Students' obstacles to "belonging" to the mathematics community

Noel-Ann Bradshaw and Tony Mann

University of Greenwich

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I loved mathematics and I was good at mathematics; I was also certain I did not have what it took to be a mathematician.

Sara N. Hottinger

Author, *Inventing the Mathematician: Gender, Race, and Our Cultural Understanding of Mathematics*

State University of New York, 2016

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Context

- We need more mathematicians (especially maths teachers)
- We want a diverse mathematical community
- We want promising mathematicians to feel they “belong” to the community

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What word did successful first year students use to describe how they felt on their first day at university?

TERRIFIED!

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Diversity

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Need to Diversify

- Mathematics pipeline is important for UK economy
- We have a lot of leaks!
- Many students who were good at maths become disillusioned with A-level or are not considered good enough to do A-level.

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A near miss

- I found **A-Level maths difficult** and interpreted my struggle as a sign that I was **not smart enough** to succeed. I **gave up** on a mathematical career and decided to pursue other interests. It was not until two years after I left school that I realised how much **I missed it**. I worried that I had given up too early and, by counting myself out, had missed the opportunity to do something I loved.

  Robyn Goldsmith (BSc Mathematics graduate and current PhD student at Lancaster University)

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Barriers to belonging

- Lack of diverse and relatable role models
- It is not clear what a mathematician does
- No one talks about the state/benefits of being stuck
- It’s assumed that you understand the language used
- The transition from school to university still needs improving

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Being stuck

When I first started my degree, I had **little confidence** in my ability. Believing I did not have what it took to finish, I set a goal to just make it through to the end of the first term. My lecturers at Greenwich were the ones who really changed my outlook. They taught me that **being stuck is an essential part of being a mathematician**.

I remember one particular conversation where my lecturers spoke about how the most successful mathematicians are stuck for years, if not decades, on just one problem. **I learnt then not to be discouraged by finding things difficult** and realised that maybe the only person that was holding me back from being the mathematician I wanted to be, was me.

Robyn Goldsmith

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How to diversify?

- Whilst many universities will still stick to A-level maths others will need to be aware of other entry requirements that could feed into maths degrees:
  - Core maths
  - T-levels
  - Access courses
- These may need changes to first year modules or a foundation year.

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Belonging

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Tony's story

- White, male, straight, middle class, … every privilege going
- No doubts about my right to belong as a mathematics student

- School sent many to study maths at university
- Teacher recent Cambridge maths graduate
- Well versed in maths notation and culture
- Well trained in exam technique

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Contrasts

Tony:

- Financially secure with student grant
- Supportive family all with university experience
- No caring responsibilities
- No health problems
- Lived 2 minutes from lecture rooms

Many of today's students:

- Must earn money as they study
- First generation at university
- Have children or other caring responsibilities
- May have health problems
- May have long journey to university

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Obstacles to belonging

- Lack of role models
- Lack of confidence
- Microaggressions

- See Francis Su's two short articles on "Mathematical Microaggressions"

- Microaggression: a small but commonplace verbal or behavioral slight that can be insulting in light of one's identity in a stereotyped group.

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Possible microaggressions

(i) Language like “obvious”, “trivial”, “easy”

(ii) Symbols like α, β, ϕ, ψ, …

(iii) Examples referring to Peter, John, Bill, …

(iv) Apparent assumptions that “mathematicians” are male, white, …

(v) Use of gender as example of a binary variable

Other ways to accidentally exclude people:

- Jokes they don’t get
- Cultural references they don’t get
- References to sports they don’t understand

These all lead people to feel they don’t belong!

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History and names

- Mathematical history is diverse but most of the mathematicians students hear about in the curriculum are white men

- Names of results can be problematic
- (“Marriage Theorem”)
- Some results are named after people with unpleasant views – how do we deal with that?

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Assessment

- People are good at different kinds of assessment
- (Sir Roger Penrose needed extra time in exams!)
- Assessment is stressful
- Damaging for health of students and staff
- Do we sufficiently consider how assessment affects diversity?
- 2020 (with no traditional exams) saw the biggest recorded drop in the BAME attainment gap

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Belonging to the community

- Communities create their identity though their language, conventions, jokes, etc

- On the one hand, sharing with students the community's conventions helps them to acclimatise
- On the other hand, feeling that they don't understand may lead them to feel they don't belong
- How can we help students feel that they belong to this community?

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Conclusion

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Conclusion

- We haven’t given answers
- There is tension between helping students getting used to unfamiliar mathematical practices and helping them to feel that they belong
- We should think about microaggressions
- And how to avoid unnecessary barriers
- The world has changed and today’s students don’t have the background some of us had in the past
- To meet the national need for tomorrow’s industries we need to diversify talent

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Thank you.

N.Bradshaw@gre.ac.uk
A.Mann@gre.ac.uk

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