

Kseniya Garaschuk and Veselin Jungic

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.

John McLoughlin, University of New Brunswick (johngm@unb.ca)
Kseniya Garaschuk, University of Fraser Valley (kseniya.garaschuk@ufv.ca)

Where are we now as a community of teaching practitioners? Can we anticipate what teaching will look like, for teachers and students, in the foreseeable future? The purpose of this note is to reflect on the post-secondary mathematics teaching community's recent experience and plans for remote teaching during the ongoing pandemic.

There is no doubt that our community's reaction to the pandemic has had several positive outcomes. Over the last several months, post-secondary mathematics instructors from coast to coast have come together to support each other. We have witnessed well-attended teaching related events ranging from multiple day conferences, to pan-Canadian seminars, to locally run seminars and ad-hoc events. Here are only a few examples of events that the authors of this note have been involved in as organizers and attendees:

- The CMS COVID-19 Research and Education Meeting (CCERM), July 13-16, 2020
- The First Year Mathematics and Statistics in Canada (FYMSiC) Online Meet Ups, a biweekly seminar series occurring in summer 2020
- The Teaching Matters Seminar series, a grassroots faculty-led initiative out of Simon Fraser University.

These three initiatives, obviously very distinct from each other, have a lot in common. Perhaps the most apparent commonality is the fact that they all attracted large audiences.

The panel discussion on the topic of contract cheating hosted by the SFU Teaching Matters Seminar attracted 300 (the capacity of the Zoom meeting room) post-secondary instructors from all across the country. In the words of one of the panelists, Dr. Sarah Eaton from the University of Calgary, "As far as I know, the webinar you organized was the largest event (virtual or otherwise) on academic misconduct in Canadian history."

FYMSiC Online Meet Ups are organized to focus specifically on topics of remote teaching and have attracted over 60 participants at every session, some attending from as far as Germany.

The presence of mathematical education and its presence at CMS meetings has grown over the past few years, but its importance and relevance has been greatly highlighted by COVID-19. The recent CMS COVID-19 Research and Education Meeting demonstrated that educational sessions, workshops, panels and discussions are a key part of the Canadian Mathematical community's interests as the majority of the 212 registrants came to attend educational events during this packed four-day virtual conference. Looking to the future, we hope that many of the aforementioned activities become regular events as we engage in a more consistent improvement of teaching practices. Specifically, we hope that educational sessions become a key part of each CMS meeting's organization and a component of faculty development.

The pandemic has highlighted that, although we may have different research interests and our jobs have more than one focus, our shared vocation is teaching. This pandemic has put a stop to status quo teaching as it is no longer physically possible. In turn, questioning and reconsidering the teaching process has resulted in previously unimaginable levels of interest into all components of teaching: from the class preparation to the creation of the learning resources to the course delivery to the critical rethinking of our learning assessment practices.

The main reason for this swarm activity is our collective wish to do whatever it takes to support our students. The well-being of our students and our responsibility to create a learning environment in which each student will get a fair chance to explore their talents and interests and gain necessary skills have been dominant themes in all of the conversations that we witnessed. The pandemic has showcased a real strength in our community and the commitment of mathematics faculty to provide our students with the best education possible, under any given circumstances.

Another reason is that as mathematicians we are by definition problem solvers. And we are facing a big problem: how do we, under the given circumstances, communicate both the big mathematical ideas and our own passion for our beloved subject to our students? How do we build meaningful relationships with our students and among our students in a virtual environment? How do we convince our students, without looking straight into their eyes and through one-on-one chats, that the learning of mathematics is necessary and of the utmost importance in this phase of their personal and academic lives? We are also united in our more practical fears and concerns: effectively running synchronous sessions, especially with large classes, dealing with student questions and potential technical issues; picking the "right"

platforms for facilitating learning, while not overwhelming students with all the different tools and technologies; working with students new to the university; establishing a sense of community and cultivating peer-to-peer and instructor-to-peer relationships; supporting students struggling academically or mentally; and, yes, developing and administering assessments online.

In the search for solutions, our teaching community (out of necessity but still somewhat spontaneously) has turned to methods and practices that characterize a common approach in mathematical research in recent years: the use of technology and community collaboration. Think of the Polymath Project, for example. Only half-jokingly do we call our current collective experience: The Polymath Teaching Project 1. Similar to the Polymath Project, the numerous initiatives are driven by the community's widespread interest and already existing high-level of the personal investment in the search for solutions by many individuals. Another similarity is the incredible amount of talent that we have seen among our, particularly younger, colleagues. Most importantly, the spirit of academic generosity in sharing resources, practices, knowledge, and ideas has been a common attitude across the board.

The crucial difference between *The Polymath Teaching Project* and its research counterpart is in the outcome that all of the involved are hoping for. *The Polymath Project 16*, for example, is looking into the problem of finding the chromatic number of the plane. We do not know if it is 5, or 6, or possibly 7, but we know that it is one of those three numbers. Contrary to this, one of the main objectives of our discussions about teaching university math courses in Canada in fall 2020 is to provide an array of only partially structured answers to the questions arising from the family of problems stated above. This way, each instructor, or a group of instructors from a particular department or school, will be able to apply and adjust commonly accepted principles to their own teaching styles and goals and their students' learning needs.

In the process of community collaboration, we have come upon an interesting juxtaposition and that is the process of personalization (from instructor's point of view) of teaching and learning in the Canadian postsecondary mathematical community. Re-using already existing resources appears to provide a natural solution to many of our problems. However, while we have witnessed rich discussions and idea sharing, it seems that nearly every instructor wants to create their own resources from scratch. A case in point is the most time-consuming online course component: asynchronous video recordings. Nearly every member of our community is or will be recording their own fall lectures.

A countless number of hours has been spent learning new technologies, making decisions about using the best software, purchasing the best recording devices, and choosing the best hosting platforms — with all of the strings attached. And this comes even before we started thinking about the best structure for our recordings. Suddenly, we are struggling with decisions such as: how long should our recordings be? should we go with the voiceover only or should we include our images there as well? should we write on the board or on a tablet? This will be followed by long hours of recording and editing. We are discovering that we often make mistakes and that we would say one thing and write another, for example. We are faced with painful dilemmas while watching our not-so-perfect recordings: to re-record or not to re-record, that is the question!

We have been eager to share what we have learned with our colleagues across the country. (Interestingly enough, we learned that Alice and Bob from the university three provinces over are recording their lectures as a dialogue between them. Maybe we should ask Carol, who is teaching another section of the same course that we teach, if we should we do something similar!) But one thing we have not done is to consider using existing lesson recordings, beautifully made and professionally edited by our colleagues. Although math is a universal language, it seems that each of us wants to teach it our own way, with our own idiosyncrasies, time-consuming and plagued with imperfections, but infused with our personalities. While online teaching offers many efficiencies, we want to see ourselves in our courses and we are willing to pay the price. It is reasonable to assume that our students will also be more engaged in our courses if they see those courses were specially made by their instructor, for them and with them in mind.

**CMS COVID-19 RESEARCH
AND EDUCATION MEETING**

VIRTUAL MEETING | JULY 13-16
CCREM20.CMS.MATH.CA

75
1945-2020

**CMS
SMC**

The recent CMS COVID-19 Research and Education Meeting demonstrated that educational sessions, workshops, panels and discussions are a key part of the Canadian Mathematical community's interests as the majority of the 212 registrants came to attend educational events during this packed four-day virtual conference. Looking to the future, we hope that many of the aforementioned activities become regular events as we engage in a more consistent improvement of teaching practices.

But what is that we really know about our students?

The authors of this note, as part of their preparation for the CMS COVID-19 Research and Education Meeting, had the privilege to talk to several incoming first-year students. We were more than impressed with these young people. The students, all of them 17-18 years old, presented themselves as thoughtful, hard-working and ambitious youth, but also as quite realistic, well-informed, and already engaged in some of the contemporary issues that our society faces. We are fully aware that we met with some of the best and the brightest former high schools that are out there. Still, the fact that many of them came from the public-school system and from schools that have been serving communities with their own sets of urban life challenges, gives us this hope that the next generation of the first-year students is capable to go successfully, with our help, through an important life transition.

For example, here is a message that the second author received recently from a former student:

Speaking honestly, this semester has been difficult for me. I find it much harder to schedule my time at home; I find myself more easily distracted by leisure activities when I can't attend classes in person. However, I have found live, synchronous lectures much easier to stay focused on than prerecorded lectures, probably because they always happen at a particular time of day (it's easier for me to schedule my studying when I know that a lecture will happen at 1:30, for example, as opposed to a recorded lecture which I tend to procrastinate watching.) In spite of these difficulties, I have been enjoying Calculus III and Linear Algebra this semester and am excited to see how these mathematical concepts will help me understand the material in MATH303 (assuming I do manage to get through the waitlist!)

At the July 27th FYMSiC session that served as a panel for high school teachers to share their experiences with the transition to remote teaching and learning, we heard the same sentiments passed down from their students. We have also heard similar concerns from students at the graduate level.

Staying focused and creating and maintaining an in-house school bubble may be a bigger challenge for many of our students, at any level of studies, than the academic challenges that we will present to them. Part of our preparation for teaching in the fall should be listening to students who are currently taking online courses. Part of our ongoing teaching practice in the fall should be conducting regular surveys about our courses: what components work, what can be improved, and what needs to be abolished. Those communications should serve as our reality checks.

This leads us to a recurring theme in the discussions among post-secondary math instructors: Do we teach mathematics, or do we teach students who study mathematics? Both of the authors of this note are strong believers in the latter. But what is it that we can realistically do in these remote-teaching-pandemic-driven circumstances to efficiently teach students? It seems that the community consensus is to create a safe environment for students and a supportive community, so that they can raise their academic and non-academic concerns with you, the instructor, and with their peers. Perhaps equally importantly, don't be afraid to share with your students, in a professional manner, your own imperfections and possible struggles addressing multiple unknowns brought forward by the pandemic.

Let us not forget that if the more experienced of us are struggling with the new normal, then those who are new to teaching will likely be under even more pressure. During the best of times, professional teaching development for our current and future teaching assistants has been scarce; in the current circumstances, this supporting teaching community is not just lacking the appropriate level of training and support to teach remotely, but also the clarity with what is expected from them by their institutions, course instructors, and students in the upcoming semester.

In this vein, the outcomes of our own teaching significantly depend on the work of the entire support system that consists of academic advisers, IT technicians, departmental secretaries and other supporting staff. We are still waiting to see any kind of proof that those colleagues are getting both the recognition for the work that they have done over the last several months and the substantial support to come in the upcoming months. Our own experiences this summer with the university teaching support staff have been very positive. Our requests for help from our librarians, technicians, course developers, and particularly our departmental administrators were resolved quickly and efficiently. The pandemic has put us physically apart, but it also has brought us, as colleagues, closer together.

But we also live in the shadow of some dark and stormy clouds.

The scariest of them is this huge, dark, ever-shape-changing body attached to the issues related to academic integrity. Since our last note, we learned about the existence and seeming omnipresence of the academic cheating industry. Suddenly, on top of all of our other worries we have a responsibility to try to protect our students from this predatory, hundreds of millions of dollars strong, international industry (for an extensive discussion of this topic please visit <https://canvas.sfu.ca/courses/14940/pages/tm-contract-cheating>). Our colleagues that are teaching this semester are telling us that we should educate our students and keep reminding them about the importance of academic integrity for their general well-being.

We need to spend more time thinking about how to de-motivate cheating, eliminating it at the root rather than dealing with its consequences. So, the first question to ask is why do students cheat in the first place? One framework we found useful was presented in the webinar organized by the Center for Teaching and Learning at the University of British Columbia (UBC):

1. Pressure/necessity: "Do I need to cheat?" When the grade depends heavily on high stakes exam(s), there seems to be no other way to succeed. Students fail to see that they can learn by actually going through the course materials (since they aren't worth much, so clearly the instructor doesn't think they are that important) and are more motivated to think that the risk is worth the reward. One way to fight this is to create an array of the frequent and low stake assessments.
2. Opportunity: "Is it easy to cheat?" In most practical terms, cheating takes time. Making questions more substantial, requiring explanations and discussion (such as stimulus questions) means you can't just ask a peer for "the answer". They will need the time to read someone else's and come up with a meaningful variation.
3. Rationalization: "Is it ok to cheat?" Students don't know what counts as cheating and a little help from the friends seems innocent to them. So, we need to explicitly educate them on it. Still this is not an ordinary 'If p , then q ' proposition, where p is "The instructors explains to her students that cheating on exams is bad for their academic growth" and q is "students do not cheat on exams." It is rather, as Frank Ramsey explained a hundred years ago, 'If p , q might result' or ' q would probably result'. Here the degree of probability is not a degree of our belief in 'Not- p or q ' (try it, it is logically equivalent to 'If p , then q ') but rather a degree of our belief in q given p . And our colleagues are telling us that it is quite reasonable (and maybe our only hope) to hold such a belief.
4. The second cloud that concerns us is the future of the general well-being of the members of our post-secondary teaching community. We have no doubt that as a group we have invested more hours in preparing for our fall courses than we would normally, possibly multiple times more. Still, deep inside, we know that this may be not quite enough for the challenge that we are facing and that we will, very possibly, have to be on our toes throughout the whole semester. Add to this that with their own children taking remote classes and their aging parents being more vulnerable than ever, our younger colleagues will have to stretch on a daily basis to manage serving as day care and in-home-schooling providers to elderly care providers to caring spousal partners to the responsible, well prepared, and focused university instructors. It sounds like too much and it is too much. We are worried that this mountain of commitments and responsibilities may negatively affect both the mental and physical health of many members of our community.

This combination of hard work, intense learning, critical hope, and justifiable fear that we, the authors of this note, share when we think about teaching in the upcoming semester reminds us about a statement attributed to Charles Darwin:

A mathematician is a blind man in a dark room looking for a black cat which is not there.

And you know what, Mr. Darwin? With the help of our students and our colleagues and a bit of luck, we will find the cat!