

The connection between gender and school mathematics: the views of queer, trans and gender non-conforming students

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The nonbinary maths project works with queer, trans, and gender non-conforming students to map their experiences of learning mathematics and their experiences of learning gender, exploring the connection (if any) between the two. It seeks to reconceptualise the relationship between gender and students' emotional connection with mathematics asking: how might gender matter differently to mathematics education research? The project involved a short survey and in-depth interviews - this paper reports on open responses to one specific survey item: 'My experiences of learning mathematics were shaped by my gender expression/ identity'. We present data on three themes: navigating cis-binary stereotypes in maths, maths as a (un)safe space and the role of maths in creating gender identities. Our analysis suggests maths can operate as a 'third space' that empowers queer, trans and gender non-conforming students as they navigate a cis-heteronormative world.

Keywords: Gender, queer, trans, gender non-conforming, mathematics identity, exclusion.

Introduction

The nonbinary maths project seeks to challenge the dominance of cis-binary gender constructs (e.g. male/female) in the mathematics education literature (Becker & Hall, 2024) and the predominant focus on the gender gap in students' socio-emotional relationships with mathematics. Historically, such 'gap gazing' (Gutierrez, 2008) has fostered deficit assumptions such as 'what's wrong with girls?' and 'why don't more girls/women choose mathematically demanding careers?' and produced a plethora of intervention strategies focused on challenging math-gender stereotypes and promoting 'women in mathematics/STEM' with limited success. Our starting point is that such binary operationalisations of gender are problematic and unethical since they: a) project on to children/adolescents one of two binary sexes (e.g. male/female) rendering invisible the array of gendered identities (and further intersectional identities) they may be connected with, and b) consider gender to be a fixed background variable that influences learning outcomes (e.g. attainment) rather than recognising gender as (re)produced through social and cultural practices which can then mediate other outcomes such as attainment.

Qualitative work in mathematics education research has responded to these concerns highlighting the complexity of gender as heterogenous, intersectional (Leyva, 2017) and played out through dynamic struggle and contradictions (Francis, 2012). By centring analysis on how gender is (re)produced through social practices/discourses, attention is shifted towards how power operates through the dominant hegemonic discourse of 'doing mathematics as doing masculinity' (Mendick, 2006). For

example, a recent paper by Jaremus (2021) on gender heteroglossia highlights how the dominant monoglossic discourse of mathematics as masculine is persistently disrupted by/in contradiction with heteroglossic voices often performed by individuals who do not readily fit the dominant gender order such as those who identify as trans, queer or gender non-conforming.

For this paper we investigate this complexity further by analysing the school experiences of university students who self-identified as queer, trans and/or gender non-conforming. We have chosen to conduct this study with these students because they are under-represented in mathematics education research (Becker & Hall, 2024; Kersey & Voigt, 2021). Further, as gender minorities, they are likely to have been required to carefully reflect and justify their gender through their adolescence and beyond. As a result, these students may offer fresh insights into the connection between gender and mathematics.

Methods

As noted above, our project involved an online survey and follow-up interviews with university students (aged 18 to 24) who self-identified queer, trans and/or gender non-conforming studying in the UK (mainly England, but also some from Scotland). 63 students completed the survey and 18 of these took part in two 1-hour interviews. It is important to note that the UK presents a particularly toxic and hostile environment, particularly for transgender women and men. An important aspect of our research methods involved articulating this project as explicitly trans-positive, that is advocating for trans-liberation, including (but not limited to) full access to trans-affirming health care, self-determination and legal protection from discrimination.

Our brief online survey was originally intended to provide some initial information as a precursor for the in-depth interviews that followed. Here we focus on the question: ‘my experiences of learning mathematics were shaped by my gender expression/ identity’. Other questions on the survey asked about how participants’ gender identity or expression shaped their experience of school and whether this had changed since finishing secondary school.

We also asked participants to describe their gender identity through an open response question: How would you describe your gender identity? This resulted in 26 different descriptions (e.g. trans masc, genderfluid). We also collected data on participants’ ethnic identities in order to consider the intersections of race and gender and counteract the predominance of white narratives in LGBTQI related research. In this regard, our recruitment strategy was unsuccessful and requires further development. 71% (43 students) of our participants reported their ethnic group as ‘white’, ‘white British’ or ‘white Irish,’ whilst 19% (12 students), reported ethnic groups

including: Arab, British Asian, Eastern European, Indian, Mixed British Asian, Mixed White/Chinese, White-Black Caribbean and White-passing. 12.6% (8 participants) did not answer this question or wrote ‘n/a’.

Table 1: Students’ programme of study at university/college

Programme	Number of participants
A-level (3 subjects including maths)	4
Aerospace Engineering	3
Computer Science	3
Mathematics	17
Physics/Astrophysics	4
Humanities	14
Science Other (e.g. Chemistry)	5
Medicine	1
Psychology/neuroscience	2
Not given	10
Total	63

Table 1 above indicates the students' current programme of study – the majority of those who took part were studying STEM disciplines and most reported positive experiences of learning maths. We found it difficult to recruit students who dislike or hate maths which again highlights the need to develop our recruitment strategy.

Findings

The data presented below comes from open response comments in answer to the item: 'My experiences of learning mathematics were shaped by my gender expression/ identity'. We use thematic analysis to code the comments according to three themes: navigating cis-binary stereotypes in maths, maths as a safe/unsafe space, and the role of maths in creating gender identities. These themes emerged through our preliminary analysis of the interview data where we composed narrative summaries for each interviewee (using both interviews). We thought it would be interesting to go back to the survey data and code open comment responses using these same themes.

Navigating cis-binary stereotypes in mathematics

Perhaps unsurprisingly, many students wrote about binary gender expectations and stereotypes operating in mathematics classrooms at school (e.g. boys being 'good', girls underperforming/lacking confidence). Some comments were explicit about this oppression:

Further maths GCSE/A-Level were not offered at my all-girls school, despite being offered at the school for male counterpart. I think there is an intimidation about maths that discourages girls. When women are already told they are less than, aspiring for a more, a difficult subject seems inaccessible. I think women and girls have this idea of I'll never be able to understand, when faced with maths because of this inherent, lesser than quality. Whereas with male students, their confidence may surpass their abilities, meaning they go further in maths than they might otherwise. They're abilities are bolstered by confidence, while women's abilities are reduced by lack of confidence.

I was told by a maths teacher that I would never be as good as my cis male counterparts at maths, because that's what the stats say.

I was raised to be a woman and I saw myself as a girl growing up. I internalised misogynistic ideas about maths and assumed my weakness in maths (compared to others in my class) was because I was a girl.

In addition, some students commented on how their gender as read by others acted as a source of privilege in relation to mathematics:

Being assigned male at birth made people push me towards mathematics more - my family, my teachers, my friends, etc

I am male, and whilst I do not feel that I particularly identify with the label and believe all such labels bring only detriment to our society, it is not a label I reject, and I have always been treated like a man(/boy). I have always been singled out by teachers for my maths ability, and whilst it

may be true that I was quite capable at maths, I can't help but feel that teacher's perceptions of me have been shaped by my gender: of course I should be notable - I am male.

I would say that I see my academic identity as far removed from my identity as a woman. I would imagine this is different from many cisgender women, who experience a social pressure their entire upbringing. As a trans woman studying mathematics, for most of my life I've done so as a boy, and so don't perceive much of the very real and often subtle gender discrimination in STEM.

Similarly, two students felt that they had been marked out as special or were privileged because being read as a girl challenged the expectation that 'boys are good at maths':

I think I was seen as exceptional in math, in part because I was a girl... which seems fundamentally problematic.

As I was perceived to be a girl with an interest in STEM, I think that my achievements were always praised and/or treated as more exceptional than they would have been otherwise, especially in maths. Because of this, I felt encouraged to continue with the subject into higher education.

But for some students, the binary discourse of 'boys are good at maths/girls need to be encouraged' was doubly oppressive since they not only experienced spaces where girls were excluded, but also felt excluded through not identifying as 'girl' or 'boy' in such spaces:

I was weaker at Maths which was in the culture of the grammar school I attended, synonymous to female sex. Top set was for boys. If you didn't get it you never would, you aren't wired that way. That was the attitude. I've always loved Maths despite not always getting things the first go. It just felt like the message was, if your brain isn't made for Maths then you can't ever be good at it. Because you're a girl, was the subtext. When I transitioned my weaker Maths skills felt like a stain against me passing - still set 2, still not a real boy with the boy brain. Of course it's all sexist nonsense but it feels very real when you are living it.

I was never comfortable with maths. Even when I was doing well, it never felt earned or sustainable, and I could never trust that I would be able to get questions right. I think that this was because I could not understand what being good at maths would mean for me. There were plenty of small comments about boys being good at maths throughout school- sometimes obvious and other times very subtle, and there was plenty of pushback in a 'girls can do it too' sense- assemblies and speeches intended to break misogynistic cultures. But I knew that neither of these were directed at me. Because I knew 'the boys do this' stereotypes didn't apply to me, but I was never spoken to in the 'girls can do this' speeches, I found myself stranded.

These two quotes imply a sense of impossibility in defining one's subjectivity in a binary gendered space. In the first quote, the student describes how the 'top set boys' identity carries the assumption of being born with a male brain (Solomon, 2012) which they felt they could never obtain as a trans man. In the second quote, the student describes being stranded by a drive to break misogynistic cultures which although may intend to promote inclusion, may actually produce forms of exclusion through the impossible spaces they set up.

The notion of impossible subjects has been taken up in mathematics education when discussing high achieving/high ability girls doing mathematics (Foyn et al., 2018) and is often associated with the fragility of occupying such discursive spaces (Solomon, 2012). Our data here points to new forms of impossibility in mathematical spaces that are linked to the complexity and oppression of diverse gender identities. We hope to unpack this further as we analyse our interview data.

Maths as an unsafe/safe space

Some comments referred to the misogyny and transphobia operating in maths classrooms:

It was complex not fitting in with the male environment in maths spaces but not understanding why, after transitioning I had a transphobic maths lecturer and it tainted my whole experience of maths. I tutor GCSE maths and I lost almost all my clients after coming out, that being said many of my family work in mathematics and science and it's helped us bond after my transition.

Some of my maths teachers had been more invested in gender power structures than others, and contributed to my persecution as such, but my learning of mathematics specifically, I don't think was particularly affected by my gender-agnosticism.

My school was very conservative and my maths Olympiad teacher was very controlling. I was stuck between two big dilemmas: why are the girls placed under different rules and also my powerlessness about being put in that category by default. Feeling like my gender assigned at birth was used to make it easier for authorities for control purposes

Notably these comments reference the behaviour of some teachers/lecturers, i.e. those who arguably hold most power in the classroom – which manifests a loss of control or powerlessness for students.

In contrast however, 11 respondents indicated that mathematics provided some support or sense of safety referring to mathematics as a stable environment or safe realm that was detached from reality or operated outside of other practices involved in learning gender in school. For instance:

Definitely gained more satisfaction in maths from the fact I was female presenting when younger and so was 'overcoming' the very implicit gender bias in those classes. In A-levels, I think maths work was always a safe realm where none of my reality had to infringe into it, just head down and do the work. It helped me feel more in control and ignore various things including that preoccupation with gender.

I think that at most the foundations of maths and learning it were a stable environment that I could always relate to whilst in school and university. This allowed me a safe space to come back to outside of gender expression where what you do has no bearing on what you look and identify as. Though, I wouldn't say that it has helped or shaped any aspect of my gender expression.

For some students, this sense of safety was connected to a perception that mathematics offers certainty through being logical and having right/wrong answers:

I'm not sure there is a direct correlation, but I do think that when people have one aspect of their life that is difficult to control / doesn't have straight answers things like mathematics which are logical and always have a right answer can help people.

I've always liked how logical maths is. The importance of the rules, compared to other subjects. I think, similarly, gender is so illogical and lacking in rules to me that I don't feel like I have any real connection to it.

These quotes are interesting – whilst the students state gender expression or identification can be ‘difficult to control’ and ‘so illogical and lacking in rules’ (which we assume refers to the labour and intensive work involved in being hammered by a cis-heteropatriarchal world and being constantly forced to justify their existence), they also portray mathematics as asocial, logical, and rule bound which contradicts the uncertainty and establishes mathematics as a safe space. In the quote below, one student describes how the objectivity of mathematics engenders a feeling of validation (legitimation...maybe even empowering) when other aspects of their identity are questioned:

I've always been alone in my maths classes, so I had space to really get into the zone, which helped me get time out of my struggles with dysphoria and other related issues. My maths teachers at secondary school were some of the most supportive staff members when I transitioned. One thing I love about maths is that it has a flow and (in a lot of cases) has a solution. Being able to work towards a clear and objective solution, in a way gives me a feeling of validation as I've faced my identity being ""up for debate"".

Such comments initially felt counter-intuitive to some of our research team since the notion of mathematics as logical, rule bound and separate from the social world has long been associated with the production of masculinity through mathematics as noted by Mendick (2006) and earlier Walkerdine (1988). We think that our students may be ‘repurposing’ or queering terms like ‘logic’ and ‘objective’ to describe their school mathematics as a space where they felt a sense of control – relative to other spaces/practices which were not safe or engendered conditions of harassment, transphobia, and questioning about the legitimacy of their gender identities. We suggest here that thinking about such ‘safe’ spaces (mathematical or otherwise) as ‘third spaces’ may be useful (Bhabba, 1994) – i.e. for these students, maths lessons operated as a kind of in-between space or conceptual zone that was less hierarchical, opening up opportunities for agency and empowerment as students navigated the ‘impossibilities’ presented by cis-binary power structures in schools. We intend to explore this further in our analysis of the interview data.

The role of maths in creating gender self-identity

Finally, whilst some students made comments that disconnected or explicitly rejected mathematics in the development of their gender identity:

I feel that I've always had quite a robotic, transactional relationship with my studies. I show up to the lectures and engage in the material, but what I do beyond that is beyond the remit of my mathematics studies. This includes my transition.

uh I never really thought about maths as like an essential part of myself.

several students positioned doing/choosing mathematics as facilitating such development. Two students wrote about choosing or rejecting mathematics because it facilitated or hindered their developing self-identity:

Mathematics as a STEM subject is often associated as a male dominated field. When developing your gender identity I found that maths was something I was interested in but felt as though pursuing maths would help me assimilate more into a male culture that I was desperately trying to blend into.

I've always been quite good at maths throughout primary school and secondary school but when I started to question my gender I think I started to reject maths as it almost made me quite dysphoric to be good at math - it seemed like a masculine trait to me. For this reason I didn't revise for GCSE maths and got a lower grade than I perhaps could've. I also didn't choose maths at A level despite it being a typically choice for my university application (medicine).

Sometimes this invoked strong emotional references to gender euphoria or love:

I found maths very gender euphoria inducing because of the stereotypes, I liked being better at it than the boys in my class

I've always kind of seen the me that does maths and the me that does everything else as two separate beings. 'I' am certainly both people, but the me that does maths is just this formless being of logic. I think it might even be the other way around - my love of mathematics has partly shaped my gender identity, though not encapsulated it.

Note in the above comment how 'logic' is used once again to signify doing mathematics as a creative space or a space where they can be a 'formless being' which we think links once again to the concept of finding a 'third space'. Another student takes this further to explain how they use mathematics to think about gender beyond binary categories:

I wouldn't say it was key. However, my ways of thinking about gender are influenced by mathematics. For example, I like to think of masculinity and femininity as (potentially Gaussian) probability distributions rather than binary categories, with different features of people being weighted differently.

Conclusion

We began this paper by highlighting the need to re-think how gender is understood/produced in mathematics education. Like others, we see gender as produced, enacted and performed in cultural, historical practices and we argue this **must** include recognition and analyses of diverse gender identifications and forms of expression. We hope this paper offers some insight and does justice to the views offered by our participants. Our analysis indicates the prevalence of binary gender expectations operating in school mathematics which operate both as a source of oppression and privilege. In some comments, this gender binary presented an impossibility generated by the contradiction between 'boys are good at maths' and its negation 'girls can do it too'. In addition, our data indicates that for some, school mathematics was seen to enact a safe space from the transphobic harassment/bullying that took place in other spaces. We have linked this to Bhabba's (1994) notion of 'third spaces' which we understand to be 'innovative sites of collaboration and contestation' where students can creatively deploy ideas of 'logic', rules, 'objectivity' in ways that offer some cover. Our final theme explored how some of the students' comments suggest that mathematical identities are

implicated in the development of gender identities either because they help to adopt or reject some form of masculinity that is made relevant to a particular self-identification or because it offers new ways of thinking beyond binaries.

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