2023 CMS Online Education Meeting

PROGRAMME

Réunion d'éducation en ligne de la SMC 2023

November 25-26, 2023
25-26 novembre 2023
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<p>| 13:00 - 13:15 | Opening Remarks | 11:00 - 11:15 | Summary &amp; Opening Remarks |
| 13:15 - 14:45 | Francis Su | 11:15 - 12:45 | Cynthia Nicol |
| 13:15 - 14:45 | Education Plenary | 11:15 - 12:45 | Education Plenary |
| 14:45 - 15:00 | Break | 12:45 - 13:00 | Break |
| 15:00 - 15:25 | Session Block 1 | 13:00 - 13:25 | Session Block 3 |
| 15:30 - 15:55 | Session Block 2 | 13:30 - 14:00 | Session Block 4 |
| 15:55 - 16:30 | Break | 14:00 - 14:30 | Break |
| 16:30 - 17:30 | Lew Ludwig | 14:30 - 14:55 | Session Block 5 |
| 16:30 - 17:30 | Interactive Presentation | 14:30 - 14:55 | Session Block 5 |
| 17:30 - 18:00 | Discussion | 14:55 - 15:00 | Break |
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Introducing the 2023 CMS Online Education Meeting!

We are thrilled to announce the latest event organized by CMS. The 2023 CMS Online Education Meeting is designed to complement the in-person mathematics education sessions at the Summer and Winter CMS meetings. Attendees can expect an engaging experience, filled with plenary talks, thematic presentations, and ample time for discussion and comments. Join us for this exciting new opportunity in education.

The CMS Online Education Meeting is a new initiative that aims to expand the reach of our educational programs and make them more accessible to a wider audience. The online format allows us to bring together educators, researchers, and students from across Canada, who might not otherwise be able to attend our in-person events.

The 2023 CMS Online Education Meeting will feature a diverse range of topics, covering various aspects of mathematics education. The plenary talks will be delivered by leading experts in the field including Cynthia Nicol (UBC) and Francis Su (Harvey Mudd College), who will share their insights and perspectives on the latest trends and developments in mathematics education.

In addition to the plenary talks, the meeting will also include thematic presentations, where attendees can delve deeper into specific areas of interest and engage in lively discussions with their peers. The ample time provided for discussion and comments will allow for meaningful interaction and exchange of ideas, making the meeting a truly collaborative and enriching experience.

We look forward to welcoming you to the 2023 CMS Online Education Meeting and hope that you will take advantage of this unique opportunity to learn, share, and connect with fellow mathematics educators from across Canada.
Bienvenue à la réunion d'éducation en ligne 2023 de la SMC !

Nous sommes ravis d'annoncer le plus récent événement organisé par la SMC. La réunion d'éducation en ligne 2023 de la SMC est conçue pour compléter les sessions d'éducation en mathématiques en personne lors des réunions d'été et d'hiver de la SMC. Les participants peuvent s'attendre à une expérience engageante, remplie de conférences plénières, de présentations thématiques et de beaucoup de temps pour la discussion et les commentaires. Rejoignez-nous pour cette nouvelle opportunité passionnante dans le domaine de l'éducation.

La réunion éducative en ligne de la SMC est une nouvelle initiative qui vise à élargir la portée de nos programmes éducatifs et à les rendre plus accessibles à un public plus vaste. Le format en ligne nous permet de réunir des éducateurs, des chercheurs et des étudiants de partout au Canada, qui ne pourraient peut-être pas assister à nos événements en personne.

La réunion d'éducation en ligne 2023 de la SMC présentera une gamme variée de sujets, couvrant divers aspects de l'enseignement des mathématiques. Les conférences plénières seront données par des experts de premier plan dans le domaine, notamment Cynthia Nicol (UBC) et Francis Su (Harvey Mudd College), qui partageront leurs idées et leurs points de vue sur les dernières tendances et évolutions de l'enseignement des mathématiques.

Outre les conférences plénières, la réunion comprendra également des présentations thématiques, au cours desquelles les participants pourront approfondir des domaines d'intérêt spécifiques et participer à des discussions animées avec leurs pairs. Le temps consacré aux discussions et aux commentaires permettra une interaction et un échange d'idées significatifs, faisant de la réunion une expérience véritablement collaborative et enrichissante.

Nous nous réjouissons de vous accueillir à la Réunion d'éducation en ligne 2023 de la SMC et espérons que vous profiterez de cette occasion unique d'apprendre, de partager et d'établir des liens avec d'autres enseignants de mathématiques de partout au Canada.
PLENARY SPEAKERS

Francis Su
(Harvey Mudd College)

Francis Su is the Benediktsson-Karwa Professor of Mathematics at Harvey Mudd College and a past president of the Mathematical Association of America. In 2013, he received the Haimo Award, a nationwide teaching prize for college math faculty, and in 2018 he won the Halmos-Ford writing award. His work has been featured in Quanta Magazine, Wired, and The New York Times. His book Mathematics for Human Flourishing, winner of the 2021 Euler Book Prize, is an inclusive vision of what math is, who it’s for, and why anyone should learn it.

Cynthia Nicol
(University of British Columbia)

Cynthia is a mathematics educator and professor in the Faculty of Education at University of British Columbia (UBC) and holds the David Robitaille Professorship in Mathematics and Science Education. Her research includes exploring approaches to connecting math, community and culture for all students and especially for students in remote, rural and Indigenous communities.
ORATEURS PLÉNIERS

Francis Su
(Harvey Mudd College)

Francis Su est le professeur de mathématiques Benediktsson-Karwa au Harvey Mudd College et ancien président de la Mathematical Association of America. En 2013, il a reçu le prix Haimo, un prix national d'enseignement destiné aux professeurs de mathématiques des collèges, et en 2018, il a remporté le prix d'écriture Halmos-Ford. Son travail a été présenté dans Quanta Magazine, Wired et le New York Times. Son livre Mathematics for Human Flourishing, lauréat du prix du livre Euler 2021, est une vision inclusive de ce que sont les mathématiques, à qui elles servent et pourquoi tout le monde devrait les apprendre.

Cynthia Nicol
(University of British Columbia)

Cynthia est une enseignante en mathématiques et professeur à la faculté d'éducation de l'Université de Colombie-Britannique (UBC). Elle est titulaire de la chaire David Robitaille d'enseignement des mathématiques et des sciences. Ses recherches portent sur l'exploration d'approches permettant de relier les mathématiques, la communauté et la culture pour tous les élèves, et en particulier pour les élèves des communautés éloignées, rurales et autochtones.
Building Virtues, Not Just Skills
Francis Su (Harvey Mudd College)

Math is often thought of as a set of skills to master. While important, what often gets lost in the drive to master skills are the parts of math that make math enjoyable, that appeal to the deep human longings we have and build virtues that serve students well no matter what profession they enter. When an employer hires a math major, it’s usually not because they want someone who can compute speedily or factor a polynomial. What they want are people with certain virtues: curiosity, persistence, imagination, an ability to change perspectives, a competence to solve problems they’ve never seen before. I'll discuss how I've changed some of my practices to encourage the development of mathematical virtues, and how I assess them. Broadening the purposes of math in this way---towards human flourishing---allows more equitable opportunities to excite a larger number of students.

Reading and Writing the World with Mathematics: Pedagogies for learning that support the well-being of self, community and land.
Cynthia Nicol (University of British Columbia)

In this presentation I share perspectives on place/land and mathematics education for reading (interpreting/making sense of) and writing (transforming/enacting change in) the world. Pedagogical approaches including data feminism, Indigenous Storywork, and making will be shared and discussed.
Learning affordances of the Dihedral Calculator: A spatial-visual approach to groups
Ami Mamolo (Ontario Tech), Parker Glynn-Adey (Toronto Scarborough)

In this presentation, we discuss an innovative approach to teaching abstract algebra concepts via the use of tangible geometric models that encapsulate group theoretic concepts. Group Theory is often undergraduate students’ first experiences with abstract algebra and can pose significant challenges due to its abstract nature (Hazzan, 1999). Typical challenges experienced by learners include understanding the relationship between a group’s elements, its associated binary operation, its order, and its axioms (Dubinsky et al., 1994). In our research, we focus attention on a group theory activity in which learners explored dihedral symmetries through a tangible geometric model, The Dihedral Calculator. This approach has historical roots in the work of Felix Klein’s Erlangen Program and draws on mathematics education research which highlights the roles spatial visual reasoning can play in supporting structural and conceptual understanding (Mamolo, et al., 2015; Zazkis et al., 1996). Our findings suggest that tactile models, when designed as purposeful representational tools, can support a shift between process and object conceptions of group operations, which is essential for structural understanding of groups (Lee & Heid, 2018), and is a well-established challenge in abstract algebra (Dubinsky & McDonald, 2001).
Lessons from Fibonacci’s Liber Abaci - And What it Can Teach Us Today
Pamela Brittain (Fields)

Liber abaci, or the Book of Calculation, was Fibonacci’s attempt to bring mathematics from the Muslim world to Western Europe. This included the Hindu-Arabic numeral system and how to perform operations using place value. This was a huge difference from the Roman numeral system and how mathematical operations were being done at the time. The book was written as a textbook that broke down the algorithms and methods many of us in North America still use today. It is for this reason that I’d like to take a look at what the Liber abaci can teach us about where the math we use today comes from and how important it is for us, and our students, to understand how the algorithms and systems being used in most North American education systems (including all the “behind the scenes” work by calculators and computers) work. This talk will be somewhat informal with opportunities for discussion and reflection on not only how this math works, but the historical context it comes from.
Developing General-Purpose Software for Math Education: Ongoing Questions
Paulina Chin (Maplesoft)

In this presentation, I will share some of the challenges that I’ve encountered in two decades of developing and working with the Maple software package and more recently, the Maple Learn online environment. I will touch upon the following topics, along with solutions we’ve implemented and ongoing issues and questions.

- Parsing ambiguous math notation. Example: Is s(a+b) an application of function s or a multiplication?
- Determining the context in which calculations are done. Example: Should the square root of -2 return undefined or a complex value?
- Providing useful answers and steps without encouraging “cheating”.
- Generating content that is appropriate, or at least customizable, for educators and students around the world, who may use different languages, conventions, and notation.
- Separating the notions of “programming” and “math computation”. Is this separation always desirable?

Much of the work requires a balance between what is feasible and easy for the developer to implement and what educators actually want. I am hoping that presenting these challenges and open questions would lead to helpful discussions with educators about their needs.
Very Detailed Workbooks in Calculus
Paul Tsopmene (UBC Okanagan)

Problem-solving stands as the primary method for mastering calculus. As students work through problem solutions, they often encounter several challenges. Some may struggle to grasp the connection between theory and the solution, while others may find solutions unclear due to missing steps or insufficient explanations. Weak algebra skills can also pose difficulties. Many agree that the latter issue is one of the main reasons behind students’ struggles with calculus. In response to these challenges, I have developed workbooks for Calculus I and II, incorporating specific features that I will present in this talk. Additionally, I will discuss a teaching approach associated with my workbooks.
The Impact of Multiple Problem Set Resubmissions in Proofs
Sarah Mayes-Tang (Toronto)

Classes Students had the opportunity to receive multiple rounds of feedback on their proof-based problem sets in second-and third-year courses for math majors. In this talk, I will discuss the impact of these policies on the students’ grades, on their attitudes towards mathematics, and on how they received the class. I will also address how the teaching team was able to make a policy like this happen in large classes of more than 150 students.
Arguments for a more explicit introduction of the history of mathematics in mathematics education coming from high school teachers
David Guillemette (UQAM)

In this communication, we will present an overview of a study that seeks to better understand the contribution of the historical and cultural dimension of mathematics in the context of the secondary school mathematics teaching. Many researchers have underlined the important support that the history of mathematics can bring to the epistemological, didactical and pedagogical reflection of teachers and to the development of tools for teaching practices. In this perspective, we have set the following research objectives: (1) to document the epistemological, didactic and pedagogical reflections of secondary school teachers on the relation between the historical and cultural dimension of mathematics and the teaching of mathematics, (2) to describe the way they engage in the development of didactic and pedagogical tools (3) describe the constraints and teaching issues experienced or apprehended. A participatory approach in research led us to organize meetings with a group of four secondary school teachers. These meetings were aiming at jointly develop teaching tools for the classroom in connection with the history of mathematics. This production was supported by both the productions and conceptual advances from research and the “practiced knowledge” of the participating teachers. As the study is still ongoing, we will focus, in this communication, on some preliminary results about arguments that were developed by the participants that support the explicit introduction of the history of mathematics in mathematics education.
Lights-Out Mathematics: Helping Students with Aphantasia on Visualization Concepts
Yuliya Nesterova (Carleton)

Aphantasia is the inability to form mental images. According to recent data, it affects 3% of the world's population. And yet, vector calculus, linear algebra — even statistics, with its corrections for continuity and hypothesis tests errors — all rely on students' visualization abilities. In the absence of any identifying test, how do we ensure students master the visual topics and how do we differentiate between an underdeveloped sense of visualization and a physical inability to do so? This talk outlines some differentiating tasks and some paths forward in providing those with aphantasia with the full cornucopia of mathematical thinking. These are the results of a self-directed study taken in summer 2021.
Why should math educators care about what is happening in numeracy education research?
Taras Gula (George Brown), Miroslav Lovric (McMaster)

Numeracy is often dismissed as math-lite and not useful to mathematicians and math educators. The term ‘numeracy’ is used interchangeably with Quantitative Reasoning (QR), Quantitative Literacy (QL) and Mathematics Literacy (ML) which does not help educators figure out just what it is that we’re supposed to help students be good at when teaching numeracy. In this session we will make the case for numeracy (along with QR, QL, ML) tasks as distinct from (or a distinct form of) mathematics tasks (and distinct from word problems and mathematical modelling) by focusing the discussion on what each is about. We will show that the thinking process that quality numeracy tasks require (i.e., transfer from concrete to abstract thinking spaces and back) is important to those studying how to strengthen student work with ‘word problem’ solving and mathematical modelling (for instance in ‘service’ mathematics courses). Finally, we will attempt to make the case for numeracy tasks and their distinctness in that they inspire the use of mathematics without being about the mathematics.
Teaching differential equations in a modeling first and throughout context
Brian Winkel (SIMIODE)

We engage attendees in seeing how the mathematics of differential equations can be taught in a modeling upfront approach using Modeling Scenarios from the set of hundreds of FREE teaching resources found in the non-profit Community of Practice of SIMIODE – Systemic Initiative for Modeling Investigations and Opportunities with Differential Equations. We will describe both elementary and advanced modeling materials such as modeling an oil slick, the length of time for an ant to build a tunnel of length x, drug absorption, sublimation of carbon dioxide, intraocular eye model dissipation, and falling column of water with an emphasis on the full modeling cycle to include data analysis and parameter estimation. All the resources and much more will come from the free online community of SIMIODE found at https://qubeshub.org/community/groups/simiode. We shall give an overview of all the resources freely available, most of which are readily downloadable and customizable.
Three Puzzles for Your First Outreach to an Elementary School

Gordon Hamilton (MathPickle.com, Mathematics Council Alberta Teachers Association)

Most mathematicians seeking to do K-12 outreach believe that their best bet is in high school. This is usually wrong. Working with elementary schools you will find students who are inquisitive, teachers who are open to collaboration and a curriculum that is more flexible than in high school. This presentation will highlight three mathematically joyous activities that you can use to engage a wide spectrum of elementary school students. These three puzzles have pedagogic advantages over standard puzzles in that their difficulty can be dialed up or down in a single sentence. The teachers you work with will find this very useful. You will also like the three puzzles because you'll struggle just as much as the kids when you dial-up the difficulty. The three puzzles will be from the book The Infinite Pickle which can be downloaded for free on MathPickle.com.
Lessons from Social Media: Crafting Engaging Math Stories
Trefor Bazett (Victoria)

Many students turn to social media like YouTube as part of their learning behaviours. What “engaging” means in the context of social media can sometimes be quite different than what we would mean in a physical classroom. As a math education YouTuber, my goal with this talk is to share the biggest lessons learned from doing social media that I’ve incorporated back into my practice as a math professor. For instance, a compelling story with a great visual hook can dramatically increase engagement on social media and help propel a math video to hundreds of thousands of views (or more!). The key question then is what elements of this storytelling can be translated back to the classroom to keep our in person students engaged and learning effectively?"
What do students learn from conducting programming-based mathematical investigations? What kind of investigations work best?

Chantal Buteau (Brock)

In this presentation, I will discuss students’ learning in an implementation at Brock University, through its Mathematics Integrated with Computers and Applications (MICA) I-II-III courses, in which mathematics majors and future mathematics teachers engage in using programming for pure and applied mathematics investigation projects (up to 14 in total) (Buteau et al., 2015). I will first illustrate a few students’ investigation projects from this 20-year-old implementation and will then discuss results from our research on students’ learning, mainly focusing on a recent exploratory study (Broley et al., 2022) that examined the kind of investigation projects that may be most effective, and ways by which they may be effective (e.g., what kind of knowledge is learned).
Martin Gardner et la question du réalisme
Frédéric Morneau-Guérin (TÉLUQ)

Le célèbre vulgarisateur mathématique Martin Gardner a eu un impact non négligeable sur les mathématiques dans la seconde moitié du 20e siècle. Sa rubrique Mathematical Games, publiée mensuellement pendant 25 ans dans les pages du magazine Scientific American, et a été lue avec avidité par la génération de mathématiciens et de physiciens qui a grandi entre 1956 et 1981 et par de nombreuses autres générations depuis lors, suscitant au passage de nombreuses vocations. L’objectif de cette présentation est de remettre en question certaines des interprétations de la pensée de Gardner dans le domaine de la philosophie des mathématiques. L’idée fondamentale qui sous-tend cette présentation est qu’en offrant un portrait plus juste (et moins caricatural) de la pensée et des thèses de celui qui est décrit comme un adhérent à une version rigoriste du réalisme mathématique ayant néanmoins fait montre de tendances formalistes, on est susceptible d’encourager de nouvelles générations de jeunes lecteurs sur une voie royale menant à la philosophie des mathématiques.
Exploring the Link Between Math Anxiety and testing strategies
Ahad Moosa (York), Nadya Askaripour (Toronto Mississauga)

In this presentation, we delve into the intriguing connection between testing and math anxiety, particularly within the realm of first-year mathematical proof courses. We address a perplexing phenomenon where test outcomes appear to inadequately mirror students' actual abilities and competencies. Drawing from our own observations, we dissect instances where test results belie students' true aptitudes. A significant portion of the presentation is dedicated to an in-depth exploration of math anxiety, a phenomenon that can profoundly impact students' mathematical performance. By delving into research findings, we illuminate the intricate web of causality between math anxiety and performance on tests. With a special focus on math test anxiety, we uncover the multifaceted ways in which anxiety can distort cognitive processes, thereby influencing test outcomes. Amidst the challenges posed by math anxiety, we present a spectrum of strategies that have shown promise in mitigating its effects. These strategies encompass pedagogical, psychological, and cognitive dimensions, highlighting their potential to alleviate the detrimental impact of math anxiety on test performance. Moreover, we highlight the need for further research in this domain, underscoring unexplored avenues that hold promise for enhancing our understanding of the complex interplay between testing, math anxiety, and student achievement.
Introduction to ODEs with climate change models: Linking 2nd year math students to the climate crisis
Rebecca C. Tyson (UBC Okanagan), Sarah Wyse (UBC Okanagan)

Climate change is the most pressing problem of our time, and in order to address the crisis we need "all hands on deck", including mathematics students. Standard 2nd year courses in ODEs generally contain little to no real climate change content, but, as it is a first course in modelling, we decided that meaningful climate-ODEs content could be created. We created a series of group work projects that related climate change models to the course content in a standard second-year Introduction to ODEs course. In this talk, we present the learning goals for the new content, and outline the group work projects we developed. In addition, we discuss challenges encountered in introducing the content, and student responses to the group work projects. We close with some thoughts for future implementation of climate change content in second year ODEs.
Leading a Math Circle is a Walk in the Park
Zack Wolske (Waterloo)

A math circle is a space for young mathematicians - or people who may not see themselves as mathematicians - to collaboratively participate in mathematical practices: looking for patterns, making conjectures, finding counterexamples, creating definitions and constructing proofs. Like any mathematical investigation, it can be hard to tell where it will lead or to give a precise plan at the outset. I will describe my planning and leading process in analogy with an activity I believe many mathematicians enjoy: going for a walk in the park. I hope this will inspire you to lead (and enjoy) a math circle session in this style.
Yes, It Blends!
Diana Skrzydlo (Waterloo)

A follow-up to a previous presentation entitled “Will It Blend? Experiences in a Flipped Classroom”, this talk will discuss lessons learned from developing and teaching a flipped course. Like many instructors, during the pandemic I discovered many advantages with online teaching, although I missed the classroom interactions. Since returning in person, I wanted to keep the best of both worlds and so I fully flipped my course, STAT 334 in both Fall 2022 and Spring 2023. Lecture material was delivered asynchronously via videos and the reduced in-class time prioritized active learning and formative assessment. Now that I’ve done it twice, I will share ideas (from my own course and others’) about ensuring student accountability to the material, getting buy-in from students, scheduling options, and the support that is available for teaching in this modality.
A Diagnostic Tool that Scales Student Voice through Semi-Automated Text Analysis and Qualitative Clustering
Connor Gregor (McMaster), Caroline Junkins (McMaster), Lindsey Daniels (UBC)

In an academic setting, a diagnostic tool can be used to measure student mastery of prerequisite skills and preparedness for a given course. We propose a framework for a diagnostic tool, which when coupled with an academic subject attitude survey, provides a comprehensive snapshot of the student cohort. The tool pairs multiple choice questions with "Explain your Reasoning" text prompts aimed at generating more nuanced insights into student thinking. We begin by qualitatively analyzing a subset of responses and identifying multiple dimensions of student voice. A supervised machine learning model permits this analysis to be scaled at a fixed cost. These insights can be communicated back to individual students, but need to be summarized and interpreted in order to be actionable for instructors; this is particularly vital for large enrollment courses. Using data clustering algorithms, trends can be identified, visualized, and communicated back to instructors. This feedback offers instructors a more nuanced view of their student cohort and facilitates engagement with the diverse voices in their classroom.
Strategies for Active Learning in Math Classrooms
Jeremy Chiu (Langara)

Problems arising in biology and business are presented, along with simple math models. The audience is encouraged to develop their own equations to model the problems. By the end of this workshop, the audience may create their own mini-math lesson.