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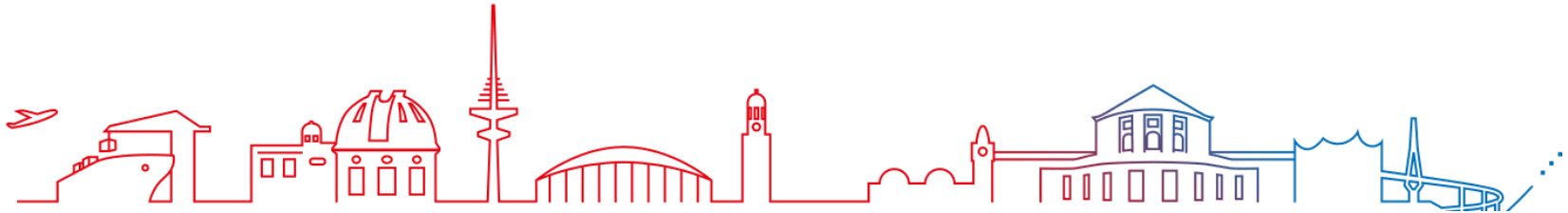
FAKULTÄT
FÜR MATHEMATIK, INFORMATIK
UND NATURWISSENSCHAFTEN



Diversity in Mathematics:
Who belongs to mathematics ?

Andrea Blunck

Agenda

1. Intro
2. History
3. Belonging to mathematics
4. What is mathematics?
5. Best practice examples

1

Intro

Who belongs to mathematics?

Goal:

- Diversity in mathematics
- Let more women and people from minority groups be part of mathematics

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these students feel out of place and lack a sense of belonging

[www.stemwomen.com, on women and non-binary students in STEM fields]

Who belongs to mathematics?

What does it mean to

- belong to mathematics?
- be a mathematician?
- become a mathematician?

Who belongs to mathematics?

What does it mean to

- belong to mathematics?
- be a mathematician?
- become a mathematician?

- Are you a mathematician? Why?
- How did you become a mathematician?

Pictures of mathematics

Draw a mathematician

Susan Picker, John Berry (2000): Investigating Pupils' Images of Mathematicians, Educational Studies in Mathematics 43

- „Draw a mathematician“ test
- 215 children of different ages in the USA, Great Britain, Finland, Sweden, Romania
- almost all pictures show men, mostly white middle-aged men with bald head or messed-up hair

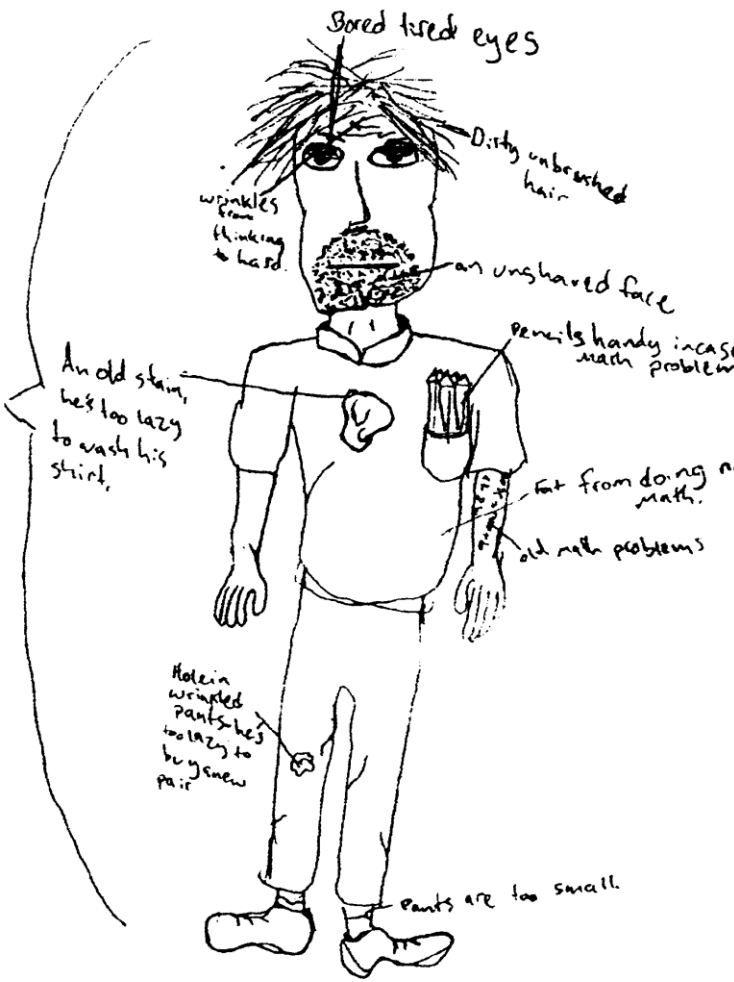
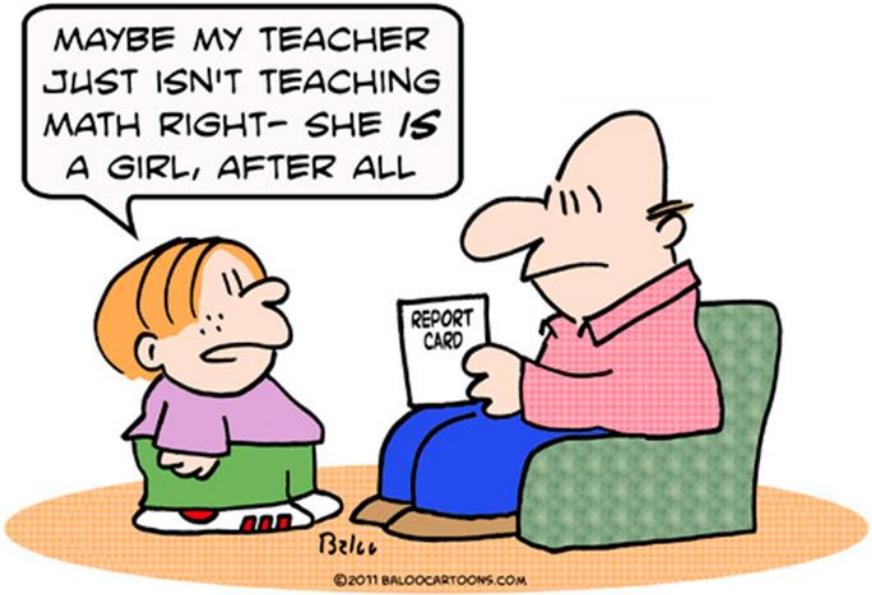
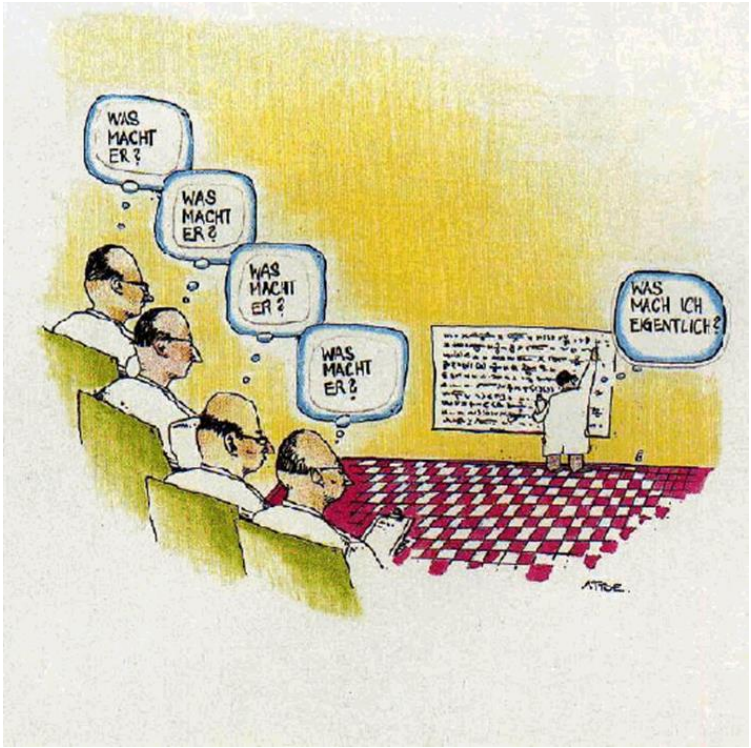


Figure 1. Male 7th Grade (UK Year 8) Pupil.

Pictures of mathematics





2

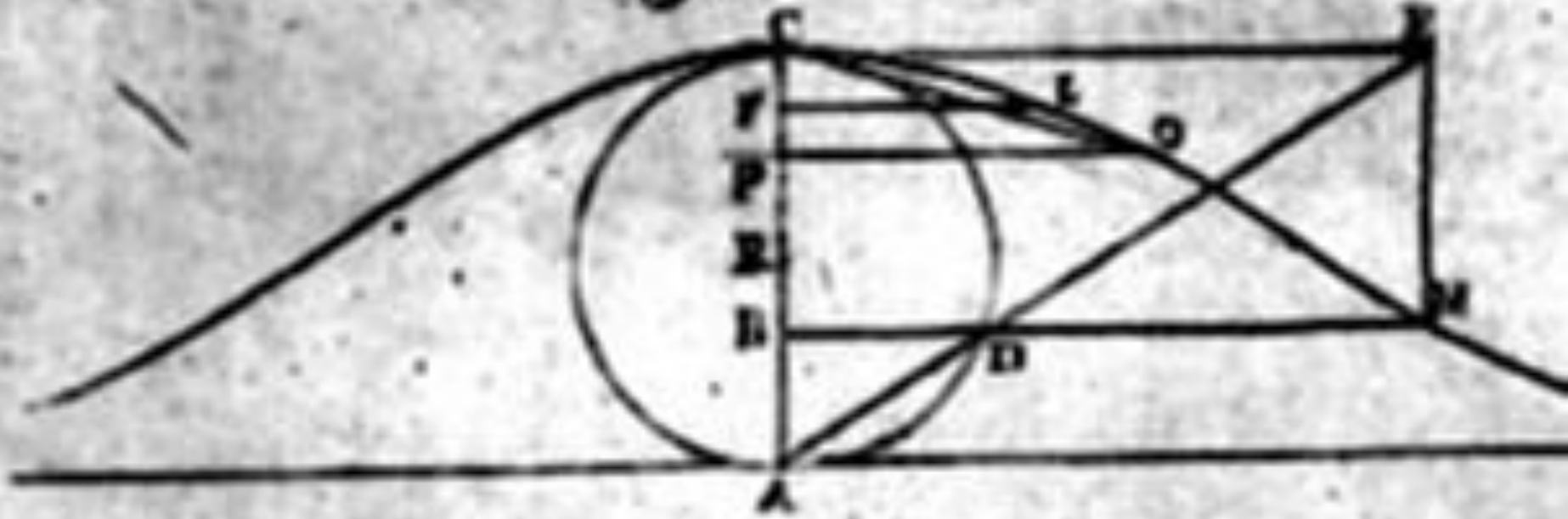
History

Women in the history of mathematics

Maria Gaetana Agnesi (1718–1799)

- Child Prodigy. Performances at her father's evening parties
- Self-study of maths (private tutors, correspondence)
- 1748 Instituzioni Analitiche ad Uso della Gioventù Italiana (first textbook on analysis in Italian language)
- Well-known to a broader public, not part of math community

Witch of Agnesi



Sofja Kowalewskaja (1850–1891)

- Sham marriage in order to be able to study in Germany
- Studies only possible with special authorization by the individual professors
- 1874 Doctorate in Göttingen (first female doctorate in mathematics in Germany)
- First female professor of mathematics (Stockholm 1884)
  - newly founded university
  - death of her husband
- Part of the mathematics community

Grace Chisholm Young (1868–1944)

- Studied at Girton College, Cambridge
- 1895 Doctorate in Göttingen
- 1896 Marriage to William Henry Young, six children
- Grace Chisholm Young never had a job in academia.
- She researched and published, often together with her husband, and contributed to almost all of her husband's publications, often without being named.

The fact is that our papers ought to be published under our joint names, but if this were done neither of us get the benefit of it. No. Mine the laurels now and the knowledge. Yours the knowledge only. Everything under my name now, and later ... everything or much under your name. At present you cannot undertake a public career. You have your children. I can and do.

[from a letter of William Henry Young to Grace Chisholm Young]

Mathematische Gesellschaft in Göttingen 1902

Women in the history of mathematics

- No access to institutions
- No formal education
- No regular way into mathematics

- Some were seen as part of the mathematics community, others not
- All of them were seen as „exceptional“

Institutions

Michael Barany: Mathematical institutions and the “in” of the Association for Women in Mathematics (2022). In: Beery, Janet L., et al. (eds.): Fifty years of women in mathematics. Reminiscences, history, and visions for the future of AWM.

- Ecole Polytechnique in Paris: established with a focus on the “male” areas of engineering or military. Women were excluded by default.
- Ladies‘ Diary: mathematical periodical (established in 1704) that made recreational mathematics a space open for women.

3

Becoming a mathematician

Becoming a mathematician

Margaret A.M. Murray: Women Becoming Mathematicians. Creating a Professional Identity in Post-World War II America. MIT Press 2000.

Interviews with 36 female math PhDs of the 1940s and 1950s.

In contrast to many male colleagues,

“these women have had neither the time nor the inclination to focus on mathematics to the exclusion of other social, personal, and intellectual concerns.

Moreover, for each of these women, becoming a mathematician meant creating a *modus vivendi* that minimized the conflict between the two cultures of post-war American mathematics: the lower-status, female-identified culture of teaching, and the higher-status, masculine culture of research.”

Becoming a mathematician

"...nine of the interviewees clearly identify themselves primarily with the research role. All nine have been involved in teaching, and some have held important administrative leadership posts; but mathematical research is the activity they talk about the most in their interviews, and research is their top professional priority. Thus they have enjoyed a high degree of consonance between their own goals and the values of the postwar mathematical community.

At the same time, the unfolding of their lives and careers has diverged sharply from the timetables in the myth of the mathematical life course. Moreover, they hold subtly different views regarding their sense of identity as mathematicians."

Becoming a mathematician

Patricia Eberlein: distinguishes between *mathematicians*, „a certain set of people that work on mathematical problems, that think a certain way“, and people who are *in mathematics*, whose primary activity is teaching. Began to think of *herself* as a mathematician within a few years of completing the PhD, when she began to produce interesting research results on her own.

Tilla Weinstein: „I didn‘t even think of myself as a mathematician—I didn‘t think of that word for myself —until quite recently. I‘d say the first time that I felt that the mathematics I was doing was somehow, finally, flowing from inside of me, was right around 1980.“

Jane Cronin Scanlon: „I‘m pretty sure that I never think that I *am* a mathematician. Sometimes I *do* mathematics.“

Lack of self-confidence

Becoming a mathematician

Lack of self-confidence

Two German studies by Irene Pieper-Seier et al., early 2000s:

- Female students of mathematics, although as successful as male students, lack self-confidence and therefore hesitate to take the risk to do a PhD.
- Moreover, they lack positive feedback and encouragement.
- Female math professors all did receive positive feedback and encouragement.
- Some of them in their career had doubts about their own abilities.
- But none of the female professors with a GDR background had such doubts.

Becoming a mathematician

Lack of self-confidence

www.science.org:

Academics who believe “brilliance” is a prerequisite for success in their field are more likely to doubt their abilities. It’s a problem that disproportionately affects women, particularly those from underrepresented racial and ethnic groups, according to a new study.

The authors recommend that academics wanting to increase the diversity of their field should try to downplay the importance of innate ability for success.

S.J. Leslie, et al.: Expectations of brilliance underlie gender distributions across academic disciplines (2015), Science 347.

”

More emphasis on the concrete steps that one can take to become a productive member of the field would probably be welcome.

[www.science.org]

4

What is mathematics?

What is mathematics?

- What is maths, what is not maths?
- Where are the boundaries?

The answers may depend on the culture.

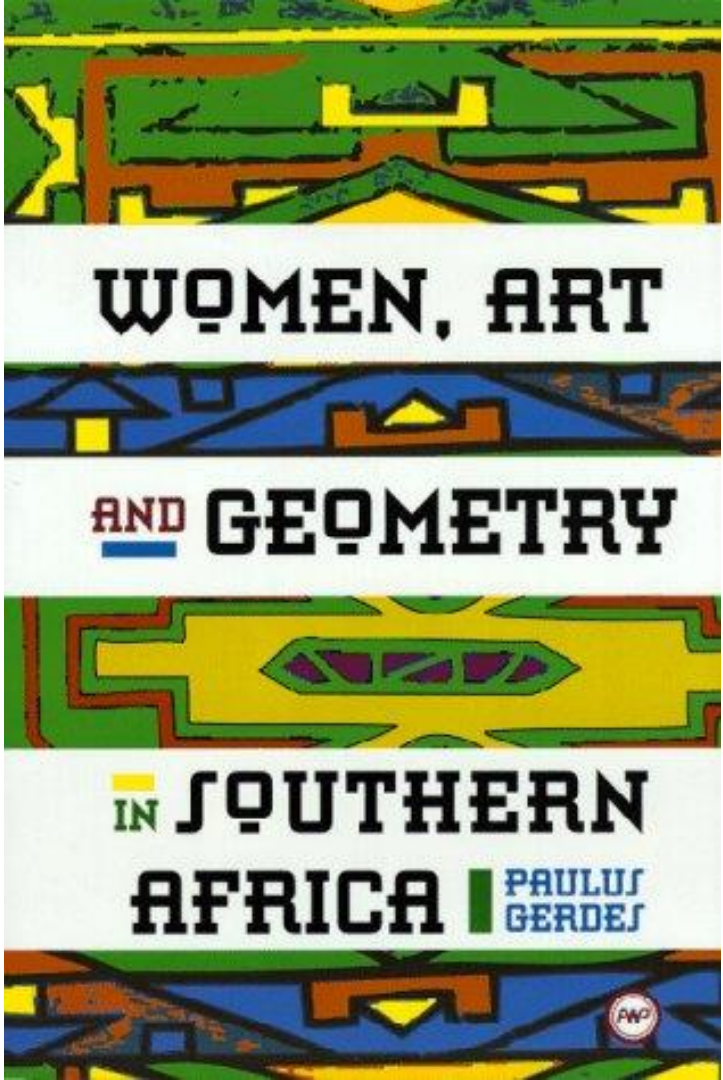
Ethnomathematics

What is mathematics?

Ethnomathematics:

- Mathematics of non-Western cultures
- also implicitly mathematical practices
- e.g. in crafts, art, architecture
- often carried out and handed down by women

Paulus Gerdes: Women, Art and Geometry in Southern Africa, 1998



What is mathematics?

From a review of Gerdes' book, by Jens Høyrup:

„In the present book, the author continues his investigations of the mathematical – in particular geometrical – thought of African cultures and of its possible utility in mathematics teaching in an African context. It concentrates on women's geometrical creations, in part because women students may need extra encouragement in Africa as elsewhere in order to counterbalance the model mathematician normally presented in cosmopolitan mathematics education, but mainly because women are the sophisticated geometers in the cultures that are dealt with in the book: they decorate the houses, they weave bags and baskets from coloured straw, they make tattooings – and some of them are experts who guide others. Here as elsewhere, sophisticated mathematics is a specialist's business, as reported in various places in the book. The notion of „sophisticated mathematics“ is justified, even though the specialists in question do not look at themselves as „mathematicians“, a role for which traditional society has no space....“

5

Best practice examples

Best practice examples

- Resources
- Teaching

Best practice examples

- **Resources**
- Teaching

”

More emphasis on the concrete steps that one can take to become a productive member of the field would probably be welcome.

[www.science.org]

Women of Mathematics from around the world

Her Maths Story

About Her Maths Story

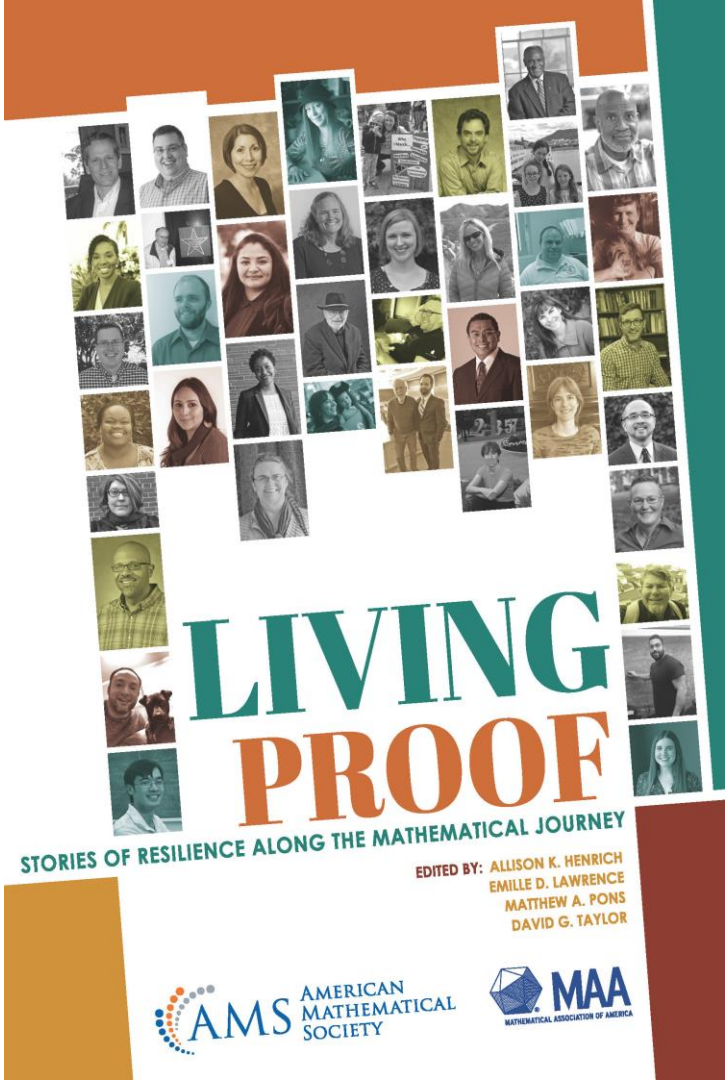
You are (thinking about) studying mathematics or have a background related to natural sciences? You are sometimes struggling in this male dominated area? You are doubting if you are good enough, clever enough and courageous enough to achieve what others seem to easily achieve in their careers?

Be our guest, we and many others have been there and we feel you. By sharing stories of other women in mathematics we want to encourage you and pass on the support we have received from role models, among others, at different moments in our lives.

Here you can find stories about women pursuing their careers in mathematical jobs to show you the endless possibilities of maths.

Our aim is to provide a platform that is informative, non-judgemental, honest, motivating and enjoyable. We hope you'll learn about women in STEM in a way that we would have loved to when we were in school or at the beginning of our studies.

Living Proof

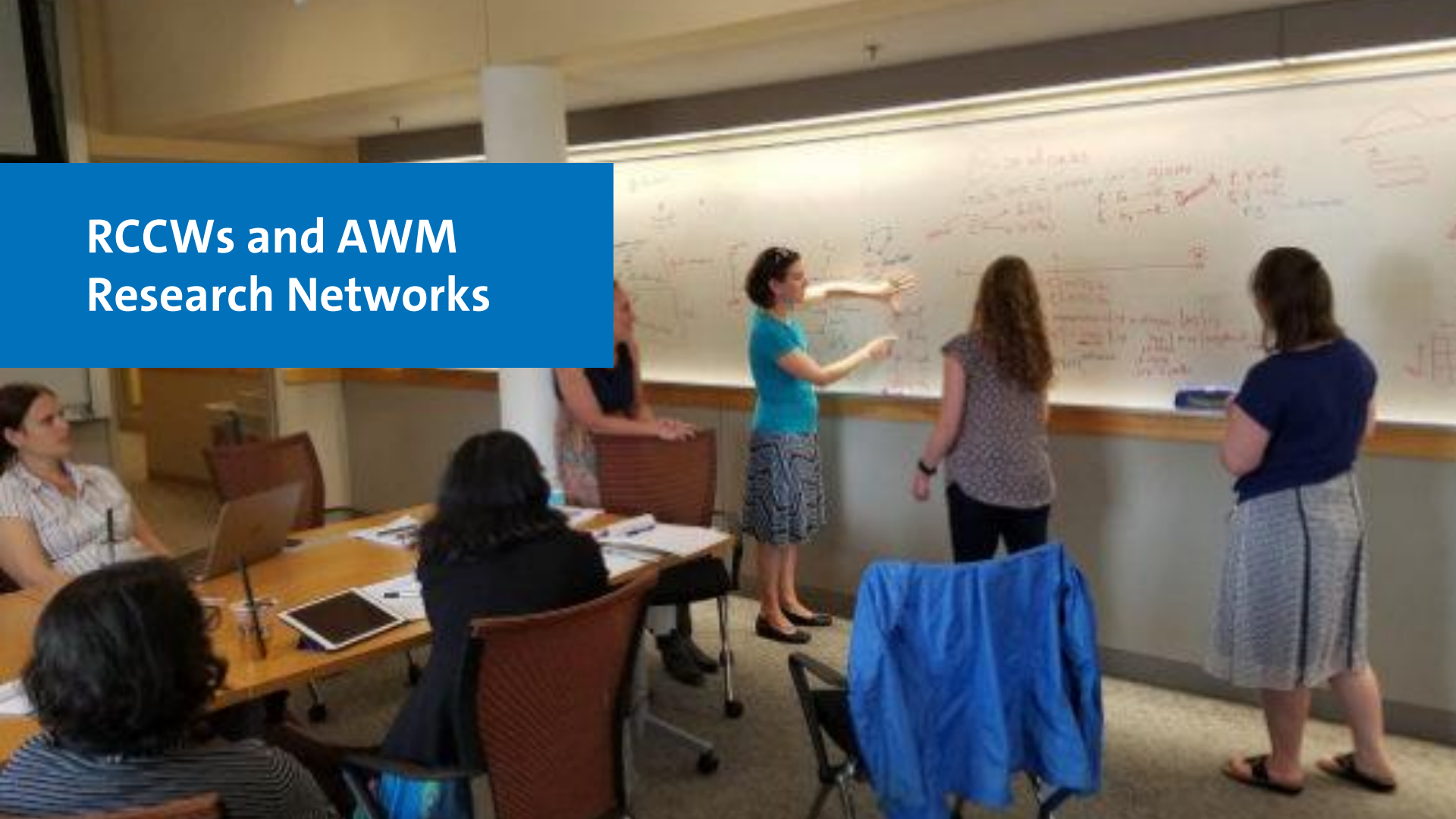


Living Proof

Living Proof: Stories of Resilience Along the Mathematical Journey is a book that was published in 2019 jointly by the MAA and the AMS (available for free download). It is a collection of stories written by 41 highly-successful mathematicians about issues they've grappled with in their math education or careers and how they've responded to these challenges. These are the stories that do not often get told out loud. They are whispered, usually among friends, or in places where someone feels safe to let their guard down. Some are about struggling to understand mathematical concepts, feeling isolated and losing confidence. Some are stories that shine a light on the racism and sexism marginalized mathematicians in our community have experienced. Every author's journey includes obstacles overcome. Some have helpful and hopeful messages, while others still stand as a challenge to the math community to do a better job welcoming and supporting anyone who has an interest in mathematics.

While the narratives shared in the Living Proof book represent a wide range of experiences, we knew that there were still so many stories to share. So, in the Fall of 2019, we launched the Living Proof blog, hosted by the AMS.

RCCWs and AWM Research Networks



RCCWs and AWM Research Networks

Research Networks are research collaborations intended to grow and support a community of researchers working in a common area, fostering long-term collaborations.

Many networks start as Research Collaboration Conferences for Women (RCCWs), week-long conferences held at mathematics institutes where junior and senior participants come together to work on pre-defined research projects.

Best practice examples

- Resources
- Teaching

Best practice examples

- Resources
- **Teaching**

Teaching

Linda McGuire, Muhlenberg College, Allentown PA: *Promoting Inclusion by Tracing Our Mathematical Roots*

“Assignments helping students eschew thoughts like “Do I belong in mathematics?”, and take steps toward answering the question “Where do I belong in mathematics?”

An extended project in many of my mathematics classes asks students to write their own mathematical biography. ... students are encouraged to communicate their story. They are prompted with questions such as: What were the most significant moments in your mathematical journey and why? Where have you seen mathematics play an important role in your own lived experience? What were your triumphs? Failures? Who inspired you? What keeps you in the mathematics classroom? What advice on studying mathematics would you give to a younger version of yourself?

There are no right or wrong answers. It is all about sharing their story as they choose to and in an engaging way.”

Teaching

“Another assignment that aligns nicely, and is often coupled, with the completion of a mathematical biography involves asking students to create their own mathematical family tree. Prompted with readings from both the national and global history of mathematics designed to render visible all “math makers”, students are asked to identify historical or current figures in mathematics whose experiences somehow link to those of the student. Students must provide some rationale for each individual they choose to include. We typically share mathematical family trees as part of an interactive poster session at the end of the semester, with several in-class “check in” conversations throughout the project process. ...

Depending on the situation, I often share my own biography and mathematical family tree (to date) with my students. My goal is simply to make clear that I am their ally and that I seek to create an inclusive and affirming space for students in my classroom.”

Teaching

Sarah J. Greenwald, Appalachian State University, North Carolina: *Importance of incorporating women's and minorities' achievements into classrooms*

Important to include:

- **mathematics**: “Women and minority mathematicians should be discussed in the context of their mathematics .... Not only does this help students view these women and minorities as real mathematicians, but it also helps students relate to the mathematics.”
- **living role models**: “our students identify more easily with living mathematicians and, in the case of women students, women mathematicians, so it is important to include them. Over the course of two years, five introductory classes were asked which mathematician they most identified with. While more than half of the mathematicians we studied were no longer living, a higher percentage of students in every class identified with a living mathematician.”

Teaching

Important to include:

- **mathematicians with diverse styles**: “One student reflected, `Learning about mathematicians and their styles helps you appreciate all the hard work they did to make your life easier.´ Not only do students appreciate and identify with these mathematicians, but including mathematicians who have different mathematical styles encourages students to reflect on how they do mathematics and helps to improve their self-confidence.”

”

In addition, numerous students have told us that studying the diverse ways mathematicians conduct research helped them to begin thinking of themselves as mathematicians.”

Thank you for your attention!

Questions and discussion