains* assigned as moderators with the additional duty to provide a report about their working group discussion.

We are happy to report that each workshop participant fully participated in all segments of the workshop.

Instead of commenting on the workshop activities one-by-one, we present some major points that were discussed. Although service courses “service” thousands of students, they are not given the attention, nor resources that they deserve and need, by their home departments or faculties. (Some participants argued that there would be no math and stats departments without the money that the service courses earn.) Junior faculty and sessional instructors, who often teach such courses, are given large teaching loads (5 or up to 7 courses per academic year) with demands on their time that are so severe that they leave very little (or no) time for anything else. However, in spite of this, and with their work penetrating deep into their private and family lives, they innovate, experiment, and put energy into improving the courses they teach. Given extra time, we all could do a lot more – for instance, to have an informed design of a service course, we must communicate with the members of relevant departments across campus. This does not involve a couple of meetings, but rather a continuous effort.

The applications of mathematics and statistics taught in a service course need to be authentic to the students in order for the service course to have value. Needless to say, we are not assuming that a service course for life scientists will educate future researchers in mathematical biology, but can nevertheless bring the applications we study closer to reality. In presenting mathematical and statistical models in our courses, we need to be clear about the assumptions that were made, and about the limitations, both with regards to the situation modeled and the mathematical/ statistical tools used.

3 Presentation Highlights

Brian Forrest, University of Waterloo:

Things are changing in the math ed community across Canada, it is getting younger. Ph.D. students are becoming more and more serious about the teaching aspects of their education as graduate students.

Young research faculty are under heavy demands and are under pressure to focus on “research first and teaching second”.

At Waterloo a significant proportion of service courses are taught by Lecturers, many who are under contract, or post-docs or graduate students (who are not invested in development and innovation).

Gerda de Vries, University of Alberta:

What do/should/can we teach?

- We should have a much wider variety of courses rather than pumping everyone through Calculus.
- Perhaps more specialized courses on abstract mathematical thinking and reasoning.
- There is an expectation for more applied content in specialized calculus courses, yet also the expectation that these courses are interchangeable, leading to courses that are packed with content.

How do/should/can we teach?

- People are starting to experiment with different methods (like blended learning).

How do/should/can we assess?

- We need to get better at articulating what students need to be able to do when they come out of our courses.
- Institutions seem to be moving towards more frequent term assessments, and lower stakes final exams BUT more classes with more frequent assessments can lead to never ending assessments for students.
- There are interesting ways to do mark breakdowns or exam regulations to combat cheating on term work.

Kseniya Garschusk, University of the Fraser Valley, and Andie Burazin, University of Toronto Mississauga:

One definition of a service course is “any course that is included in a program in order to achieve the objectives of the program that is provided by a school other than the school that owns the program”.

Learning objectives should be a conversation and collaboration between those who need the course and those who teach the course. Ultimately, however, it is the math departments’ responsibility to design and deliver a math course.

Is it important to teach mathematics as a mental activity for critical thinking, or delivering only the mathematical content that is required?

- Both are important, both have value, both are intertwined.
- Too much focus on techniques can lose the focus on the concepts behind those techniques.

Who should teach the services courses?

- It depends on the person, and it depends who you ask.
- Traditional disciplinary boundaries are disappearing, reinforcing the need for communication.
- Some universities have actually hired ‘outside’ experts (like physicists or biologists) to teach service courses within the mathematics departments.
- We can lose credibility if our ‘application’ problems are not accurate with respect to their own discipline.
- We can standardize foundational material, and leave the rest flexible to context.
- Blended learning can be used to address the content vs concept dichotomy.

4 Outcome of the Meeting

Here is a brief summary of the main conclusions of the workshop:

- Math and Stats departments must pay lot more attention to their service courses.
- Service courses provide unique opportunities to teach mathematics that is interesting, exciting, and stimulating, and that addresses authentic life situations. This is where we are forced to re-think the mathematics content, to benefit not only service courses, but all math courses.
- Service courses are mostly taught by younger instructors; often they are on limited-term contracts or hold more permanent, but non-tenure track positions.
- Instructors teaching service courses bring huge amounts of enthusiasm and energy into their courses. They are willing to experiment with a variety of pedagogical approaches and technology (plenty of evidence to this presented at the workshop).
- A successful design of a service course requires continuous communication with faculty in all departments whose students will be taking the course. Course design is an intense, time-consuming process, and those involved in the design should be given time necessary to develop the course.

- Much-needed innovation in math and stats instruction happens in service courses! This is a major reason why math and stats departments across the country should pay more attention to these courses, as well place more resources (human and money) into them.
- For the reasons mentioned above and given the stigma that comes with the attribute “service,” it might be a good idea to find a more suitable name; for instance, to rename “service courses” into “mathematics and statistics courses,” and refer to their complement as “courses for mathematics and statistics majors.”

The next iteration of the national dialogue about teaching the first year math courses in Canada will be hosted by the University of Alberta, Edmonton, AB, between May 3-5, 2019. In 2020, the conference will be hosted by the University of Toronto Mississauga.

References

- [1] D. Barr, A. Burazin, K. Garaschuk, V. Jungić, and M. Lovrić M., First Year University Mathematics Across Canada: Facts, Community and Vision, *CMS Notes* **50(4)** (2018) 10–13
- [2] V. Jungić and M. Lovrić, Call for National Dialogue: The Present and Future of Teaching First Year Mathematics at Canadian Universities, *CMS Notes* **49(5)** (2017) 10–12
- [3] The First Year Mathematics and Statistics Courses Repository, [https:// firstyearmath.ca](https://firstyearmath.ca)