First Year Mathematics in Canada
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Future Directions

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Introduction

Thinking about the future, especially the somewhat distant future, is not easy. What will math textbooks look like 20 years from now? Will there be any textbooks left? How will students be learning mathematics in 2068? One working group at a recent CMESG (= Canadian Math Education Study Group) meeting in Squamish, British Columbia (June 1st-5th, 2018) had a task of imagining high school (and related university) mathematics curriculum for the 21st century. All kinds of things were discussed. Numerous ideas were written down on large pieces of paper and taped to the walls. As we were asked to read them all and reflect, we soon realized that all of these "innovative" ideas on the walls were 20th century ideas! Clearly, it is quite a challenge to imagine what the future will be like.

Nevertheless, we tried. The representatives of academic publishers Nelson Education and Pearson presented their views of the immediate future, which still very much looks like today. We are not at all sure exactly how good, imaginative, effective online math learning should look like.

Five-Minute Talks Report

During the April 2018 conference, 28 participants volunteered to give 5-minute talks about their teaching practices and experiences and possibly about plans for the immediate future following with a 1-minute question and answer session. The following is a report of the 5-minute talks. It highlights possible future directions when teaching or mentions teaching challenges that need to be addressed. We attempted to categorize the talks, but of course, it is rough attempt, for instance to those presenters whose themes span more than one category.

In the classroom, course structures, teaching techniques, teacher training

Parker Glynn-Adey (UofT Mississauga)
- Make space for discussion time with students in lecture
- Establishing dialogue in class: you do one example and have the students do another
- Survey the students to get a feel for your audience

Indy Lagu (Mount Royal)
- Language is important when communicating mathematics: "Do you have any questions?" versus "What are your questions?", "Show your work" versus "Provide evidence for your answer"
- Teach your students to behave as mathematicians on a level appropriate to them
- In smaller classrooms, have students work in random groups on whiteboards

Carmen Bruni (Waterloo)
- How do we train future instructors?
- Run a 12-week training seminar on teaching for graduate students

Alfonso Gracia-Saz (UofT)
- What flipped classroom is all about: present conceptual questions, give students individual time to think, collect answers, give time to peer discuss, collect answers again

Bernardo Sousa (UofT)
- Motivate math with magic
- Make it meaningful: create a pattern invariant under folds which leads to discussion on invariants

Darja Barr (Manitoba)
- Re-envisioning course structure: create a two track system where you slide from track A into track B if you fail a unit test and repeat the material; two fails are you're out
- Significantly reduced failure rates, increase in average GPA and decrease in math anxiety

Andrew Skelton (Guelph)
- Developing "outlier" courses: interdisciplinary topics, no prerequisites, rich area of exploration
- Inquiry based teaching: for each topic, explore, critique, improve it

Wes Maciejewski (San Jose)
- Create space and time to experience math
- Find comfort in uncertainty
- Make it ok to learn math

Kseniya Garaschuk (UFV)
- Teach students to read and write
- When teaching or giving assessment questions, respect the context

Assessments

Tarun Sheel (MUN)
- Are course objectives different in small classes versus large classes?
- What types of assessments should one use if the fail rate is 50% with perfect written assignment?

Michelle Davidson (Manitoba)
- Spread out the marks throughout the course to alleviate stress

- Introduce a variety of teaching techniques to reach more students

Jason Siefken (UofT)
- Find questions that balance mathematical depth yet present communication opportunities
- Make it count: grade questions for clarity of communication as well as correctness

Lauren DeDieu (Calgary)
- Create opportunities for students to practice writing: frequent writing assignments with lots of reflection e.g. "tell me how the class is going"
- Develop rubrics for clear expectations and marking criteria

Ilona Kletskin (UOIT)
- Frequent assessments, such as weekly quizzes, allow students to stay on track
- Informal office hours (Math Cafe) help build rapport with students

Students and their learning

Dan Wolczuk (Waterloo)
- The experiment has changed: what worked in high school won't work in university
- Create workshops to teach learning skills and strategies to students
- Teach the students how to play with math, how to study, when to ask "What if" questions, growth mindset, grit, failure is ok!

Gary Au (Saskatchewan)
- Give informal midterm course evaluations and discuss with the students how to implement changes
- Give reflective questions on exams such as 'Describe one math idea that you found helpful.' (do not tell the students ahead of time so that the responses are authentic)

Azar Shakoori (UOIT)
- Students who fail calculus are not motivated when taking the course for the second time
- Active learning techniques and engaging students does not seem to improve their interest in the course
- What can we do about course retention?

Randall Pyke (SFU)
- Give very detailed learning objectives so that students can use to study from and have a list of conceptual necessities
- Use learning objectives to guide sessionals in their teaching of the course

Fazle Chowdhury (U of T Scarborough)
- Six things to keep in mind: 1. Physiological problem (anxiety, etc), 2. Some just don't care. 3. Attention span. 4. They don't see the value. 5. Language. 6. Procrastination.

Vijay Singh (SFU)
- What motivates our students?
- Use personal examples to make connections

Zhaoyun Wang (U of T)
- What is intended, implemented and attained curriculum?
- Canadian high school curriculum has a lot more repetition from grade to grade than Chinese curriculum

Xiamei Jiang (U of T at Scarborough)
- What high school skills do students need to succeed in university?

Technology

John Craighead (MUN)
- Crowdmark (which $10 per student per term) to grade students' work

Louise Krmpotic (Maplesoft)
- Mobuis is a very interactive learning platform designed by Maplesoft that can be customized with videos, lecture notes, etc.

Patrick Walls (UBC)
- Use Jupyter platform to teach mathematical computing – currently available in K-12 in BC
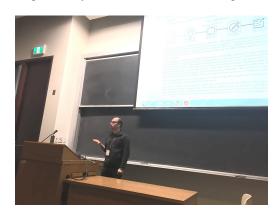
Spencer Snell (Western):
- Learning Catalytics from Pearson has some nice features

Rob Borgersen (Manitoba)
- Youcanbook.me (office hours scheduler) and socrative.com (cell phone alternative to clickers)

Cameron Morland (UWaterloo):
- Snap.berkeley.edu - do math versus living math

Future Directions

What exactly are some future directions? As commented in the introduction, that is hard to figure out. However, let's remind ourselves that we did arrive at a consensus through our DOTmocracy activity. In our view, the top five items are:

- Teaching materials should be open and free to all
- Active learning and how we can support instructors doing it
- Cooperation between departments when designing and imparting interdisciplinary courses
- Education will improve only when assessment does
- Are students mature enough to take courses as we plan them?

The next five on the list were:

- Numeracy
- Online homework: friend or foe?
- The high school curriculum is very narrow
- Students should learn how to write proofs in first year Linear Algebra courses
- Relationship between Computer Science and Mathematics at universities

What Next?

Reports from our conference will appear in the Fields Notes (likely in Fall 2018) and in the October 2018 issue of the CMS Notes. We will link these reports to our webpage https://firstyearmath.ca/

We are happy to announce that there will be a follow-up conference in April 2019 in Edmonton, Alberta. And, very likely, in April 2020 at the University of Toronto in Mississauga, Ontario.