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Education Notes bring mathematical and educational ideas forth to the CMS readership in a manner that promotes discussion of relevant topics including research, activities, issues, and noteworthy news items. Comments, suggestions, and submissions are welcome.

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Introduction

In the middle of the 2019-2020 school year, the COVID-19 pandemic hit Canada. By the end of March, most schools and universities had shut down in-person classes. Ongoing courses had to be transformed for online delivery almost overnight, and new courses that were starting in the spring were being taught online by instructors with little to no experience with this medium.

In light of this, it should come as no surprise that most of the discussions at the CMS COVID-19 Research and Education Meeting (CCREM), held between July 13th and 16th, focused on issues of remote teaching.

One of the sessions at this event was organized by Peter Taylor, and titled *When a Door Closes ... The Creative Fallout of the Pandemic.* The goal of this session was to discuss the changes made due to the pandemic that we would like to keep and develop as we move forward.

The speakers at this session included university instructors from multiple provinces who had gone through the unexpected transition to online teaching, university instructors with no online teaching experience, and, of course, the authors of this article: a Master's student who taught outreach online and an undergraduate student who was taking a remote course at the time.

In what follows, we present a snapshot of some of the discussions we had with our fellow speakers following this session. We hope this will serve as a time capsule recording some thoughts that we had prior to jumping into the new school year. What changed since then? Have our priorities shifted? How have our views on remote education changed with experience?

What we value in times of chaos

This pandemic is overwhelming. In addition to the stress it adds to everyday life, it forces us to collectively learn to employ technologies that many of us never (or rarely) have touched before 2020. The array of available technologies is bewildering, so we wanted to focus on keeping things simple for ourselves and our students. Below, we describe some of the priorities session presenters focused on preserving, and strategies they used to do so.

Mathematics

Of course, the priority in a mathematics classroom is to teach mathematics. We must not lose sight of that.

Community

How do we turn an online classroom into a learning community? In order for students to feel connected to each other, they must *do* something together. For this reason, group work is vital to give students a chance to collaborate with each other in the virtual "room". We discussed the merits of assigning the students to groups (it saves organizational time, students meet more people, they hear more diverse perspectives, and no one gets excluded) and of letting students choose their own groups (students feel more in control, can self-select whether to talk to others, and can form and reinforce connections with people they know they like). Allowing students to tackle components of a course that might be more stressful (such as presentations) together can further reinforce an atmosphere of mutual support.

The pandemic also exacerbates the importance of support systems for students outside the classroom, such as teaching assistants, student unions, counselling, and peer study groups. In addition, technologies that allow students to reach out directly to each other, such as the private chat function in a videoconference software, can also help the school environment feel more human.

In thinking about the kind of community we create for our students, we are also led to consider our own roles. Teachers set the tone for the class through their level of organization, flexibility, and approachability. Many teachers have a well-established persona, a face they feel comfortable presenting to their classes, and while this persona may work well in their usual classroom environment, the unfamiliar online setting can quickly throw it off. The gestures we are used to making do not come across over a webcam, the back-and-forth exchanges we are used to having with our students can all too easily become clunky and artificial, and our familiar toolkits of blackboards and chalk have been replaced with windows and keyboards. Many teachers must therefore revise the persona they present, which creates an uncertainty that can make us feel vulnerable. However, as Laurestine Bradford pointed out in her presentation [1], this vulnerability can be an asset, as it can make us more approachable and less intimidating, so that our discomfort can aid our students' comfort.

In the new medium, there are various means of engaging students in conversation in ways that we could not before. Margaret-Ellen Messinger and Andrijana Burazin, in their presentations [7, 2], described various benefits to both polling and chat functions in videoconferencing tools: students help each other out, you get a window into student thinking, and you get input from students who would ordinarily be quieter. How can we then import those functions into an in-person class?

Assessment

Despite the pandemic, we are required to evaluate students and give them grades. Without proctored exams, traditional testing is next to meaningless, and we are compelled to seek innovative assessment structures. Here are some ideas presented at the session:

- Designing test questions that require critically evaluating a problem or data, explaining reasoning, and synthesizing information in new ways. Of course, we must first teach these skills, before testing students on them.
- Including more presentations and long assignments in the course marking scheme.
- Replacing exams with a final project.

When it comes to incorporating student projects in a class, the pandemic has a specific silver lining, which we describe in the next section.

COVID-19 as an object of study

With regard to student projects centred on mathematical modelling, presenter France Caron noted that "the more relevant the topic, the greater the interest in capturing its complexity." [2] In this respect, the coronavirus presents a unique opportunity: we now have a topic that is highly relevant to all of our students. Indeed, we are seeing almost unprecedented popular interest in mathematical models, as we all scramble for mathematics to tell us how socially distant to be, whether it's okay to ride public transit, where to wear masks, when to wash them, and more. This opens the door to high student engagement in projects modelling COVID-19, which can touch on differential equations, agent-based simulation, probability, and numerous other mathematical concepts. It is a golden opportunity to show our students how and why math can be important to them.

But this opportunity will not last forever. As time goes on, students will grow tired of hearing about the pandemic, and these projects may lose their appeal. In what other ways can we make our classes relevant to our students' lives? Kseniya Garaschuk [6] talked about implementing more "just-in-time" teaching in her courses, by committing to include current events (pandemic related or not) as a way of making the course situated in time and space. Any topic the student personally cares about will provide ideal motivation for a modelling project.

As an aside: the authors of this report were used to developing activities whose value was "intrinsic" – which had a beautiful mathematical structure regardless of any real-world context. As such, we viewed COVID-19-based projects as anomalous, in that the extrinsic motivation was so massive as to eliminate the need for intrinsic interest. One of the presenters explained to us that in a modelling context, it is almost meaningless to distinguish intrinsic from extrinsic motivation. The goal of any modelling project is precisely the connection between the mathematics and application, and this connection to context must drive everything the modeler (or student) does. And, indeed, the fit of a well-made model has its own inherent beauty that is just as lovely as a beautiful theoretical problem.

In an ideal modelling project, the teacher will take something students already find important, and encourage them to use math to say something meaningful about it. They must also leave students enough space to make the project truly their own. However, students' personal goals and aspirations are as diverse as our students themselves. So, our big question about student modelling projects is: *How do you help students find something they care about, and find the math in it?*

Another approach to motivating mathematics through modelling projects is to embed the models in a larger story that is told over an extended period of time. Kseniya Garaschuk showed an example of such a story she described in [5]: mathematical tools get developed along with the story, and complexity of mathematical analysis is required by the increasing complexity of the questions that arise in a genuine context.

Storytelling in the time of COVID-19

Even outside of modelling projects, the presentation of course material can always benefit from good storytelling, which involves a clear overall structure, motivated transitions, and a point. This is more important now than ever. One presenter, Ed Doolittle [4], explained how having to stay indoors during the pandemic is similar to an Indigenous experience of winter – and winter, in this worldview, is a time to sit together and share stories.

That said, the distance between teachers and students offers special impediments to storytelling. Most notably, we can no longer see the people we are speaking to. Many teachers are used to watching certain particularly expressive students to gauge the audience, a technique which is now next to impossible. We also lose access to the underappreciated wealth of information that we gather from our less expressive students in the form of shuffling papers, whispers to neighbours, and glances at phones.

So, to tell stories these days, we must turn to modes of communication that do not rely on physical proximity to students. Such modes do exist; ever since the invention of cinema, people have been developing ways to tell good stories through pre-recorded videos, and in some cases have met with great success.

Fortunately, if we do not have time to become expert filmmakers, there are simpler ways of telling good stories at a long distance. Yuveshen Mooroogen described, in his presentation [8], his experience with taking a course via telephone, and how the "gossipy" flavour of the medium put him on equal footing with his instructor, allowing him to steer the conversation and the course towards areas he found interesting. Of course, this method does not generalize to arbitrarily large classes. We also find long-distance storytelling in books. If there is a textbook that does well at situating material in a good story, then the teacher can partly relinquish the storytelling duty, and spend valuable virtual class time in other ways, such as clarifying specific exercises.

In reality, the storytelling medium we choose is subordinate to the kind of story we want to tell. We mean this in two senses. First, the medium we should choose depends on what we want to say. Second, the choice of medium, whatever it is, is far less important than knowing what we want to say. When a class has a clear story and message, this can usually survive even awkward long-distance technologies; conversely, when a class does not have a clear story, it is easily derailed during this distracting time of pandemic. We come in this way to the following question: *What kinds of stories should we be telling our students?*

Conclusion

We hope that this snapshot of our CCREM experience will help the reader reflect on what they have learned from the past few months. As the fall draws to an end, we brace ourselves for the winter, armed with courage and imagination, but this time also with experience.

Acknowledgements

Laurestine (Lola) Bradford is a master's student in the Department of Linguistics at the University of Toronto, where she also completed a bachelor's degree in Mathematics and Philosophy. Lola has long been involved in math outreach and education. She hopes to study what ideas from language acquisition can tell us about how people learn mathematics.

Yuveshen (Yuve) Mooroogen is an undergraduate student at the University of Toronto. Ever since a particularly charismatic first-year course in analysis, he has been pursuing a degree in mathematics. Currently, he is interested in functional analysis and math education. Yuve believes that a compelling narrative is the backbone of any good learning experience.

References

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