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# CMS NOTES de la SMC

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CMS NOTES

## What is the probability of a horse?

Cover Article October 2024 (Vol. 56, No. 5)

**Liam Watson** (University of British Columbia)
*Director VP - Pacific*

Here is a story that I heard second hand: A math inquiry was redirected to the shared phone in our graduate office space. The caller was interested in the probability that his daughter and her newly-acquired horse might share the same birthday. More precisely (or, actually, considerably *less* precisely) the caller wanted some measure of a bad omen, he being convinced that this coincidence of birthdays was a bad omen and his daughter not. This call, made with the intention of quickly settling the matter via expert consult, took much longer than it was meant to. For one thing, it was difficult to convey that a clear definition for "bad omen" is really tricky to pin down. And further, that this lack of definition places mathematical tools somewhat out of arms reach. I am not sure if it is good luck or bad that the student who picked up the phone was studying category theory. But it only improves the story as far as I am concerned.

Even if it didn't happen exactly this way, I love this story. It perfectly captures a certain mismatch between what a mathematician does and what one might imagine they could be doing. There is a whimsical element to it that, if I am being honest, I wish were a little more true about the day-to-day of my job. More and more I find myself noticing the gap between what I thought I was getting into versus what I actually do, most of the time, for a living. And this is not to say that that general feeling is particular to academia; I recently read that burnout might best be defined as a mismatch between expectations and reality in one's workplace. That is worth considering and, for anyone trying to understand burnout, Jonathan Malesic's *The End of Burnout* is certainly worth reading.

Of course people don't really call landlines anymore—that is what email is for—though like nearly everyone, I expect, my email inbox has become a near-useless space of loosely triaged items where only the hottest-burning fires receive attention. And I have learned that an effort to really combat the problem only makes it worse, as observed and interrogated in Oliver Burkeman's alt-treatise on time management *Four Thousand Weeks*. In particular, responding to email generates more email. (It may do other things too, but this is the only outcome that is guaranteed.)

I should note, or I suppose admit, that email is on its way out. For better or worse, change is what happens. My emails from students read more and more like text messages—complete with emojis and typos. I am also learning that some of my colleagues have if far worse: The number of this-information-was-aready-provided-to-you requests (including, but not limited to, deadlines and exam locations) appear far higher for instructors from traditionally under-represented groups. While this suggests I can't really complain, it also suggests that I *should* complain in the hopes that said colleagues get some of their valuable time back.

A move towards more forums that emulate social media spaces would be worse; perhaps even irresponsible. Students have their attention pulled in too many directions as it is and, on top of that, the negative health impacts of social media seem very real. There is an inherently social dimension to what mathematicians do that I am not convinced is enhanced by drawing on or incorporating social media tools. At the very least, we need to make our transition to the next thing thoughtful and deliberate. Students need fewer digital points of contact and instructors need fewer queries from said points of contact. Amazingly, the problem appears to be the same on both sides: Meaningful blocks of time need to be re-captured in order to get back to the straightforward (if challenging) matter of doing the work of learning and teaching.

What made me reflect on this? I received a great email that I probably can't take the time to respond to. And the problem is that there is a really short answer, but I can't think of how to provide it so that I don't come off as an arrogant resident of the ivory tower. I'm being asked to settle a debate, appealing to my expertise in topology, but the real answer is that the problem is not well posed. In the case at hand, *topological* is being used, loosely, as an an adjective without any real definitions in sight. Which would be fine, except that depending on the definitions either side of the argument comes out on top. I know I am overthinking this one; it is easier to delete an email than to hang up a phone mid-call, after all.

I am regularly reminded by those non-mathematicians close to me that real life does not move purposefully from careful definitions towards clear solutions. While mathematics can support critical thinking it is too much to expect that mathematical tools might clear up the messiness of day-to-day life. Given this, both queries to settle arguments and requests for already-provided information seem misdirected—and perhaps this is a place where a better understanding of what a mathematician does might help. Or maybe it is more important to think about how to encourage, or even require, more thoughtful communication from our students. Given that this is clearly a media-independent problem, it is something that is going to require more serious thought. Right after I deal with some of this other email.

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**Canadian Mathematical Society** — 616 Cooper St., Ottawa, ON K1R 5J2, Canada

# Quelle est la probabilité d'un cheval ?

Article de couverture
Octobre 2024 (tome 56, no. 5)

**Liam Watson** (University of British Columbia)
*Director VP - Pacific*

Voici une histoire qui m'a été racontée : une demande mathématique avait été redirigée vers le téléphone commun de notre bureau des diplômés. L'appelant s'intéressait à la probablement que sa fille et son nouveau cheval partagent la même date d'anniversaire. Plus précisément (ou, en fait, beaucoup *moins* précisément), l'appelant voulait connaître la mesure d'un mauvais présage, étant convaincu que cette coïncidence d'anniversaires était un mauvais présage et que sa fille ne l'était pas. Cet appel, effectué dans l'intention de régler rapidement la question par le biais d'une consultation d'experts, a pris beaucoup plus de temps que prévu. D'une part, il a été difficile de faire comprendre qu'une définition claire de « mauvais présage » est vraiment délicate à établir. D'autre part, cette absence de définition met les outils mathématiques quelque peu hors de portée. Je ne sais pas si le fait que l'étudiant qui a décroché le téléphone étudiait la théorie des catégories est une chance ou une malchance. Mais en ce qui me concerne, cela ne fait qu'améliorer l'histoire.

Même si les choses ne se sont pas passées exactement de cette manière, j'adore cette histoire. Elle illustre parfaitement un certain décalage entre ce que fait un mathématicien et ce que l'on pourrait imaginer qu'il fasse. Elle comporte un élément fantaisiste que, pour être honnête, j'aimerais retrouver un peu plus dans le quotidien de mon travail. De plus en plus, je remarque l'écart entre ce que je pensais faire et ce que je fais réellement, la plupart du temps, pour gagner ma vie. Et cela ne veut pas dire que ce sentiment général est propre au monde universitaire ; j'ai lu récemment que l'épuisement professionnel pourrait être mieux défini comme une inadéquation entre les attentes et la réalité dans son lieu de travail. Cela vaut la peine d'y réfléchir et, pour tous ceux qui essaient de comprendre l'épuisement professionnel, l'ouvrage de Jonathan Malesic, *The End of Burnout*, vaut certainement la peine d'être lu.

Bien sûr, les gens n'appellent plus vraiment les téléphones fixes – c'est à cela que sert le courrier électronique – mais comme presque tout le monde, je suppose, ma boîte de réception est devenue un espace presque inutile d'éléments vaguement triés où seuls les feux les plus brûlants reçoivent de l'attention. Et j'ai appris qu'un effort pour vraiment combattre le problème ne fait que l'aggraver, comme l'observe et l'interroge Oliver Burkeman dans son traité sur la gestion du temps *Four Thousand Weeks*. En particulier, répondre aux courriels génère davantage de courriels. (Il se peut qu'il y ait d'autres effets, mais c'est le seul résultat qui soit garanti).

Je dois noter, ou plutôt admettre, que le courrier électronique est en voie de disparition. Pour le meilleur ou pour le pire, c'est le changement qui se produit. Les courriels que m'envoient mes étudiants ressemblent de plus en plus à des SMS, avec des emojis et des fautes de frappe. J'apprends également que certains de mes collègues ont connu bien pire : le nombre de demandes d'informations (y compris, mais sans s'y limiter, les dates limites et les lieux d'examen) semble beaucoup plus élevé chez les instructeurs issus de groupes traditionnellement sous-représentés. Si cela suggère que je ne peux pas vraiment me plaindre, cela suggère également que je *devrais* me plaindre dans l'espoir que ces collègues récupèrent un peu de leur temps précieux.

Une évolution vers davantage de forums imitant les espaces de médias sociaux serait pire, voire irresponsable. L'attention des étudiants est déjà trop sollicitée et, en plus, les effets négatifs des médias sociaux sur la santé semblent très réels. Le travail des mathématiciens comporte une dimension sociale inhérente dont je ne suis pas convaincu de l'amélioration par l'utilisation ou l'incorporation d'outils de médias sociaux. À tout le moins, nous devons faire en sorte que notre transition vers la prochaine chose soit réfléchie et délibérée. Les étudiants ont besoin de moins de points de contact numériques et les instructeurs ont besoin de moins de requêtes de la part de ces points de contact. Étonnamment, le problème semble être le même des deux côtés : des blocs de temps significatifs doivent être récupérés afin de revenir à la question simple (bien que difficile) de faire le travail d'apprentissage et d'enseignement.

Qu'est-ce qui m'a amené à réfléchir à cela? J'ai reçu un excellent courriel auquel je ne prendrai probablement pas le temps de répondre. Le problème, c'est qu'il y a une réponse vraiment courte, mais je ne sais pas comment la donner pour ne pas passer pour un résident arrogant de la tour d'ivoire. On me demande de trancher un débat en faisant appel à mon expertise en topologie, mais la vraie réponse est que le problème n'est pas bien posé. Dans le cas en question, le mot « topologique » est utilisé, de manière vague, comme un adjectif sans qu'il y ait de véritables définitions en vue. Ce qui serait très bien, sauf qu'en fonction des définitions, l'un ou l'autre côté de l'argument l'emporte. Je sais que je réfléchis trop à cette question; après tout, il est plus facile d'effacer un courriel que je raccrocher le téléphone en plein milieu d'un appel.

Les non-mathématiciens qui m'entourent me rappellent régulièrement que la vie réelle n'évolue pas délibérément de définitions minutieuses vers des solutions claires. Si les mathématiques peuvent soutenir la pensée critique, on ne peut pas s'attendre à ce que les outils mathématiques puissent clarifier le désordre de la vie quotidienne. Dans ces conditions, les demandes de règlement des différends et les demandes d'informations déjà fournies semblent mal orientées – et c'est peut-être là qu'une meilleure compréhension du travail d'un mathématicien pourrait s'avérer utile. Ou peut-être est-il plus important de réfléchir à la manière d'encourager, voir d'exiger, une communication plus réfléchie de la part de nos étudiants. Étant donné qu'il s'agit clairement d'un problème indépendant des médias, il faudra y réfléchir plus sérieusement. Juste après avoir traité une partie de cet autre courriel.

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CMS NOTES

## On Contests

Editorial October 2024 (Vol. 56, No. 5)

**Robert Dawson** (Saint Mary's University)
*Editor, CMS Notes*

Earlier this month I was attending a regional undergraduate conference, at Acadia University. The Science Atlantic Math/Stats/CS conference has been running for almost fifty years now, cycling around most of the region's universities on about a ten-year cycle: and I've been involved in most of those years.

For its first decades, what's now Science Atlantic was called "APICS" (the "Atlantic Provinces Interuniversity Committee on the Sciences"), and the math and stats group didn't always share an event with computer science. But it's still recognizably the same event that I first went to, as a first-year undergraduate student on the Dalhousie problem-solving team. I think the late Jon Borwein was driving the minibus. I'm still involved with that contest in most years, though these days I'm helping set the questions. There have been a few changes over the years: most notably, the two-person teams actually work together, collaborating on a single set of answers. Back in the day, each of the two team members would find, or try to find, their own set of solutions. They'd be graded independently, and then, after grading, the two scores would be added together. Around the time of the change, we observed that the students seemed to enjoy the team format more. So much time has passed now, of course, that we don't have a valid comparison, but I think it's still true. Also, it's a nice contrast to the Putnam, which, sticking to a winning formula, has changed very little (except for the creation of the Elizabeth Lowell Putnam Award) since its early days.

One of the things I learned when I came back as a faculty member was how much work goes on behind the scenes to make it all happen! Those contest answers get shuffled into heaps, one grader for each of eight questions (it used to be six) and somehow the grading gets done at odd moments of Friday night and Saturday morning. Then there's a careful adding-up of score and a recheck of any specially close totals, all in time for the prizes to be awarded.

At the end of the day, how important are problem-solving contests? There are whole areas of mathematics — category theory, numerical analysis, algebraic geometry, mathematical statistics — that don't lend themselves to the construction of contest problems. And it's certainly true that many great mathematicians didn't distinguish themselves in such contests, and indeed maybe never took part! Conversely, if you browse the list of Putnam Fellows, you'll see a few household names (to pick a few, Elkies, Milnor, Kaplansky, and Feynman) interspersed with those of people you've probably never heard of. It's not surprising that the Putnam Fellows of the last few years are, for the most part, not yet famous: more intriguingly, the Putnam fellows of (say) the sixties or seventies seem to me somewhat less well known than those of the forties. Maybe the Putnam has changed, after all. Or maybe mathematics has.

But certainly some of the skills learned and honed in problem-solving contests are useful. They provide some excitement and challenge to students who may not be ready for real research. It seems to me that that's enough to ask.

NOTES de la SMC

## Au sujet des concours

Éditorial
Octobre 2024 (tome 56, no. 5)

**Robert Dawson** (Saint Mary's University)
*Editor, CMS Notes*

Au début du mois, j'ai assisté à une conférence régionale pour les étudiants de premier cycle, à l'Université Acadia. La conférence *Science Atlantic Math/Stats/CS* existe depuis près de cinquante ans maintenant, et fait le tour de la plupart des universités de la région sur un cycle d'environ dix ans : et j'ai participé à la plupart de ces années.

Au cours des premières décennies, ce qui est aujourd'hui Science Atlantique s'appelait « APICS » (*Atlantic Provinces Interuniversity Committee on the Sciences*), et le groupe de mathématiques et de statistiques ne partageait pas toujours un événement avec l'informatique. Mais c'est toujours le même événement auquel j'ai assisté pour la première fois, en tant qu'étudiant de première année de l'équipe de résolution de problèmes de Dalhousie. Je crois que le défunt Jon Borwein conduisait le minibus. Je participe encore à ce concours la plupart des années, même si, ces jours-ci, je participe à l'élaboration des questions. Il y a eu quelques changements au fil des ans : en particulier, les équipes de deux personnes travaillent ensemble et collaborent à une seule série de réponses. Auparavant, chacun des deux membres de l'équipe trouvait, ou essayait de trouver, ses propres solutions. Ils étaient notés indépendamment les uns des autres, puis, après la notation, les deux notes étaient additionnées. À l'époque du changement, nous avons observé que les étudiants semblaient apprécier davantage le format d'équipe. Bien sûr, il s'est écoulé tellement de temps que nous ne disposons pas d'une comparaison valable, mais je pense que cela reste vrai. En outre, c'est un contraste intéressant avec le Putnam, qui, fidèle à une formule gagnante, a très peu changé (à l'exception de la création du prix Elizabeth Lowell Putnam) depuis ses débuts. L'une des choses que j'ai apprises lorsque je suis revenu en tant que membre de la faculté, c'est la quantité de travail qu'il y a en coulisses pour que tout cela se produise ! Les réponses au concours sont mélangées en tas, un correcteur pour chacune des huit questions (il y en avait six auparavant) et, d'une manière ou d'une autre, la notation se fait à des moments bizarres du vendredi soir et du samedi matin. Ensuite, on additionne soigneusement les scores et on revérifie les totaux particulièrement serrés, le tout à temps pour la remise des prix. En fin de compte, quelle est l'importance des concours de résolution de problèmes ? Il existe des domaines entiers des mathématiques – théorie des catégories, analyse numérique, géométrie algébrique, statistiques mathématiques – qui ne se prêtent pas à la construction de problèmes de concours. Et il est certainement vrai que de nombreux grands mathématiciens ne se sont pas distingués dans ces concours, voire n'y ont jamais participé ! Inversement, si vous parcourez la liste des Fellows Putnam, vous verrez quelques noms connus (pour n'en citer que quelques-uns, Elkies, Milnor, Kaplansky et Feynman) entrecoupés de ceux de personnes dont vous n'avez probablement jamais entendu parler. Il n'est pas surprenant que les Fellows Putnam de ces dernières années ne soient, pour la plupart, pas encore célèbres : plus curieusement, les Fellows Putnam des années soixante ou soixante-dix (disons) me semblent un peu moins connus que ceux des années quarante. Peut-être que le Putnam a changé, après tout. Ou peut-être que les mathématiques ont changé. Mais il est certain que certaines des compétences acquises et affinées lors des concours de résolution de problèmes sont utiles. Ils apportent un peu d'excitation et de défi aux étudiants qui ne sont peut-être pas prêts pour la recherche réelle. Il me semble que cela est suffisant en soi.

CMS NOTES

# Farewell Teaching

Education Notes October 2024 (Vol. 56, No. 5)

**Veselin Jungić** (Simon Fraser University)

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

During my visit to a school in Kamloops, B.C., an eight-year-old student asked me what the world would look like without mathematics. I told them that I was not sure about the whole world, but my world would be a boring place without all the challenges, excitement, and people that mathematics has brought into it. What I didn't tell this natural-born- philosopher was that I believe that mathematics, from counting one's fingers to engaging in its most abstract forms, is a human way of interacting with the real world, both as individuals and for humanity as a whole.

For almost five decades, as a mathematics teacher, facing that human side of mathematics was a reality of my day-to-day life.

## Teachers

Both of my parents were teachers. My Mother was a Grade K-4 teacher, and my Father was Grade 7-8 physics and mathematics teacher. Now, at the end of my own teaching career, I see that, besides being my first teachers, my parents also served as my teaching role models. Just as my Mother before me, I was committed to give everything I had to support each of my student's intellectual, personal, and academic growth; and, as my Father before me, I was always fascinated by human knowledge and eager to share with my students my curiosity about the mathematical aspects of the world around us.

During my studies, I was fortunate to have a string of memorable teachers, from my kindergarten teacher, Mrs. Zlata Telalbašić, to my Ph.D. advisor, Professor Tom Brown. For example, even though, thanks to my Father, the learning of mathematics has been part of my life for as long as I remember, the demonstration of proofs in Euclidian geometry by my high school mathematics teacher, Mrs. Nasiha Kasumagić, sparked my decision to become a mathematician. As another example, the obvious joy with which Professor Mahmut Barjaktarević taught Mathematics Analysis, my very first undergraduate course, influenced my own approach to presenting mathematics.

Still, I think that my best teachers were my sons and my students.

From my sons, as a parent and a witness to their educational journeys, I learned that regardless of all of the love, the best of intentions, experience and knowledge, a teacher needs to respect the fact that students follow their own talents and intellectual interests, and ultimately make their own choices and decisions. This includes a teacher's awareness that going to school is only a segment of a student's life. Consequently, a student's commitment to their studies may be affected, in a positive or a negative way, by a set of non-academic constraints.

From my students I learned humility.

Despite of all willingness and efforts to share my knowledge and be my students' academic guide, I could not reach everyone in a good way. My classes were a cross section of society and, as such, a reflection of social complexity, including the ever changing political, economic, technological, and educational landscapes. Adding to this, my own rendering of the world around me at an instant of time was not always in sync with the level of diversity of skills, knowledge, educational histories, and learning styles of my students. Accepting the fact that my students may understand some of the ongoing processes in our shared reality better than I did was not easy.

In short, my students taught me that a teacher is a human, not a god, and that all I can do as a teacher is *my* side of our joint undertaking: doing my best to be well prepared for each class, providing clear expectations, being respectful and fair, and willing to engage in academic, and occasionally non-academic, conversations with students.

## The Dark Side of Mathematics

Teaching and promoting mathematics over many years made me aware of the *dark side of mathematics*. In addition to being used as a tool of judgement, for so many of my students and for, what I believe is, a noticeable segment of the general population, mathematics is a source of frustration and fear, and an object of open hate.

During my travels with the Math Catcher Outreach Program, I have met students as young as ten years old, that told me that they *hate mathematics*. In almost every class that I visited, and I visited Grades K-12 mathematics classrooms across British Columbia, there was a group of students acting like they were somewhere very distant from that room. For me, that kind of behaviour demonstrated, in a passive way, a dislike and animosity towards mathematics. In my precalculus classes, I sometimes worked with smart, ambitious, and hard-working young people that were so afraid of mathematics that this fear blocked them from even trying to do what they were asked. In situations like these, I often felt rather as a *math therapist* than as a math teacher.

In my view, the mathematical academic totem pole has a strange power to influence the sight of some of mathematicians and mathematics teachers on it: when those individuals look up the pole, everyone above seems very close, almost equal to them, but when they look down everyone below seems very, very far away.

Is a person *stupid* if they do not understand an *obvious* mathematical fact and if they cannot perform a *simple* mathematical task? Yes, in the opinion (and practice) of some teachers, at any level of mathematical instruction. This kind of negative judgement leaves deep mathematical scars that are always painful when touched and are hard to witness.

My personal struggle as a mathematics teacher has been to find a balance between my conviction that mathematical knowledge is necessary for an individual, as well as a community, to safely navigate reality, as well as my conviction that, for an *ordinary* person, learning mathematics is difficult. In my experience, learning a mathematical fact and retaining it over time by a student is the output of a function with, for me, an unknown number of variables. What had I done in my classroom that was too much for my audience? Or too little?

Have I made a dent in the dark side of mathematics?

## Then and Now

If I recall fifty years ago to when I was a student, the university mathematics teacher's role was really to be a *demonstrator* of the content knowledge. The teacher would say what they had to say, do on the board whatever they had to do, and leave the room at the end of the lecture. My impression at the time was that our teachers could not care less if we, their students, were able to follow a lecture or not. And, by definition, a university professor deserved everyone's respect just by being on stage.

This, I think, has changed a lot; now, an instructor who is simply serving as a demonstrator would not go very far to receive students' attention and respect. In my view, the modern teacher in lower-level university mathematics courses is a *moderator* of the content knowledge, someone who is introducing new concepts and helping students to grasp those concepts through various tools of the modern instruction. Those tools include in-class activities, like one of many student response systems, visualizations of mathematical facts, innovative course assessments, all kinds of teacher-student and student-student ways of communication, recorded lectures including the hybrid models of delivering a class, and other online learning resources.

For me, part of my teaching role was always to serve as a *motivator*. This included my efforts to help my students grasp why the topic we discussed was exciting; why learning it may be beneficial for their intellectual development; or why it could be useful for a job or a real-life situation they would experience in the future. I also saw as my responsibility as a teacher to communicate to my students that learning and doing mathematics is an experience that can lead to feelings of pride, happiness, and joy.

But I think that my life as a teacher was simpler even 15-20 years ago than what it has been over the last several years. For example, what was a two-page Course Outline handed-out during a first class is now a complex learning management course container that requires regular monitoring and updating throughout the semester. Or, a drop-in assignment box in the hallway has been replaced by one or more commercial products that students need to pay for, something that disturbs me still. Or, learning how to use and manage various pieces of educational devices and technologies, has become necessary to keep up with the expectations by students and standards set up by our institutions and communities of practice.

As someone who, in 2002, was tasked to promote the use of the Learning Management System of the time in my department; who was a pioneer in creating and using open-source online assignments in the early 2000s; who, in 2008, with Jamie Mulholland, created a full set of recorded Calculus I lectures; and, in 2012, together with Jamie Mulholland and Cindy Xin, experimented with the *flipped* classes, I know that the current set-up of lower division courses was created with the aim to make learning of mathematics more accessible to students. And I know that there is no way back.

My concern is that over the years, we added another thick level of complexity to teachers' jobs. This demanding part of their job, may take teacher's attention away from in-person communications with students and from enhancing their knowledge of the mathematics they teach.

## Failures and Successes

How do we define success or failure as teachers?

I think that trying to improve one's teaching practices is a never-ending process. If a mathematics teacher wants to be effective in what they do, it is necessary that they keep learning all the time. This includes both learning new pedagogies and staying on the top of the mathematical content they present.

But trying new things also means a risk of failure.

At one point in my career, I requested to teach a remedial mathematics course with the highest failure rate among all courses with a significant enrollment at my university. Once I started thinking about the way *I* would like to teach the course, the rules and expectations set up by my department felt like a straitjacket. I realized that the only room for change was in two areas:

- To adjust the philosophy of the course to my own experience and understanding of what it is that a student really needs to know to successfully complete the follow up courses.
- To break down, in-class and out-of-class, as much as possible the barrier between the instructor and individual students.

Fast forward, regardless of all of the work that I put in the understanding, preparing and teaching the course over two years, I was not able to significantly improve the class passing rates. My best was not good enough.

My failure was rooted in my belief that I would be able to make a significant change without addressing the general framework of the course: the class size, the out-of-classroom course support, the assignment structure, and the course prerequisites. Another mistake was in my underestimation of the power of the class diversity.

Here is another of my failures as a teacher, a long-lasting *moral wound*. In one of my Calculus classes, there was a student who I knew for several years through my friendship with their parents. The student, otherwise an intelligent, energetic, and outgoing young person, gave up quite early on attending lectures and submitting assignments. Regardless of the extra work towards the end of the semester, the student failed the course. Even now, it hurts me tremendously when I think that I was not able to motivate the student to fully commit to their studies and to do better in the course. What hurts me even more is the certainty that in large classes, that I taught so often, there were students who faded away without me ever noticing it.

For me, a teaching success was to realize that I played even a very small positive role, in a student's academic life.

During one remedial math course that I taught early in my Canadian teaching career, a student told me that they were just returning to school after a severe head injury sustained in a car accident. When I close my eyes, I can still hear their trembling voice and sense the mixture of hope and fear that they felt. The student worked hard, did very well in the course, and I truly believe that mathematics was part in student's healing process.

Many years later, in a third-year math class that I taught, there was a student who would come to my office after each lecture. They didn't actually have questions related to the course; instead, the student wanted to talk to me about their own mathematical thinking and ideas. And the student was a volcano of ideas flying all across the mathematical spectrum! I introduced the student to some of my colleagues and invited them to join the IRMACS Ramsey Theory Working Group. Currently, my former student is one of the most prominent young combinatorialists in the world.

Probably the most significant teaching award that I've ever received is a message from one of my former Indigenous students who is to about to start their own career as a teacher: "You believed in me at the time when I didn't believe in myself."

## Farewell Teaching

I think that the best part of my job as a university math instructor was the privilege of constantly sharing the company of young people and contributing to the quality of their present and future lives. What am I going to do without that source of energy and purpose that has been keeping me go on for so long?

But it is time to go. The fact that I have only *my former students* is slowly sinking in to my mind.

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## Teaching problem-solving using a systematic, deliverable-driven framework

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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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### The problem of solving a problem

Ana started thinking about problem-solving, really thinking about problem-solving, when, after many years of teaching she finally heard, truly heard, the exasperations she had heard up until that point a million times:

*I don't know where to start!*

Which was, almost surely, followed up by

*I don't know where to go next!*

Until then, she addressed each of those questions every time in the context-specific way: she would rewind her thought process for the specific problem at hand, employing the infamous "reverse engineering" approach. But then she started wondering — is there a pattern in her thinking? Is there, perhaps, a way to approach this in a more general, yet specific way? She was, of course, familiar with Polya's four principles. She even remembers printing them out once and taping them to the student desks in hopes Polya's four-step method, handy and in-your-face like that, would decrease the frequency of the questions above and increase the frequency of success her students would achieve when tackling problems. That turned out to be a fool's errand — students seemed no wiser. Though, as is so often the case, we learn from failures as well as from successes, or maybe even more so.

So we'd like to ask you a favour: when you get to the end of this sentence, take a moment to consider the following question:

*What is the first thing one should do when asked to solve a problem?*

Can you share with us what your answer to this question was, before reading further? Here is a one-question, anonymous survey to do so: https://forms.gle/W1RVAM6PqDNeSLUy8. We are curious.

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You may have answered: first understand the problem.

Or maybe you said: well, that depends on the problem.

There are many other possibilities for your answer. What we propose is that, whether you are a mathematician or not, neither of the two answers above are particularly helpful. The first one is too vague. The second one gets us nowhere because there are infinitely many problems and classifying them all is simply impossible. However, each answer above has something that is worth unpacking so that we can indeed have a concrete and helpful first step.

A review of literature shows that there is extensive discussion on problem-solving and teaching problem-solving, with deep historical roots. The research and teaching community discussion addresses different aspects related to problem-solving, from problem recognition, to problem formulation, problem-solving, solution verification, and solution communication. When it comes to the process intrinsic to solving problems, most discussion on problem-solving techniques revolves around mathematician's George Pólya's four principles: understand the problem, devise a plan, carry out the plan, look back.

In the context of teaching problem-solving, we find that Polya's principles are too general, particularly when it comes to teaching novice problem-solvers. To a novice problem-solver, Polya's instructions for considerations in understanding the problem can feel overwhelming. Moreover, they carry great risk of information overload and derailing. In addition, we believe that they are too ambitious, particularly in the instruction to first devise a plan, then to execute the plan. In this article, we will describe an attempt to unpack Polya's general instruction in a way that guides novice (and experienced) problem-solvers in answering two quintessential questions in problem-solving:

*How do I know where to start?*

*How do I know where to go next?*

We will provide an overview of the problem-solving framework proposed in the Problem-Solving Framework discussion paper by one of the authors that works to address these questions, and more. The framework is characterized by the focus on the deliverable and the principle of just-in-time information. We will also discuss how this approach may tackle the shortcomings of current strategies and practices in teaching problem-solving in secondary and post-secondary classrooms, particularly in mathematics. In full transparency, we will also discuss some challenges that arise in applying this framework, both intrinsic and extrinsic.

We adopt from the Problem-Solving Framework discussion paper the following definitions:

- The term *problem* will mean the totality of the problem description, which consists of explicit or implicit statements of one or more deliverables, conditions imposed on the deliverable(s), and background information for the purpose of context-setting.
- The term *context* will describe the situation, background or environment where the problem is situated or specific information adjacent to a word or expression and describing its meaning, and can refer to *general context* or *specific context*, depending on the level of detail.
- The term *deliverable* means a tangible or intangible product produced as a result of a project and intended to be delivered to a customer; in our context it shall mean the specific product to be delivered to the problem-poser as part of the project of solving a problem.

## Deliverable-driven problem-solving framework

### How do I know where to start?

The first step should establish the target or what we refer to as *deliverable*. This consists of two components: summarizing the general context, then identifying the deliverable(s), in that order.

For example, the problem statement may be something like this:

*Bla blab la blabl abla … describe the plant… blab la blabla.*

The task to *describe the plant* gives us the deliverable, which is the *description of the plant*. However, without the general context, we don't know if *the plant* refers to a sunflower or a factory or something else that can also be referred to as *a plant*. Thus, that first step of getting the sense of the general context is important to infer meaning to the words used in identification of the deliverable. It is not, however, important to know at this point (or perhaps at all) that the sunflower is 15 cm tall or that the plant is the GM factory in Oshawa.

Which brings us to the importance of the principle of *just-in-time-information*, taking us to the second question…

### How do I know where to go next?

Still <u>not</u> by considering and listing out all the information provided!

The answer to that question will depend on what we know about the deliverable. The emphasis here is on what *we know*, and not what *we're told*.

For this, our next step is to write down or in some other way plant our deliverable statement, say:

*Deliverable: description of the plant?*

This we should do for three reasons: initial target-setting, easy reminder of our target when we're knee-deep in working towards it, and verification at the end that we indeed delivered what we were supposed to deliver (and did not go off on a tangent somewhere, delivering something unrelated). The deliverable statement should always be the first thing we make a note of in the write-up (or talk-up) of our solution.

We then have to exercise again the discipline of the mind by stepping away from the problem statement and instead by recalling all we know in general about the deliverable. This will include the meaning of the words in the deliverable statement within the general context of the problem, and perhaps formal definitions and the associated characteristics of the deliverable, its constituent components, and general relationships (in math, read: formulas, equations or inequalities) between the deliverable and other concepts related to it within the problem's general context. With that, our target has meaning.

Alan H. Schoenfeld speaks of this in Mathematical Problem Solving[1] as "resources", when saying that "To understand why an attempt to solve a problem evolves the way it does, we need to know first what `tools` the problem solver starts with. Ideally this first category, resources, provides that kind of information.  It is intended as an inventory of all the facts, procedures, and skills – in short, the mathematical knowledge – that the individual is capable of bringing to bear on a particular problem. The idea is to characterize what might be called the problem solver's "initial search space." What avenues are open, at least potentially, for exploration?"

Thus, after identifying the deliverable, we should then make a note of the general characteristics and relationships we are able to recall about the deliverable as a concept, preferably in writing or in some other way, synthesizing them when possible in a way that is descriptive or constructive of our deliverable. This will then serve to guide us as we start building it using our general knowledge and considering, eventually but not yet, the specific conditions on our deliverable provided in the problem statement. In a way, this step of "unpacking" the deliverable is what one might think of as the first step in building a pathway towards it.

Inevitably, our deliverable will be an object or a concept (we avoid here the philosophical discussion on objects and concepts) defined by a series of characteristics that may or may not be related to each other in some way, with each of those characteristics, in turn, defined through some other objects or concepts defined by … *ad finitum* (hopefully).

For example, say that we identified

*Deliverable: domain of* $f(x)$*?*

Before we get into the specific conditions given in the problem, such as, say, the formula for , we must first unpack the meaning of the deliverable. Specifically, we must unpack the meaning of the symbols  and the word domain. This is a prerequisite to the necessary conclusion that, to deliver the domain, we have to look for all possible values of  that will be able to produce results using the rule that defines the function . And it is only at this point that the rule of  is relevant – an example of *just-in-time-information* principle.

Yet, most of the time, when we the math teachers are presenting a solution to this type of problem (or the process of solving it), we start with the statement of the rule (i.e., the formula for ) and often we do not explicitly state the deliverable and even less often do we write it down. We assume that the students have identified it and will be recalling it on their own if needed. We also often hope that students know the associated definitions and their constituent characteristics, and are able to articulate them to themselves as they are solving the problem and to others as they are presenting their solution. We often simply write the formula for  and proceed with writing up inferences, and we assume that, in that moment and upon later revisits, what we *want* (i.e., the deliverable) is obvious. In other words, when we start demonstrating the solution process, by starting with the formula and following by (or completely omitting) the deliverable statement, we are sending the message to the student that the condition on the target is more important than the target itself (or, even worse, that the condition is the only important thing in solving a problem).

Thus, to bring our discussion back to the general process, only once we made a note of the deliverable, reflected on what we know in general about it, and deconstructed it into constituent parts, we should go on a hunt for *specific* conditions given in the problem statement. In this hunt we should consider only those that are directly related to the deliverable itself or to its constituent parts. Here again we have to exercise the discipline of the mind. We must avoid taking note of conditions not directly related to the deliverable or its parts – we should make note of information only when relevant, in the moment when it is needed. We avoid to the best of our ability the attraction of "bright shiny objects" such as values and other specific descriptors that, though they may be useful later (*may* is the operative word here), they are not necessary in this moment.

In general, the answer to the question *Where do I go next?* will always, first and foremost, depend concurrently on answers to *Where do I ultimately want to go?* and *Where am I now?* The answer to the first question will depend on whether our target of the moment is the overall deliverable or, perhaps, a constituent component of our deliverable – a sub-deliverable. The answer to the second question, the placement in the *now*, will depend on what we know about our (sub)deliverable, both generally and through conditions directly related to the target of the moment.

We then use those specific conditions to further unpack the deliverable through its constituent parts, repeating the process of identification of mini-targets, or sub-deliverables. We do this until we are able to produce the deliverable within the full expanse of our general knowledge and the specific conditions expressed in the problem statement. Finally, a quick glance at our initial deliverable statement should confirm that indeed we have accomplished the task that was given to us.

## The problem of teaching how to solve problems

### The mess (and the fun) of it all

You are likely to agree with us that problem-solving is not, by any means, exclusively linear. It involves a messy, frustrating process that is an interchange of branching out, jumping off, and circling back, but within each of those pathway types there are portions that involve linearity: *first this, then that*. It is those components, the iddy-biddy chunks of a straight path, that give us a break, that allow us to take a breath, to get a sense of making progress, of moving forward.

It is, indeed, the mess of it, the frustration felt and conquered, what in the end gives us a sense of satisfaction and pride when we have arrived at the solution, when we *delivered*. But this mess and frustration can also be debilitating. It can prevent our students from building both the skill and the confidence in solving problems if they don't have an inkling of where to start and where to go next, then next, then next, at least occasionally and at least in a way that inches them closer to the target.

This is where we the teachers have a key role to play. We have to practice discipline on our part, the kind of discipline where we resist simply demonstrating solutions to problems and assuming that the students are sitting inside our heads, following along our thought flow. We must resist over-relying on assumptions about the knowledge of the student or the reader of the solution, most of which, in practice, are only reasonable if the student or the reader is already an expert on the subject.

Instead, we should consistently demonstrate the actual messy and frustrating process of finding a solution to a problem, but in a way that provides a string of guiding lights applicable to all problems, no matter the complexity or the topic. Summarizing our discussion above, we propose that this string of guiding lights should be the question-answer interplay of

*What is the general context? What is the (sub)deliverable? What do I know in general about the (sub)deliverable? How can I use what I know to "unpack" my (sub)deliverable? What specific conditions am I given in the problem that directly relate to my (sub)deliverable? How can I use them to further "unpack" the (sub)deliverable? Is this the best I can do or is there more I can "unpack"? How can I use what I "unpacked" to "re-pack" it to get my deliverable? Did I get to my deliverable? What are the conditions on how I should present my deliverable?*

## At what price and for what prize?

Speaking from personal experience – this is tough!

First of all, there's only so much time. And words take time. But guidance takes words. As does the expression of our thoughts. They are so much quicker to process when they stay in our heads.

Speaking our thoughts out loud also requires us to slow them down. And that takes effort. And discipline. It's just so much easier to present the final product, a neat and clean solution, and be done with it. In a way, Brent Davies speaks of this in The mathematics that secondary teachers (need to) know[1], putting forward and expounding on the notion that "the effective mathematics teacher is an expert who can think like a novice". We extend this further to "the effective teacher of problem-solving is an expert who can *model thinking* like a novice problem-solver. Davies speaks to the danger of viewing something as "obvious" and the importance of unpacking the thing that we consider "obvious" when teaching. Using vocabulary such as "realizations", "entailments", and "landscapes", Davies discusses why it is important for teachers that definitions and rules, relationships between concepts, and the contexts within the definitions, rules and relationships are recalled and processed within the given problem. What we have to own up to, however, is that this is difficult work.

Another struggle is the resistance – oof. Old habits die hard, especially when they require less effort (even at the expense of success). Starting out on a problem by writing down all of the information that is provided, without a thought of how, or even if, it is relevant requires very little mind effort. It also gives comfort – at least I have something even if I have no clue how to proceed! On the other hand, attacking a problem by starting with identification of the deliverable and digging into the brain for what we know about it requires immediate mind effort. It takes weeks, months, of true and unrelenting persistence to begin to develop in students the resistance to hooking onto bright shiny objects before securing their sights onto the target.

Yet the rewards are amazing. After twelve weeks of hard work in learning to apply the deliverable-driven, just-in-time information approach, students express genuine pride in the change to their ability to tackle problems. In math courses where this approach to teaching problem-solving has been applied, student testaments have provided the promise of this teaching practice:

*I can understand word problems better than I could before taking this course. Additionally, I am able to work much faster and understand what the question is asking for quickly.*

*I am most proud about learning how to properly analyze what words mean in word problems instead of focusing on numbers first.*

*I am better at math! I can rearrange equations properly, and have a system to tackle word problems. They don't frustrate me as much now.*

*I'm proud that now I can read application questions and solve them by formulating a formula through recognizing the task and walking step by step to complete that task.*

*I am most proud about being able to think through questions more in-depth and be able to understand them better without going straight to numbers. I am proud that I am able to understand and complete word problems easier than before this course.*

Other observed but not yet specifically measured benefits of this approach include significant growth in students' skills in communicating their thought processes, their practice of inductive, deductive and abductive reasoning, and their ability to generalize processes and results beyond the specifics of a given problem. As anything in life, this approach to teaching problem-solving comes with a price, but it is one worth the prize, at least from the experience of those who practice it.



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## Rigor in Context

**Zoe Ashton** (The Ohio State University)

*CSHPM Notes brings scholarly work on the history and philosophy of mathematics to the broader mathematics community. Authors are members of the Canadian Society for History and Philosophy of Mathematics (CSHPM). Comments and suggestions are welcome; they may be directed to the column's editors:*
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One of the defining features of modern mathematical proof is rigor. We can spell out what rigor is in formal derivations where the acceptable inferences, axioms, and formal language are all defined. Of course, mathematical proofs in practice are rarely like logical derivations—they're gappy, in a natural language, and often use diagrams. So, rigor in practice has a "know it when you see it" quality. It has often been thought that the rigor of mathematical proofs ought to be defined in terms of formal rigor. What I'd like to suggest in this column is that rigor evaluation might have a much more social nature.

According to the "standard view" of rigor proposed by philosophers of mathematics, a mathematical proof is rigorous only in the instances in which it could be translated or fleshed out into a valid formal derivation in a suitable system. Numerous philosophers of mathematics have raised objections to the standard view. The objections arise since the standard view fails to make sense of how a mathematician could ever judge historical and diagrammatic proofs to be rigorous. Euclid, for example, seems to give some rigorous proofs long before there was a definition of a formal language. In addition, many proofs in geometry and topology rely on diagrammatic manipulations. It's unclear whether those proofs even can be formalized at all. Altogether, the standard view of rigor fails to identify many rigorous proofs as rigorous.

Part of the issue is that proof evaluations seem to vary across practice. Standards of rigor seem to depend on the mathematical subfield, location, and time period. We also tend to adjust our demands for rigor based on our pedagogical and communicative goals. There may be some way to reconcile formalizability with these facts about practice. But I think the more natural direction is to explore the context-sensitive and social aspects of rigor. I am not alone in this approach to rigor—for instance, Tanswell (2017) has argued for a virtue-theoretic account of rigor. According to that view, rigor is a kind of characteristic of a mathematician, much like curiosity or intellectual humility. Larvor (2012) has also argued for a context-sensitive account of rigor under which a rigorous proof is one that conforms to the permissible actions in a domain. In soccer only certain movements are allowed, but those same movements wouldn't be permissible in gymnastics. Likewise, in knot theory, only certain inferences are deemed permissible, which might be impermissible in probability theory.

Like Tanswell and Larvor, I'm interested in examining rigor through a context-sensitive and social lens. But I'm mostly motivated by claims, like Hersch's (1993), that argue proof really aims at conviction and explanation. The difficulty is in spelling out who we are aiming to convince. I've argued before (2021) that the universal audience is the target audience based on the goals of proof. A universal audience is an imagined audience constructed to represent all reasonable people. This audience is a mental fiction that will be specific to each mathematician. In everyday life, people imagine arguing to certain kinds of audiences. Before meeting your class, you might imagine a general audience of students in order to develop a presentation they will understand. You use your past experiences with real audiences of students to do so. A universal audience is developed in a similar fashion. We imagine a general audience of reasonable people based on our past experiences with reasonable people.

I argue that a proof is completely rigorous when each step is one to which the mathematician's universal audience assents. Each inference is judged to be rigorous when it convinces one's universal audience. For the mathematician, this amounts to the judgment that "this inference would convince everyone." This account is consistent with historical judgments of rigor, since the concept of an audience dates back far longer than that of a formal language. It also is consistent with diagrammatic proofs, since it doesn't require a translation into another language to determine whether or not a field-specific diagrammatic move is performed correctly. For example, a proof in knot theory that employs a Reidemeister move, one of three simple deformations for knot diagrams, will not need to be translated in order to judge whether or not it is rigorous. Moreover, my account allows one to make sense of comparative rigor judgments in a straightforward way. Mathematicians frequently give "more rigorous" or "less rigorous" proofs depending on the context.

"Non-standard" accounts of rigor don't gild proof evaluation in objective terms. This may seem problematic, but I think it gives us a richer framework to understand unjust parts of the history of mathematics. In particular, the audience view allows us to examine how subjective perceptions of groups might affect rigor judgments. To close this column, I'll outline such a case.

von Neumann (*Wikipedia*); Bell (Linda Hall Library); Hermann (*Physics Today*).

In his 1932 *Mathematical Foundations*, John von Neumann published a purported proof of the impossibility of hidden-variable theories in quantum mechanics. It was accepted as a rigorous proof until 1966, when John S. Bell published a devastating objection to the proof, noting that it contains a problematic assumption—that of the linearity of expectation for all possible observables—which does not actually hold. For example, there are well-known counterexamples involving eigenvalues in the quantum mechanical case. As a consequence, von Neumann's proof was revealed to be a fundamentally circular argument. It seemed that there had been a lapse in rigor unnoticed in the entire community. On its own, this is an interesting story about how long it might take to correct incorrect rigor judgments. Von Neumann clearly thought his own proof was rigorous. And at least a few mathematicians also judged it to be so. Bell managed to point out an assumption that most reasonable people would not agree with, which resulted in the community recognizing the von Neumann proof as non-rigorous. The counterexamples highlight that the proof is not correct. But rigor doesn't entail correctness since a circular proof shouldn't be regarded as rigorous even if it happens to have a correct conclusion. In fact, the circularity of the proof could be identified without counterexamples. And, John Bell was not the first to point out that circularity in von Neumann's proof!

In 1935, Grete Hermann (2016) published an essay entitled "Natural-Philosophical Foundations of Quantum Mechanics," which had a section called 'The Circle in Neumann's Proof.' She thus had already argued that von Neumann's proof is circular because it attempts to rule out the existence of dispersion-free states by assuming the additivity rule, but the additivity rule only holds when there are no such states. Hermann's argument was almost entirely ignored in the years between von Neumann and Bell. Seevinck (2016) and Paparo (2012) have both tried to determine why Hermann's argument was ignored. Some of their proposed reasons are that the paper was not published in a popular journal, von Neumann was an almost prophet-like figure, she was young, she was a woman, she was a political outsider, she typed that part of her article in a small font, she did not ascribe significance to her own argument, and she "did not desire the status of a revolutionary or radical" (Seevinck 2016, p. 116).

The purported reasons seem to fall into three categories. Reasons in the first category suggest that Hermann's work was ignored because of her failure to realize its own importance. I include purported explanations involving the size of the font, the unpopular journal, and her desire to not be revolutionary in this category, but I think these reasons are not particularly strong. It seems fairly obvious that she did attribute importance to her argument since she went through the trouble of having it published and she subtitled the von Neumann section in a clear, non-conciliatory way. The second category of reasons suggests that the work was not read since it was not published in a popular journal, but we know the paper was read by important contemporaries. As Seevinck (2016) points out, Carl Friedrich von Weizsäcker wrote a review of the 1935 essay. Further, Hermann composed the argument while working with Werner Heisenberg at his institute in Leipzig. The journal she published in was not the strongest, but the arguments within the paper were clearly read by important physicists at the time.

Having ruled out the first two categories, we are left with the sad but obvious conclusion that she was ignored due to some social characteristic. It doesn't matter for the purposes of this column whether that social factor was her youth, sex, political orientation, or perceived status relative to von Neumann. Prejudice based on one of those factors allowed mathematicians and physicists to ignore her circularity objections. Another potential explanation is that the community wanted von Neumann to be right, and so for Hermann to be wrong, which caused them to ignore Hermann's objection. Either way, rigor judgments surrounding von Neumann's proof and Hermann's objections were not objective or based on formalizability. They were products of a more complicated, and unjust, milieu that influenced mathematical judgments.

Hermann's story is not a happy one. But it is useful in examining how intertwined our mathematical practices can be with our social experience. It seems to me that an important step to avoiding these injustices is to have philosophical accounts that allow us to discuss them. The "standard view" of rigor leaves very little room to explore cases such as Hermann's. Instead, we should turn to "non-standard" views of rigor like those explored in Tanswell (2017) or Ashton (2024).

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**Michael Barr**

The Body Roundness Index (BRI) is an index created to address the fact that the Body Mass Index (BMI) is deeply flawed since it doesn't account for the fact that muscle tissue is denser than fat. It also doesn't account for the fact that fat around the middle of the body is apparently more harmful than peripheral fat. This article appeared in the Journal of the American Medical Association:

https://jamanetwork.com/journals/jamanetworkopen/fullarticle/2819558

which refers to an article in a journal called Obesity:

https://onlinelibrary.wiley.com/doi/10.1002/oby.20408

The latter paper develops a formula for the BRI based on a model of the human body as an ellipse (really an ellipsoid of revolution, but they call it an ellipse) with the semi-major axis half the height and the semi-minor axis computed from the waist measurement, treated as the circumference of a circle. This results in the following bizarre looking formula:

$$BRI = 364.2 - 365.2\sqrt{(1 - \frac{[w/2\pi]^2}{[0.5h]^2})}$$

with $w$ the waist and $h$ the height both measured in cm. The number in the radical is just the eccentricity of the ellipse. But where do 364.2 and 365.5 come from? The authors of the Obesity article comment, "This formula was derived solely to scale eccentricity values to a more accessible range of values." That explanation really explains nothing. If you use 300 for both of the constants, that would have the same effect. In fact 100 would work as well.

First, we remark that with trivial algebra, their formula can be immediately simplified to

$$BRI = 364.2–365.5\sqrt{1 - (\frac{r}{\pi})^2}$$

where $r = w/h$ is the ratio of the waist to the height and it doesn't matter whether the waist and height are measured in cm or inches or, for that matter, light-years or Angstroms. More important, since $r/\pi$ is most likely to be $< 1/5$ and its square $< 1/25$ we can use the well-known approximation $\sqrt{1+h} \approx 1 + h/2$ when $|h|$ is small. Applying this we get

$$BRI \approx 364.2 - 365.2(1 - \frac{1}{2}(\frac{r}{\pi})^2) = 182.75(\frac{r}{\pi})^2 - 1.3 \approx 18.5r^2 - 1.3$$

Moreover, since the result puts you in a range ($> 6.8$ is bad), why bother with that odd looking $1.3$? For that matter, why bother with that $18.5$? Just use $r^2$ and say that $> .44$ is bad. If you want to avoid fractions, use $10$ as the multiplier and skip the $1.3$. Or simply use $r$ and say that $r > .66$ is bad. Or even simpler, say you are obese if your waist is more than $2/3$ your height.

I should also mention that, like the BMI, your BRI can also be too low. The longevity curve is U-shaped. Your life expectation goes down significantly if your waist is less than half your height. These conclusions are much more useful than the complicated formula.

My point here isn't that what they are doing is necessarily a bad idea. Indeed I think the basic idea is sound. Some ranges are good; some are not. My point is that they have taken a very simple idea and surrounded it by unnecessarily complicated mathematical obfuscation. This may was probably caused by mathematical naiveté, but it really hides a basically simple concept–study obesity by the eccentricity of a containing ellipsoid–behind an odd formula.

I would like to thank Robert Dawson who made many useful comments and also found the articles referred to above. I had written the original based only on an article in the NY Times.

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## Call for Submissions: CMS Notes Mathematics, Outreach, Society, Accessibility and Inclusiveness Column (MOSAIC)

The Canadian Mathematical Society (CMS) invites you to submit articles to be featured in the MOSAIC column of the CMS Notes.

MOSAIC (Mathematics, Outreach, Society, Accessibility, and Inclusiveness Column) is directed by the CMS Equity, Diversity, and Inclusion (EDI) committee.

The column offers a space of expression for you to ask, listen, learn, share experience, and propose solutions to build a more diverse, just, and stronger mathematical community. For instance, you are welcome to submit an article sharing challenges and successes in enacting EDI initiatives within your university, with competitions, outreach activities, or other events.

Your email submission should include your article in both Word and PDF formats. Please submit your article to the EDI Committee at mosaic@cms.math.ca.

. . .

La Société mathématique du Canada (SMC) vous invite à soumettre des articles à paraître dans la colonne MOSAIC des Notes de la SMC.

MOSAIC (colonne sur les mathématiques, la sensibilisation, la société, l'accessibilité et l'inclusion) est dirigée par le comité sur l'équité, la diversité et l'inclusion (EDI) de la SMC.

Cette rubrique offre un espace d'expression où vous pouvez poser des questions, écouter, apprendre, partager votre expérience et proposer des solutions pour construire une communauté mathématique plus diverse, plus juste et plus forte. Par exemple, vous pouvez soumettre un article sur les défis et les succès rencontrés dans la mise en œuvre d'initiatives EDI au sein de votre université, lors de concours, d'activités de sensibilisation ou d'autres événements.

Votre courriel doit contenir votre article aux formats Word et PDF. Veuillez soumettre votre article au comité EDI à l'adresse suivante : mosaic@cms.math.ca .

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## Call for Nominations for 2025 Excellence in Teaching Award

Calls for Nominations October 2024 (Vol. 56, No. 5)

The CMS Excellence in Teaching Award Selection Committee invites nominations for the 2025 Excellence in Teaching Award.

The Excellence in Teaching Award recognizes sustained and distinguished contributions in teaching at the post-secondary undergraduate level at a Canadian institution. The award focuses on the recipient's proven excellence as a teacher at the undergraduate level as exemplified by unusual effectiveness in the classroom and/or commitment and dedication to teaching and to students.

The CMS aims to promote and celebrate diversity in the broadest sense. We strongly encourage department chairs and nominating committees to put forward nominations for outstanding colleagues regardless of race, gender, ethnicity or sexual orientation.
A nomination will consist of:

- a signed nominating statement from a present or past colleague, or collaborator (no more than three pages) having direct knowledge of the nominee's contribution;
- a curriculum vitae (maximum five pages);
- three letters of support, at least one from a former student (who has followed a course more than a year ago) and one from the chair of the nominee's unit. The letter of the Chair of the nominee's unit could include a one-page summary on information from student evaluations, or similar information;
- other supporting material (maximum 10 pages).

Nominations and reference letters should be submitted electronically, preferably in PDF format, to awards-prizes@cms.math.ca no later than the deadline of **November 15, 2024**. Any nomination submitted past this deadline will not be taken into consideration for this year's award.

For further details, please view the call here.

**Canadian Mathematical Society** — 616 Cooper St., Ottawa, ON K1R 5J2, Canada


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Société mathématique du Canada
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UNIVERSITY OF THE FRASER VALLEY
Mathematical Modelling of Traffic Flow
Basics of mathematical modelling with specific applications of vehicular traffic.
TIM HOHEISEL
MCGILL UNIVERSITY
Continuous Optimization
The maximum entropy on the mean method for linear inverse problems
ASSAF SHANI
CONCORDIA UNIVERSITY
Logic/Set Theory
Borel reducibility and the method of forcing
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avec des applications spécifiques au
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La méthode du maximum
d'entropie sur la moyenne pour
les problèmes linéaires inverses.
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Réductibilité de Borel et
méthode de forçage
INSCRIPTION :
winter24.cms.math.ca


The 2024 CMS Education Meeting (Online) is happening again thanks to the success of the inaugural meeting. Complementing the in-person mathematics education sessions at the Summer and Winter CMS meetings, the 2024 CMS Education Meeting (Online) will feature fabulous plenary talks and wonderful presentations on a variety of themes in mathematics education, as well as provide ample time for comments and discussion. These education meeting (online) will take place over two days and prior to the in-person CMS Winter meeting.

The organization and the registration for this event will be handled by the CMS. For those who register for the in-person CMS Winter meeting, the registration for the preceding online meeting is free.

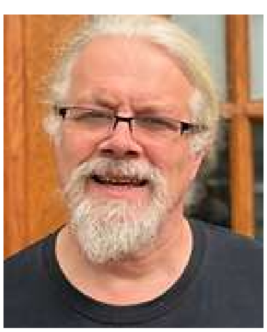
The 2024 CMS Education Meeting (Online) is scheduled for Friday, November 22nd, 2024, (from 16:00 EST to 19:00 EST), and Saturday, November 23rd, 2024, (from 11:00 EST to 15:00 EST). Information about the meeting (schedule, themes, etc.) will be posted on the CMS website. A call for presentation proposals will go out soon, with the submission deadline of Friday, September 27th, 2024.

## Plenary Lectures

### Brent Davis (University of Alberta)

**Friday, November 22 | 5pm EST**

Brent Davis is from northern Alberta, where he taught secondary school mathematics through most of the 1980s. He began his university career in the mid-1990s and has been Canada Research Chair in Mathematics Education at University of Alberta, David Robitaille Chair in Mathematics Education at University of British Columbia, and Distinguished Research Chair in Mathematics Education and Werklund Research Professor at University of Calgary. His research is focused on the educational relevance of recent developments in the cognitive and complexity sciences. Over the past 12 years, through the "Math Minds" project, he has worked with multiple western Canadian school districts to improve the learning of mathematics. Brent has published books on school mathematics, curriculum theory, teacher education, and epistemology, and his scholarly writings have appeared in Science, Harvard Educational Review, Journal for Research in Mathematics Education, and other leading journals.



### Robert Dawson (Saint Mary's University)

**Saturday, November 23 | 11am EST**

Robert Dawson did his undergraduate degree in mathematics and physics at Dalhousie, and a PhD at Cambridge. He has taught mathematics courses ranging from statistics to differential equations at Saint Mary's University for more than thirty years, and has done research on topics ranging from lichenometry to higher-dimensional category theory. In his spare time, he writes science fiction. He believes that the world needs more bicycles.

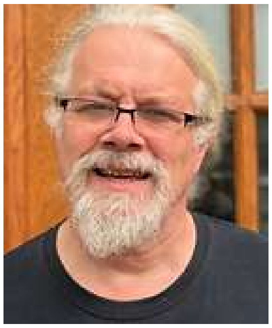

La réunion d'éducation de la SMC 2024 (en ligne) est de nouveau organisée grâce au succès de la réunion inaugurale. En complément des sessions d'enseignement des mathématiques en personne lors des réunions d'été et d'hiver de la SMC, la réunion d'enseignement de la SMC 2024 (en ligne) proposera de fabuleuses conférences plénières et de merveilleuses présentations sur une variété de thèmes dans l'enseignement des mathématiques, tout en offrant beaucoup de temps pour les commentaires et les discussions. Cette réunion d'éducation (en ligne) se déroulera sur deux jours et avant la réunion d'hiver de la SMC en personne. L'organisation et l'inscription à cet événement seront prises en charge par la SMC. Pour ceux qui s'inscrivent à la réunion d'hiver de la SMC, l'inscription à la réunion en ligne qui précède est gratuite. La réunion éducative 2024 de la SMC (en ligne) est prévue le vendredi 22 novembre 2024 (de 16:00 HNE à 19:00 HNE) et le samedi 23 novembre 2024 (de 11:00 HNE à 15:00 HNE). Les informations relatives à la réunion (horaire, thèmes, etc.) seront affichées sur le site Web de la SMC. Un appel à propositions de présentation sera bientôt lancé, la date limite de soumission étant fixée au vendredi 27 septembre 2024.

## Conférences plénières

### Brent Davis (University of Alberta)

**Vendredi le 22 novembre | 17 h HNE**

Brent Davis est originaire du nord de l'Alberta, où il a enseigné les mathématiques au niveau secondaire pendant la majeure partie des années 1980. Il a commencé sa carrière universitaire au milieu des années 1990 et a été titulaire de la chaire de recherche du Canada sur l'enseignement des mathématiques à l'université de l'Alberta, titulaire de la chaire David Robitaille sur l'enseignement des mathématiques à l'université de la Colombie-Britannique, et titulaire de la chaire de recherche distinguée sur l'enseignement des mathématiques et professeur de recherche Werklund à l'université de Calgary. Ses recherches portent sur la pertinence pédagogique des développements récents dans les sciences de la cognition et de la complexité. Au cours des 12 dernières années, dans le cadre du projet « Math Minds », il a travaillé avec plusieurs districts scolaires de l'ouest du Canada pour améliorer l'apprentissage des mathématiques. Brent a publié des ouvrages sur les mathématiques scolaires, la théorie des programmes, la formation des enseignants et l'épistémologie, et ses écrits scientifiques ont été publiés dans Science, Harvard Educational Review, Journal for Research in Mathematics Education et d'autres revues de premier plan.



### Robert Dawson (Saint Mary's University)

**Samedi le 23 novembre | 11 h HNE**

Robert Dawson a obtenu son diplôme de premier cycle en mathématiques et en physique à Dalhousie, et un doctorat à Cambridge. Il a enseigné des cours de mathématiques allant des statistiques aux équations différentielles à l'université Saint Mary's pendant plus de trente ans, et a effectué des recherches sur des sujets allant de la lichénométrie à la théorie des catégories de dimensions supérieures. Pendant son temps libre, il écrit de la science-fiction. Il pense que le monde a besoin de plus de bicyclettes.

Canadian Mathematical Society
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RÉUNION D'HIVER DE LA SMC
NOVEMBER 29 - DECEMBER 2 | 29 NOVEMBRE - 2 DÉCEMBRE
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André Boileau (UQAM)
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Student Poster Session | Présentation par affiches par les étudiants
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## Childcare Now Available at the 2024 CMS Winter Meeting




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## ICIAM Dianoia -Volume 12 Issue 4 October 2024



## Poster Session



**The CMS student committee**

Dear students in mathematics and statistics,

Are you working on a mathematical project that you want to share with your fellow math enthusiasts? Then sign up for the AARMS-CMS Student Poster Session at the 2024 CMS Winter Meeting in Richmond, taking place from November 29th to December 2nd! We accept abstracts from both graduate and undergraduate students.

At the poster session, you will be asked to give a short (~3min) presentation of your poster to judges and answer any questions about your research. Three winners will be selected based on content, organization, and presentation. Each winner will receive two complimentary tickets to the banquet, a framed award certificate, as well as a $100 prize (if the number of participants allows it).

The deadline to submit your abstract is **November 17th, 2024**. To submit an abstract, fill the needed information in this form. Abstracts will be accepted on a rolling basis.

For poster tips please visit our website. To register for the 2024 CMS Winter Meeting, please visit the CMS meeting website.

We look forward to seeing you at the meeting!

The CMS student committee

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Chers étudiant.es en mathématiques et statistiques,

Travaillez-vous sur un projet mathématique que vous souhaitez partager avec vos collègues passionnés de mathématiques? Alors inscrivez-vous à la séance d'affiches des étudiants de l'AARMS-CMS lors de la réunion d'hiver 2024 de la SMC à Richmond, qui aura lieu du 29 novembre au 2 décembre! Nous acceptons les résumés des étudiants de premier et de deuxième cycle.

Lors de la session d'affiches, il vous sera demandé de faire une courte présentation (~3min) de votre affiche aux juges et de répondre aux questions concernant votre recherche. Trois gagnant.e.s seront sélectionné.e.s sur la base du contenu, de l'organisation et de la présentation. Chaque gagnant recevra deux billets gratuits pour le banquet ainsi que 100 $ et un certificat encadré (si le nombre de participants le permet).

La date limite pour soumettre votre résumé est le **17 novembre 2024**.Veuillez remplir les informations demandées dans ce formulaire pour soumettre votre résumé.

Pour des conseils sur les affiches veuillez consulter notre site web. Pour vous inscrire à la réunion d'hiver 2024 de la SMC, veuillez consulter le site web de la conférence.

Nous avons hâte de vous voir à la réunion!

Le comité étudiant de la SMC

## CUMC 2025 Call to Host



**Ludovick Bouthat**
*CMS Studc Chair*

On behalf of the *Canadian Mathematical Society's Student Committee* (*CMS Studc*), we are pleased to formally announce the opening of the bids to host next year's *Canadian Undergraduate Mathematics Conference* (*CUMC*)! Now's your chance to bring the *CUMC* to your institution!

If you are interested in organizing *CUMC* 2025 at your university, we encourage you to submit a bid to *Studc* by sending the information requested in the *CUMC* Bid document (found at https://studc.math.ca/?page_id=107) to the *StudC* chair at chair-studc@cms.math.ca. Bidding for *CUMC* 2025 will close at **23:59pm EDT on November 6th**. The group selected to host *CUMC* 2025 will be announced in early December.

You can find more information on *Studc*'s website https://studc.math.ca/?page_id=4. Please address any further questions to the chair of *Studc* at chair-studc@cms.math.ca.

Sincerely,

Ludovick Bouthat, *CMS Studc* Chair

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Le comité étudiant de la *Société Mathématique du Canada* (*SMC Studc*) annonce officiellement l'ouverture des candidatures pour organiser le *Congrès canadien des étudiant(e)s en mathématiques 2025*. C'est votre chance d'accueillir le *CCÉM* à votre université !

Si l'organisation du *CCÉM* 2025 vous intéresse, nous vous encourageons à envoyer une candidature au *Studc* (chair-studc@cms.math.ca) en répondant aux diverses questions trouvées dans le formulaire d'application disponible à la page https://studc.math.ca/?page_id=812. Vous avez jusqu'au **6 novembre à 23h 59 EDT** pour soumettre votre candidature complète. Le groupe sélectionné pour organiser le *CCÉM* 2025 sera annoncé en début décembre.

Vous trouverez plus d'informations sur le site du *Studc*https://studc.math.ca/?page_id=70. N'hésitez pas à contacter les présidents du *Studc* pour toute question (chair-studc@cms.math.ca).

Sincèrement,

Ludovick Bouthat, président.e.s du *SMC Studc*

## Student Research Session

CMS Student Committee

October 2024 (Vol. 56, No. 5)

**The CMS student committee**

Dear students in mathematics and statistics,

The Canadian Mathematical Society Student Committee invites undergraduate and graduate students to present their research at the Student Research Session during the 2024 CMS Winter Meeting in Richmond. The meeting will take place from November 29th to December 2nd.

Applicants must submit their presentation abstracts to studc-winter24-talks@cms.math.ca in either English or French no later than **November 11th**. Abstracts will be evaluated and accepted on a rolling basis. Because space is limited, interested students are encouraged to submit an abstract as soon as possible.

The proposed presentation should introduce the student's research to a general mathematical audience. All areas in pure / applied math, statistics, and math education will be considered. For more information, please visit the meeting's website or contact the organizers. After approval of their presentation, speakers must register for the meeting. Registration costs for student members of the CMS who are presenting are significantly reduced.

We look forward to seeing you at the meeting!

The CMS student committee

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Chers étudiant.es en mathématiques et statistiques,

Le Comité étudiant de la Société mathématique du Canada invite les étudiants de premier et de deuxième cycle à présenter leurs travaux de recherche lors de la séance de recherche étudiante de la Réunion d'hiver 2024 de la SMC à Richmond. La réunion aura lieu du 29 novembre au 2 décembre.

Les candidats doivent soumettre leur résumé de présentation en français ou anglais à l'adresse studc-winter24-talks@cms.math.ca au plus tard le **11 novembre**. Les résumés seront évalués et acceptés au fur et à mesure. Le nombre de places étant limité, les étudiants intéressés sont encouragé.e.s à soumettre leur résumé dès que possible.

La présentation proposée doit présenter la recherche de l'étudiant à un public mathématique général. Tous les domaines des mathématiques pures et appliquées, des statistiques et de l'enseignement des mathématiques seront pris en considération. Pour plus d'informations, veuillez consulter le site web de la réunion ou contacter les organisateurs. Après approbation de leur présentation, les orateurs doivent s'inscrire à la réunion. Les frais d'inscription des étudiants membres de la SMC qui présentent un exposé sont considérablement réduits.

Nous avons hâte de vous voir à la réunion!

Le comité étudiant de la SMC