CWM NEWSLETTER
ISSUE 14, DECEMBER 2025

Editorial To The Fourteenth Issue

Dear Readers,

Welcome to the 14th edition of the CWM newsletter. We are delighted to share this issue with you, though we must begin with a heavy heart.

It is with profound sadness that we announce the untimely passing of our dear friend, colleague, and CWM member Tony Ezome. Tony served CWM with remarkable dedication, vision, and leadership, particularly on issues affecting Africa. Our thoughts and heartfelt sympathies are with his family, students, and colleagues during this difficult time. A beautiful testimonial by Marie Françoise Ouedraogo can be found in this newsletter. May he rest in peace.

While we grieve Tony's loss, we also carry forward the collaborative spirit and vision he so passionately championed. In that spirit, we are excited to share some wonderful developments in our community. We are happy to announce the third World Meeting for Women in Mathematics—$(WM)^2$—on July 22, 2026, in Philadelphia, USA, the day before ICM 2026. Building on the success of our previous meetings, this promises to be a vibrant celebration of mathematical excellence and community.

The $(WM)^2$ and the CWM Call are our signature events, and hosting both in 2026 will affect our annual budget. Because of this, we have decided to postpone the launch of the CWM Call for proposals until we have a clearer picture of our finances. Thank you for your understanding as we work to ensure both initiatives receive the support they need.

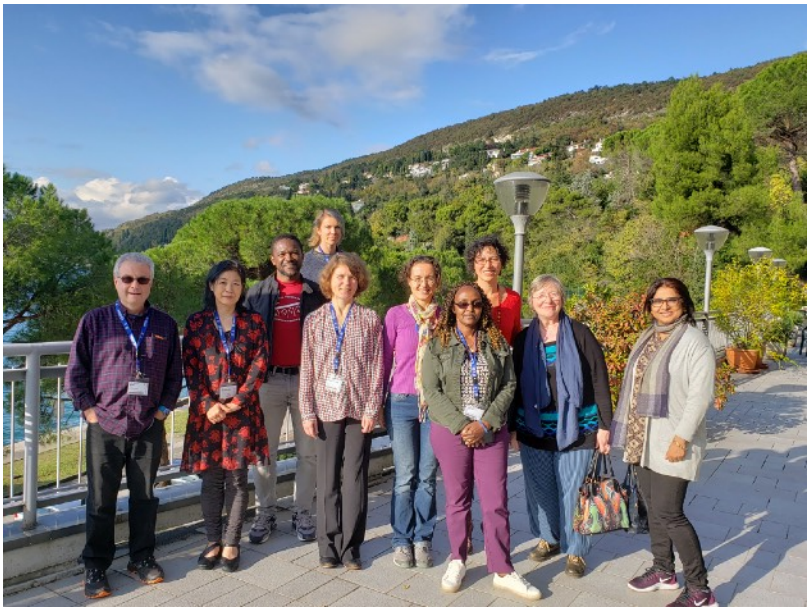
This issue also brings joyful news: we celebrate the election of CWM member Selma Negzaoui as President of the African Women in Mathematics Association and share updates from SCGES. We are pleased to feature Gizem Karaali's thought-provoking article "Humanistic Mathematics, Humanizing Mathematics: Why Now?" which offers valuable insights on making mathematics more accessible and meaningful.

We hope you enjoy reading, and as always, thank you for being part of this growing and vibrant community.

Ekin Özman

A testimonial for Tony Ezome

It is with great sadness that we announce the untimely passing of our friend and colleague Tony Ezome, who died in an accident on October 5, 2025, in Libreville, Gabon, at the age of 45.



Annual CWM Meeting 2019, Trieste. Tony Ezome is third from left.

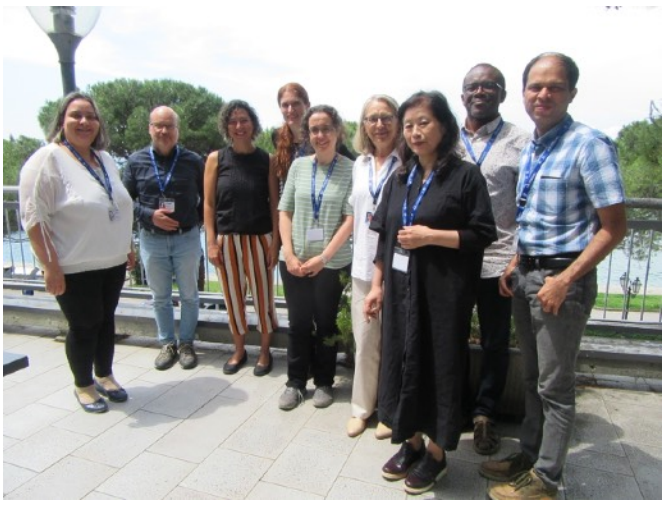
Tony was appointed a member of CWM in 2019 by the IMU Executive Committee and was reappointed for a second term in 2023. Throughout these years, he served CWM with great commitment and enthusiasm, demonstrating remarkable vision and leadership, especially on issues related to Africa. He was also actively involved in numerous projects aimed at developing mathematics across the continent. We have lost a wonderful colleague, a great friend, and a strong ally.

Tony's passing is a profound loss. Our thoughts and heartfelt sympathies are with his family, students, and colleagues. May he rest in peace.

Several institutions prepared tributes to Tony. Follow the links below to access them:

- African Network for Arithmetic Geometry and Applications (ANAGA)
- ICTP
- Société Mathématique de France (SMF)
- Institut National de Recherche en Informatique et en Automatique (INRIA)
- CIMPA newsletter

In addition to the many projects Tony was involved with in Africa, he was an important ally of women mathematicians and



Annual CWM Meeting 2024, Trieste.

made significant contributions to advancing the participation of women in mathematics in Africa. To honor these contributions, we invited **Marie Françoise Ouedraogo** to share her memories of Tony.

Testimonial by Marie Françoise Ouedraogo

My first interactions with Tony Ezome date back to 2013, when I was in charge of the commission "Women and Mathematics" of the African Mathematical Union (AMU) and Tony was ambassador of the ICM 2014 Invitation program NANUM 2014 . He was publicizing the program with special attention to women mathematicians. Since then, Tony encouraged and supported us in all activities such as organization of workshops and participation as lecturer to workshops. The creation of the African Women in Mathematics Association (AWMA) in July 2013 allowed us to set up a partnership between AWMA and PRMAIS to develop Teaching and Research in Mathematics in Africa. This collaboration included financial support to the organizers of workshops and to women participants to attend workshops organized by AWMA and other international events.

Tony Ezome contributed greatly to the promotion of mathematics in Africa and especially to the promotion of women mathematicians in Sub-Saharan Africa. He coordinated several projects with the support of organizations such as CIMPA, CNRS, INRIA, and the Simons Foundation. With the latter and its Africa Mathematics Project, he was head of two projects: the Pole of Research in Mathematics and their Applications in Information Security (PRMAIS) from 2013 to 2018 and the Pole of Research in Mathematics in Africa (PREMA) from 2018 to 2021. These projects involved researchers from diverse countries of Africa: Burkina Faso, Cameroon, Gabon, Niger, Nigeria, Madagascar, Senegal and Tunisia. To illustrate this collaboration, for instance in the Master's program in Mathematics at University Nazi

Boni (Bobo-Dioulasso, Burkina Faso), specializing in Mathematical Theories and Applications, Tony taught the course "Algebraic Geometry in Cryptography." He came to this University to teach in September 2018, September 2019, and November 2021. In September 2020, the year of the COVID-19 pandemic, he taught the course remotely. In 2021, he supervised the Master's thesis of a student, Sankara Karim. Through the various projects he coordinated, he ensured funding for the participation of researchers and students from Burkina Faso in scientific events he regularly organized or co-organized in Gabon, Cameroon, Benin and Côte d'Ivoire.

One of the objectives of these two poles, PRMAIS and PREMA, was to give a significant and distinctive dimension to the presence of women and to promote the development of mathematics among women in Africa in general. At the beginning of their implementation, there were four female members out of a total of ten. These women were all doctoral candidates and thanks to the scholarships awarded by these poles, they were able to successfully conduct their doctoral research and defend their dissertations. Within these poles, Tony Ezome appointed Amina Pecha to be in charge of the women in Mathematics section. Her role consisted of overseeing the development of mathematics among women in Africa, collaborating with networks of women mathematicians. To this purpose, she set up the Association of Cameroonian Women Mathematicians (CAWOMA) in 2016, in collaboration with the African Women in Mathematics Association (AWMA) and co-organized in July 2019 two major scientific meetings in Cameroon namely a CIMPA research school on "Algebraic Geometry, Number Theory and Applications in Cryptography and Robot kinematics" and an AWMA-workshop of African women mathematicians, an AWMA activity in the central region of Africa. This was done with financial support from PRMAIS and with the participation of Tony as organizer and lecturer. Finally, she also participated in several international scientific events, including RAIM (Rencontre Arithmétique de l'Information et Mathématiques – Arithmetic, Information and Mathematics Meeting)

at the Institut Henri Poincaré in Paris in 2014, the AWMA-workshop in Naivasha, Kenya in 2015, the Pan African Congress of Mathematicians (PACOM, W-PACOM) in Rabat in 2017, the International Congress of Mathematicians (ICM) 2018, and the first edition of $(WM)^2$ in Rio de Janeiro in 2018. Furthermore, it is important to note that the financial support provided by these poles increased the participation of young female students from Cameroon, Gabon, Congo, Senegal, Madagascar, and other African countries in several scientific meetings, such as the CIMPA schools and the AMS (African Mathematics School). Currently, there are more than ten African women with doctorates in mathematics who have benefited from the financial support of PRMAIS and PREMA.

Marie Françoise Ouedraogo is a mathematician and professor in the Mathematics Department at the University of Ouagadougou, Burkina Faso, where her research focuses on pseudodifferential operators and superalgebras. She holds the distinction of being the first woman in Burkina Faso to earn a doctorate in mathematics. A dedicated advocate for women in mathematics across Africa, she served as President of the African Women in Mathematics Association (AWMA), which was established in 2013 to contribute to the development of mathematics and women mathematicians throughout the continent. She was also a member of the Committee for Women in Mathematics (CWM) from 2015 to 2018, where she worked to advance gender equity in the mathematical sciences.

CWM NEWS

The third edition of (WM)² in 2026

CWM is very excited about the upcoming third edition of the World Meeting for Women in Mathematics (WM)², scheduled to take place on July 22nd, 2026, at the Pennsylvania Convention Center in Philadelphia, USA, as a satellite event the day before the ICM 2026. The (WM)² is held every four years in conjunction with the ICM and is dedicated to building a thriving worldwide community of women mathematicians. This third edition promises mathematical excellence, community building, and meaningful dialogue on advancing the participation and visibility of women in mathematics worldwide.

The scientific program will feature four invited research talks by:

- Kirsten Eisentrager (Penn State University, USA)
- Luz de Teresa (UNAM, Mexico)
- Chelsea Walton (Rice University, USA)
- Melanie Weber (Harvard University, USA)

In addition to these research presentations, the event will include a poster session, and discussions on key issues facing women in mathematics.

We are pleased to share that the ICM 2026 Travel Support Program will cover travel dates that include July 22, ensuring that grantees from developing countries can arrive in time to fully participate in (WM)².

More details, including registration, schedule, and the call for posters, will be available at worldwomeninmaths.org for updates. We expect to open registration for the (WM)² in December 2025. We look forward to welcoming the mathematical community in Philadelphia in 2026!

Postponement of the CWM Call 2026

The (WM)² and the CWM Call are CWM's main signature events, and while we are thrilled to host both initiatives in 2026, their co-occurrence will understandably have

a significant impact on our annual budget, requiring careful financial management. To ensure responsible stewardship of our resources, we have decided to temporarily postpone the launch of the CWM Call for proposals until we have a clearer picture of our budgetary constraints.

Please stay tuned for further updates. We hope to launch the CWM Call later in 2026.

News from the Standing Committee for Gender Equality in Science (SCGES)

- **SCGES Releases Recommendations:** SCGES has published three sets of recommendations, now available on its website and as downloadable PDFs. These documents offer guidance for promoting gender equality in science, both within scientific communities and at various levels of influence. The recommendations include:
  - SCGES Recommendations for Scientific Unions.
  - SCGES Recommendations for Instructors and Parents.
  - SCGES Recommendations for Science Local Institutions.

All three are informed by the findings of the Gender Gap in Science (GGS) Project and aim to support systemic change and inclusive practices across the global scientific landscape.

- **The SCGES fifth annual report is published.** Starting with a short synthesis by SCGES chair Carol Woodward, it contains a synthesis of the information obtained from Collecting Data on Gender Balance in Partner Unions, Working Group reports and short reports by 21 members of SCGES, all of which have a stated commitment to promote gender equality and women in science. Exchanging information on all related issues and making them visible is a major motivation for the partners who work together in SCGES. See here.

- **Women in scientific organizations: global evidence from science academies and unions.** The 13th SCGES webinar is organized jointly with ISC and IAP, on International Day of Women and Girls in Science – 11 February 2026 between 2 – 4 PM UTC. Here is the webinar registration form.

CWM Member Selma Negzaoui elected President of the African Women in Mathematics Association

CWM is delighted to announce that CWM Member Prof. Selma Negzaoui was elected President of the African Women in Mathematics Association (AWMA) on October 8, 2025. CWM warmly congratulates Prof. Negzaoui and the new AWMA Executive Board on their election, and wishes AWMA and the new board every success for the 2025–2029 term. AWMA will surely continue to serve, represent, and excel in supporting African women in mathematics.

For more information on the new AWMA Executive Board, please visit AWMA's website.

Below is a short testimonial from the new AWMA President, Prof. Selma Negzaoui:

I am deeply honoured and humbled to have been elected President of AWMA for the 2025–2029 term. This new responsibility represents both a privilege and a meaningful challenge. It opens a new perspective for me—one that combines service,

From left to right: Ini Adynia (Vice Secretary), Zeinab Mansour (Vice President for North Africa), Selma Negzaoui (President), Marie-Françoise Ouedraogo (Outgoing President), Faguèye Ndiaye (Secretary General), and Sophie Dabo-Niang (Treasurer). Picture courtesy of Prof. Samia Achour.

commitment, and the aspiration to contribute to a stronger and more connected community of African women in mathematical sciences.

As I look ahead, I feel a profound sense of responsibility towards the many women and young girls who aspire to pursue mathematics across Africa. AWMA has already built a solid foundation through its numerous initiatives, and I am committed with the new Executive Board, to building on this legacy. My vision for the coming years focuses on three main directions: strengthening collaboration across the continent and the diaspora, expanding opportunities for training and mentorship, and increasing the visibility and impact of African women mathematicians at regional and international levels.

I am confident that, through collective effort, we will continue to advance AWMA's role as a strong, dynamic, and inspiring association for generations to come.

OTHER NEW AND ANNOUNCEMENTS

2026 AWM Awards and Prizes at JMM

The Association for Women in Mathematics (AWM) will present the AWM Prizes and Awards at the AWM Reception and Awards Presentation on January 6 at JMM 2026 in Washington, D.C.

The 2026-2027 **Ruth I. Michler Memorial Prize** has been awarded to Martha E. Precup, Associate Professor of mathematics at the Washington University in St. Louis. Precup has been selected to receive the Michler Prize for her research interests which center on the rich combinatorics and algebraic geometry that arise in the study of flag varieties. More information is here.

The 2026 **AWM Service Awards** recipients are: Matthew Krauel, Assistant Professor, California State University, Sacramento, who is being recognized for his leadership of the AWM-JMM Organizing Committee, beginning as poster judge, continuing as poster judging coordinator, and finally moving into the role of committee chair; and Betsy Stovall, University of Wisconsin Professor of Mathematics, Letters and Science Mary Herman Rubinstein Professor, and AMS Associate Secretary for the Central Section, who is being recognized for spearheading the local organizing efforts to create a spectacular 2025 AWM Research Symposium in Madison.

The AWM Service Award, established by the AWM Executive Committee in November 2012, recognizes individuals for helping to promote and support women in mathematics through exceptional voluntary service to the Association for Women in

Mathematics. The award is given annually to a select AWM Volunteer or group of AWM volunteers in recognition of their extensive time and effort devoted to AWM activities. More information is here.

The recipient of the 2026 **AWM Research Prize in Algebra and Number Theory** will be Sarah Peluse, Associate Professor at Stanford University. Peluse is recognized for her breakthrough work in number theory, combinatorics, ergodic theory, and representation theory. Established in 2012, the AWM Microsoft Research Prize in Algebra and Number Theory was first presented in 2014. The prize is awarded every other year and serves to highlight to the community outstanding contributions by women in the field and to advance the careers of the prize recipients. Press release is here.

The 2026 **Louise Hay Award for Contributions to Mathematics Education** will be presented to Gerunda B. Hughes, Professor Emerita, Howard University. She is being honored for her exceptional contributions to mathematical assessment at all levels, her long-standing service to the education community, and her impactful work as a mentor and advocate for underrepresented students.

Established in 1991, the Hay Award recognizes outstanding achievements in any area of mathematics education. Louise Hay was widely recognized for her contributions to mathematical logic, for her strong leadership as Head of the Department of Mathematics, Statistics, and Computer Science at the University of Illinois at Chicago, for her devotion to students, and for her lifelong commitment to nurturing the talent of young women and men. The annual presentation of this award is intended to highlight the importance of mathematics education and to evoke the memory of all that Hay exemplified as a teacher, scholar, administrator, and human being. Press release here.

The 2026 **Gweneth Humphreys Award** will be awarded to Anant P. Godbole, Professor Emeritus of Mathematics and Statistics, East Tennessee University, and Adjunct Faculty, High Point University. The Award recognizes his significant and lasting contributions in mentoring and for his impact on the mathematics community.

This award is named for M. Gweneth Humphreys (1911–2006). Professor Humphreys earned her master's degree from Smith College and her PhD at age 23 from the University of Chicago in 1935. She taught mathematics to women for her entire career, at Mount St. Scholastica College, Sophie Newcomb College, and finally for over thirty years at Randolph-Macon Woman's College. This award, funded by contributions from her former students and colleagues at Randolph-Macon Woman's College, recognizes her commitment to and her profound influence on undergraduate students of mathematics. Press release is here.

The recipient of the 2026 **AWM Sadosky Research Prize** in Analysis will be Hong Wang, associate professor of mathematics at New York University's Courant Institute of Mathematical Sciences and permanent professor of mathematics at Institut des Hautes Études Scientifiques (IHES). Wang is recognized for solving central problems in Harmonic Analysis through the introduction of ground-breaking ideas. In particular, for substantial contributions to the Fourier restriction problem, the Kakeya conjecture, and Geometric Measure Theory.

Established in 2012, the AWM Sadosky Research Prize recognizes exceptional research in analysis by a woman early in her career. The award is named for Cora Sadosky, a former president of AWM, and is made possible by generous contributions from Cora's husband Daniel J. Goldstein, daughter Cora Sol Goldstein, and friends Judy and Paul S. Green and Concepción Ballester. Press release is here.

The 2026 AWM **Dissertation Prizes** will be presented to Naghmeh Akhavan(University of Maryland, Baltimore County) and Tejasi Bhatnagar (University of Wisconsin-Madison). The AWM Dissertation Prize was established in 2016, an annual award recognizing exceptional work in a dissertation defended in the last 24 months. The award is intended to be based entirely on the dissertation itself, not on other work of the individual. More information is here.

AWM will award the 35th Annual **Alice T. Schafer Prizes** for Excellence in Mathematics by an Undergraduate Woman to Khyathi Komalan, a mathematics major at California Institute of Technology, Chloe Marple, a mathematics major at Pomona College, and Saskia Solotko, a mathematics major at Tufts University. In 1990, the Executive Committee of the AWM established the annual Alice T. Schafer Prize for Excellence in Mathematics by an Undergraduate Woman. The prize is named for Alice T. Schafer (1915–2009), one of the founders of AWM and its second president, who contributed greatly to women in mathematics throughout her career. Press release is here.

You can read the old issues and subscribe the CWM newsletter here.

https://www.mathunion.org/cwm/about/cwm-newsletter

HUMANISTIC MATHEMATICS HUMANIZING MATHEMATICS: WHY NOW?

By Gizem Karaali, Pomona College

Why do you teach mathematics?

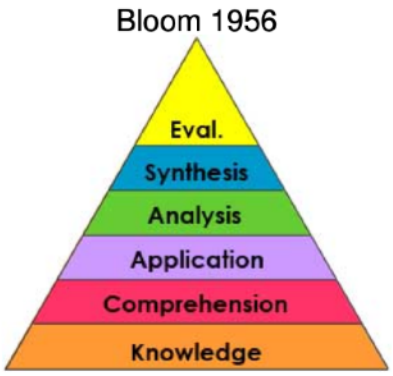
I have been teaching math for a while now and I have been asked this question many times. My very first answer to this has always been quite selfish: *Because I like it! I like math and I like teaching it.* Then I get more pragmatic: *Because they pay me to do it and because it's perhaps the only thing I know how to do well.* But the question is a tough one and it often transforms into the student question of "But why do I have to learn it?"

We have always had some stock answers to that second question: "Because it's useful." "Because it's good for you!" "Because it teaches you how to think!" And here's another one: "Because math is beautiful!" And yet another one: "You learn math, and we teach math because it's a human endeavor and learning it helps you, me, us, connect with our common human heritage."

We all know that these answers are not always enough to convince students. Honestly, they were not even enough to convince me fully, but I did not know what to do with that until I learned about Bloom's Taxonomy.

Bloom's Taxonomy is a classification of types of educational tasks and objectives educators use it to evaluate the learning tasks they design to achieve certain educational goals. The original taxonomy dates back to the 1950s, when a committee convened to develop language and models to help educators design and improve curricula and assessment tasks. The final classification that became known as Bloom's Taxonomy comes from The Taxonomy of Educational Objectives: The Cognitive Domain, published in 1956. Then later in early 2000s, Anderson and Krathwohl completed a systematic revision of the taxonomy, replacing nouns with verbs to describe the six levels.

As you can see on the left in the figure below, the triangle describing the original taxonomy has only nouns for the different levels, and evaluation is the highest level. On the right, you see the revised taxonomy, which uses verbs instead. You can also see that the



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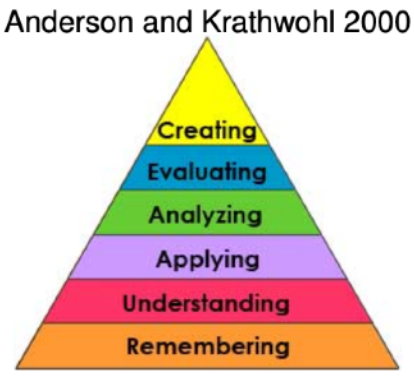


Image source: http://www.odu.edu/educ/roverbau/

top two levels have been switched: evaluating becomes level five while creating (synthesis) becomes level six.

When I first learned about Bloom's Taxonomy, I felt forced to think more carefully about the types of assessment tasks I was using in my own teaching, and I realized that teaching math to encourage the types of thinking that could rise to the higher levels of Bloom's Taxonomy was quite a challenge. Along the way I began to think more intentionally about what makes a good homework problem and what makes a good test problem.

Below I share with you two pairs of "good problems". The first is from a standard calculus textbook[1]:

Consider a rectangular plot of land measuring 100 feet by 200 feet. The corners are labeled as follows:

- **A**: bottom-left corner
- **B**: top-left corner
- **C**: top-right corner
- **BC**: the top horizontal side, 200 feet long

Point **P** lies somewhere along side **BC**, at a distance x from **B** (so the distance from **P** to **C** is 200 - x). The vertical distance from **A** to side **BC** is 100 feet.

Pipe is to be laid from **A** to **P** (cutting diagonally across the lot underground), and then from **P** to **C** (along the side of the plot). The cost of laying pipe through the lot is $30 per foot, while the cost of laying pipe along the side of the plot is $15 per foot.

a) Let f(x) be the total cost, where x is the distance from **P** to **B**. Determine f(x). Note that f is discontinuous at (x = 0) (when (x = 0), the cost of the entire pipe is $15/ft).

b) What is the most economical way to lay the pipe? What if the cost along the sides is $24/ft?

[1] Calculus by Jon Rogawski (2007)

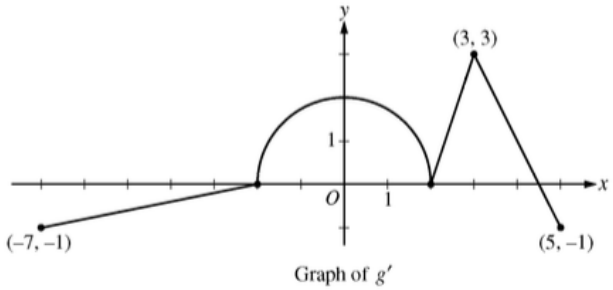
This is a typical optimization problem, and it is a solid one. You might say it involves quite a bit of thinking. But wait! Let us look at a few pages earlier in the book. Here is a solved problem from the same chapter:

Cowboy Clint wants to build a dirt road from his ranch to the highway so that he can drive to the city in the shortest amount of time. Clint's ranch is located 4 miles away from the highway, measured perpendicularly. Directly across from the ranch, on the highway, lies a reference point. The city is situated 9 miles farther down the highway from this reference point. Clint can choose a point **P** on the highway to connect his dirt road. If he connects at point **P**, then:

- The dirt road runs diagonally from the ranch to point **P**, with length $\sqrt{4^2 + x^2}$, where x is the horizontal distance along the highway from the reference point to **P**.
- From point **P**, Clint continues along the highway to the city. The remaining highway distance is 9 - x. The speed limit is 20 mph on the dirt road and 55 mph on the highway.

At what point along the highway (i.e., what value of (x)) should Clint join the dirt road so that his total travel time is minimized?

This is almost the same problem. with a figure that would be almost the same for our hard problem. But of course, you say, textbooks are for teaching and learning, so solved examples like the homework problems will be there for sure. So then I give you a second set, from the Calculus AB Advanced Placement (AP) exams. On the left, is a free-response problem from 2010.



Graph of g'

5. The function g is defined and differentiable on the closed interval $[-7, 5]$ and satisfies $g(0) = 5$. The graph of $y = g'(x)$, the derivative of g, consists of a semicircle and three line segments, as shown in the figure above.

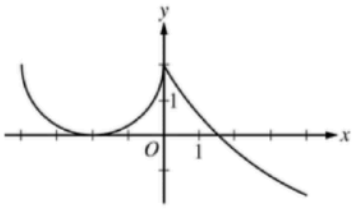
   (a) Find $g(3)$ and $g(-2)$.

   (b) Find the x-coordinate of each point of inflection of the graph of $y = g(x)$ on the interval $-7 < x < 5$. Explain your reasoning.

   (c) The function h is defined by $h(x) = g(x) - \frac{1}{2}x^2$. Find the x-coordinate of each critical point of h, where $-7 < x < 5$, and classify each critical point as the location of a relative minimum, relative maximum, or neither a minimum nor a maximum. Explain your reasoning.

This question brings together a whole lot of mathematical ideas that the student is supposed to engage with in order to solve it. But wait! Let's look back a year! Here is a free-response question from the 2009 AP Calculus AB exam:

Let us now ask productive teacherly questions like "What do you notice and what do you wonder?" Well, I notice that if I have seen this 2009 problem before, the 2010 problem will be quite doable. And I wonder, is our job as math instructors only to train students to be able to solve problems they have seen before?



Graph of f'

6. The derivative of a function f is defined by $f'(x) = \begin{cases} g(x) & \text{for } -4 \le x \le 0 \\ 5e^{-x/3} - 3 & \text{for } 0 < x \le 4 \end{cases}$.

The graph of the continuous function f', shown in the figure above, has x-intercepts at $x = -2$ and $x = 3\ln\left(\frac{5}{3}\right)$. The graph of g on $-4 \le x \le 0$ is a semicircle, and $f(0) = 5$.

(a) For $-4 < x < 4$, find all values of x at which the graph of f has a point of inflection. Justify your answer.

(b) Find $f(-4)$ and $f(4)$.

(c) For $-4 \le x \le 4$, find the value of x at which f has an absolute maximum. Justify your answer.

Let me say this as a factual assertive statement: "Our job is to train students to solve problems they have seen before." How do you like that job description?

I don't like that job description at all. My frustration is best captured by John Steinbeck, who writes in The Log from the Sea of Cortez:

The lies we tell about our duty and our purposes, the meaningless words of science and philosophy, are walls that topple before a bewildered little "Why".

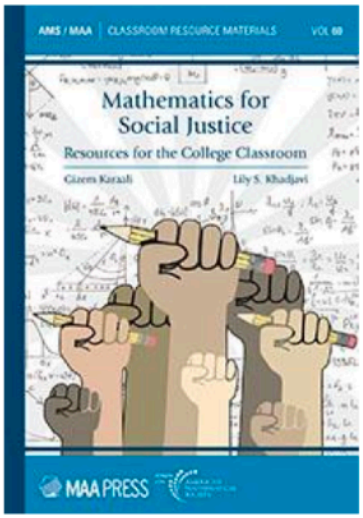
You might think that maybe calling our purported goals of teaching math a "lie" is a little too strong. How about calling it a myth? Many years ago while I was ruminating on these very questions, I came across the article "Peddling the myth: why do we teach mathematics" by Paul Andrews, who writes in his abstract:

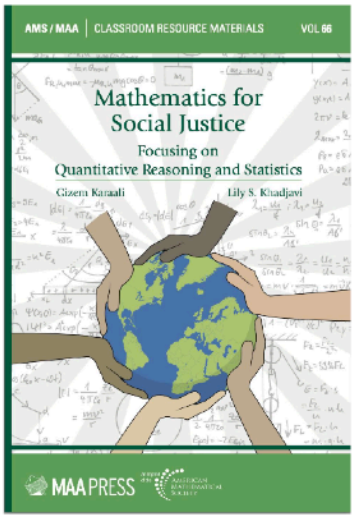
The continuing tradition of justifying mathematics on the basis of its usefulness is a stumbling block to mathematical education [...] Tasks that teachers perceive to be embedded in some form of real-world reality trivialize mathematics, patronize children with their banality, and undermine children's natural inquisitiveness. Mathematics teaching needs to focus on mathematics for what it is and not on its applications.

Andrews's article is really good, and it was great for me to read at the time, and I fully recommend it. But for a more comprehensive answer to the "why teach math?" question, I needed to look further. It was Paul Ernest whose writing came to the

rescue for me. In his article "Why teach mathematics?" Ernest listed four good reasons for why we should teach mathematics:

- To reproduce mathematical skill and knowledge-based capability
- To develop creative capabilities in mathematics
- To develop empowering mathematical capabilities and a critical appreciation of the social applications and uses of mathematics
- To develop an inner appreciation of mathematics: its big ideas and nature





Two books on teaching math for social justice, coedited by the author. Students want to know why they are learning mathematics. Math for social justice content allows them to see math as a living medium which can empower them to solve the urgent problems they (and their communities) care about.

Only when I read this article could I begin to feel like I was no longer drowning. Then I decided to see what math education researchers thought about the question "why teach math?" Together with a few students I began a project on the purposes of mathematics education. We dug deep into the first two volumes of an esteemed math education research journal (Educational Studies in Mathematics) to see what we could find through computational methods for text analysis that were slowly becoming more and more popular at the time. Our analysis allowed us to isolate five general goals of for mathematics education. Math is taught because:

- ... it is elegant and beautiful as a subject.
- ... it provides students a rigorous way of thinking.
- ... it provides students an intuitive way of thinking.
- ... it is useful to know some math in life (Quantitative Literacy).
- ... it is useful to society (Scientific / Advanced Applications).

Back in 2014, I was quite satisfied by these this five-cluster categorization of mathematical education goals. I felt like I finally knew why I was teaching mathematics, and from that time on, my goal would be basically to figure out how to do this job well.

Then ChatGPT burst onto the scene in November 2022.[2]

Already in December of that year people were predicting the end of the world or at least the end of the academic essay. We math instructors might have felt a bit more immune at least for a bit because as I wrote in January 2023, the large language model ChatGPT was based on could not yet solve some very basic math problems. But this one is young and keen, and it learns really fast: today ChatGPT can do a whole lot more. In particular it can solve many more standard math problems; it can write python code and produce functional LaTeX code; it can also create striking visuals, interpret images, and decipher human handwritten math. It can also refer to real-time information via its integration through search engines and browsers.

Students from the author's class who are proudly displaying the Sierpinski pyramid they built together. When students build mathematically interesting constructs together, they have fun and also find new ways to make math their own.

I have written elsewhere my thoughts on the many ethical considerations about generative AI for the mathematics classroom. But ChatGPT is not the only artificial intelligence of interest to mathematics instructors and mathematicians. The legacy of the 1976 computer proof of the four-color theorem lives on and with a vengeance. Today there is a lot of work on artificial intelligence systems that can support mathematical reasoning activities of human mathematicians and perhaps even take over as needed when things get too complex. For a review of where things stand these days with respect to AI for mathematical reasoning, you can check out the second issue of Volume 61 of *The Bulletin of the American Mathematical Society*, available online freely, as well as the recent publication of the United States National Academies of Science, titled *Artificial Intelligence to Assist Mathematical Reasoning*, also available online for free.

Perhaps all this might not seem immediately relevant to folks teaching math (unless you are teaching a proof-based class, in which case there's a more obvious

[2] Here I use the name ChatGPT like many folks use the words "Kleenex" and "Coke"; these are each the specific names for specific brands, but we use them casually to stand for a whole family of products marketed by a wide range of commercial entities. So when I write ChatGPT, you can also include all its siblings there, like Claude, Perplexity AI, Gemini, Bard, Copilot, and so on.

pedagogical argument to be made that theorem provers might be helpful). So let us limit ourselves here to the immediate classroom implications of currently available mainstream platforms based on generative AI.

Sasha Sidorkin, an educator who has been writing about AI and education for a while, says:

I am struck by the immensity of the challenge before us. It is not just about adapting to a new tool; it is about redefining the very foundations of how we teach and learn. It is about finding a way to harness the power of AI without sacrificing the soul of education. This is a journey that will require bold experimentation, deep collaboration, and a willingness to embrace the unknown. But it is a journey we must undertake, for the stakes are too high to ignore. The future of education hangs in the balance, and it is up to us to shape it with wisdom, courage, and a steadfast commitment to the human experience of learning.

I agree.

Coming back to the original question of why we teach math, we might now ask: Has anything changed? We know that math has not changed. But why should we teach math at this point in time as both the math we teach at school and the math mathematicians do in their practice become more and more accessible to artificial intelligence? Why should human children need to learn math if one day soon, machines will do it for them? Some folks will say that that day is not here yet, but we should probably not put all our eggs on that "yet" basket.

But even if or when a time comes where machines can design and program themselves and solve many of our mathematical problems much faster than we can on our own, I believe there should be room for mathematics in a good education. So here is my updated answer to why we should still teach math (and if not forever, at least for the foreseeable future):

Mathematics is about asking questions, solving problems, trying to understand big pictures. It is still beautiful and elegant. It can still provide students a rigorous way of thinking and an intuitive way of thinking. It is still useful to know some math in life, and it is fundamental for scientific and other advanced applications, perhaps now even more than before. And math is still very much a human endeavor.

We need to build on that humanity to make sure our original goals are still a part of the mission of mathematics education. This requires us to add to our goals, if

we have not already done so, attending to the humanity of our students[3]. In short we cherish the humanity of mathematics all the while benefiting from machines that can help us solve harder and harder problems. We cherish its beauty and elegance where truth of a statement is never the only value worth seeking. We build on its capacity to teach students to think systematically and creatively. We educate quantitatively literate future citizens of the world who can comprehend quantitative information and relationships whenever they come across them in their daily lives and careers. We support and train tomorrow's scientists and researchers who will build upon today's knowledge to reach further heights. And all throughout, we cherish once more the humanity of our mathematics and, of course, of our students.

An easily accessible platform for humanistic mathematics, Journal of Humanistic Mathematics.

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[3] I have a lot more to say about this, but I am running out of words. So for now, I will simply refer you to texts like *Rehumanizing Mathematics* and to outlets like the Journal of Humanistic Mathematics., an open-access journal that publishes articles focusing mainly on the doing of mathematics, the teaching of mathematics, and the living of mathematics. As such, the content explores the aesthetic, cultural, historical, literary, pedagogical, philosophical, psychological, and sociological aspects of mathematics to emphasize its nature as a human endeavor.