Equity in Maths Education

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Introduction

In preparing this talk, I came to realise that the topic of equity in maths education is a writhing mass of educational theory, policy and practice – as well as moral philosophy and politics!

But it's an *important* writhing mass.

I'll begin the talk by glancing at a few general characterisations of equity in an educational context.

I'll then present some data on WSU students who might be said to belong in so-called equity groups.

And I'll finish by outlining some of the background reading I've been doing on the topic.

Somewhere amongst this, I'll reflect on my own understandings, values and practices with regard to equity in maths education, particularly in the university setting.

Equity in an educational context

Can I ask you to pause for a moment to think about what equity means to you in an educational context?

Some commonly used words taken from the literature might chime with your ideas:

fairness	justice	access
diversity	social transformation	marginalisation
underrepresentation	equality	opportunity
multilingual	dominant language	minority language
ESL	CALD backgrounds	gender parity
LGBTI	closing the gap	race
ethnicity	culture	Indigenous
poverty	working class	Low SES
disadvantage	disability	power
elite	oppression	white middle-aged
dominant mathematics	Western mathematical canon	institutional culture

Equity in an educational context

The WSU *Equity and Diversity Strategic Plan for 2013–18* has this to say about equity:

In a university context, equity is the guarantee of fair treatment of all those with a stake in the institution (including both aspiring and current students and staff). It involves equal access to a fair share of the opportunities and resources managed by the University, unhindered by possible or perceived social and economic class boundaries or by unlawful discrimination.

Thus, equity involves more than simply equality. Equality is satisfied when policies are applied and resources are distributed equally, and it accepts that differences among individuals may result in variable outcomes, while equity seeks to influence outcomes by linking policies and resources to needs.

Equity recognises that there are real differences among people, and it takes these differences into account to preserve fair processes, opportunities and sometimes outcomes. It does not require or imply any lowering of standards, but it takes watchful care to avoid the development of unfair practices and policies that might result in the serious underrepresentation or marginalisation of any section of the population or in disadvantages to those individuals striving to achieve their educational and professional ambitions.

Equity in a maths education context

Gutièrrez ([6]) offers this three-part definition of equity in mathematics education:

1. Erasure of the Ability to Predict Students' Mathematics Achievement and Participation Based Solely on Characteristics Such as Race, Class, Ethnicity, Sex, Beliefs and Creeds, and Proficiency in the Dominant Language.
2. Erasure of the Ability to Predict Among Students the Practice of Mathematics to Analyze, Reason About, and Especially Critique Knowledge and Events in the World Based Solely on Characteristics Such as Race, Class, Ethnicity, Sex, Beliefs and Creeds, and Proficiency in the Dominant Language[1].
3. Erasure of Inequities Between People, Mathematics, and the Planet.

[1] "This aspect of equity has a critical focus and suggests that marginalized students will also have opportunities to see relations between mathematics and their personal worlds and that both dominant and marginalized students will have opportunities to use mathematics to critique the world" ([6], p. 158).

Bringing the two together

In their introduction to *New Directions for Equity in Mathematics Education*, Secada et al. note that:

"...we should develop the subtlety of thought and the kinds of inquiry that will enable us to understand how opportunity is unequally distributed in this society, the role that mathematics and education play in that stratification, and how we might reclaim the aegis of educational reform to include the creation of a fairer social order as a legitimate goal" ([11], pp. 4-5).

WSU context: Socio Economic Status

SES of students enrolled in six of the major first-level units that MESH supports, Mathematics for Engineers Preliminary (MEP), Mathematics for Engineers 1 (ME1), Mathematics for Engineers 2 (ME2), Professional Practice Experience 1 (PPE1), Quantitative Thinking (QT) and Statistics for Business (SFB).

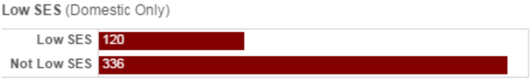
The data covers the Autumn and Spring sessions 2016.

SES[2]	MEP		ME1		ME2		PPE1		QT		SFB	
	n	%	n	%	n	%	n	%	n	%	n	%
Low	120	26.3	110	25.2	101	20.8	294	24.5	208	23.6	454	22.1
Medium	229	50.2	221	50.7	245	50.4	557	46.4	486	55.2	1079	52.6
High	69	15.1	63	14.4	61	12.6	166	13.8	150	17	364	17.7
Not App.	38	8.3	42	9.6	77	15.8	171	14.3	33	3.7	151	7.4
Unclass.	0	0	0	0	2	0.4	8	0.7	4	0.5	3	0.1
Unknown	0	0	0	0	0	0	4	0.3	0	0	2	0.1
	456		436		486		1200		881		2053	

[2] Low SES is determined based on students' postcode of permanent home residence as per ABS Census code, with SES value derived from ABS Socio Economic Indexes for Areas (SEIFA) Index of Education and Occupation for postal areas. The Low SES equity group only includes domestic students. International students are excluded from the base population.

WSU context: Socio Economic Status

"International students are excluded from the base population".



SES	MEP	
	n	%
Low	120	26.3
Medium	229	50.2
High	69	15.1
Not Applicable (International)	38	8.3
Unclassified	0	0
Unknown	0	0

WSU context: First in Family

Around half of the engineering students and two thirds of the nursing students we support are First in Family.

FiF	MEP		ME1		ME2		PPE1		QT		SFB	
	n	%	n	%	n	%	n	%	n	%	n	%
FiF	260	57	212	48.6	242	49.8	811	67.6	552	62.7	1257	61.2
Noy FiF	195	42.8	224	51.4	241	49.6	386	32.2	318	36.1	787	38.3
Unknown	1	0.2	0	0	3	0.6	3	0.3	11	1.2	9	0.4
	456		436		486		1200		881		2053	

WSU context: ATSI

Relatively low percentages of Indigenous students are sustaining their study in engineering. Business students also have a low representation.

ATSI[3]	MEP		ME1		ME2		PPE1		QT		SFB	
	n	%	n	%	n	%	n	%	n	%	n	%
Ind.	8	1.8	2	0.5	4	0.8	25	2.1	17	1.9	16	0.8
Non Ind.	448	98.2	434	99.5	482	99.2	1175	97.9	864	98.1	2036	99.2
Unknown	0	0	0	0	0	0	0	0	0	0	1	0
	456		436		486		1200		881		2053	

[3] An indicator to identify a person of Aboriginal and/or Torres Strait Islander descent who identifies themselves as an Aboriginal and/or Torres Strait Islander and is accepted as such by the community in which they live. Limited to domestic students only. International students are excluded from the base population.

WSU context: Gender

The gender disparity in engineering is nowhere near improving. It would be interesting to survey women entering WSU with ST~~E~~M ambitions who opt not to study engineering.

What is standing in their way? Do they have any anxieties about career opportunities or work cultures beyond graduation?

Gender	MEP		ME1		ME2		PPE1		QT		SFB	
	n	%	n	%	n	%	n	%	n	%	n	%
Female	32	7	36	8.3	32	6.6	975	81.3	545	61.9	824	40.1
Male	424	93	400	91.7	454	93.4	225	18.8	336	38.1	1229	59.9
	456		436		486		1200		881		2053	

WSU context: Language Spoken at Home

LSaH	MEP		ME1		ME2		PPE1		QT		SFB	
	n	%	n	%	n	%	n	%	n	%	n	%
English	283	62.1	264	60.6	245	50.4	653	54.4	615	69.8	1374	66.9
Arabic	46	10.1	44	10.1	59	12.1	34	2.8	69	7.8	92	4.5
Urdu	12	2.6	9	2.1	8	1.6	3	0.3	15	1.7	29	1.4
Dari	8	1.8	4	0.9	4	0.8	12	1	6	0.7	23	1.1
Viet.	7	1.5	16	3.7	18	3.7	43	3.6	17	1.9	74	3.6
Assyrian[4]	7	1.5	6	1.4	6	1.2	0	0	2	0.2	18	0.9
Mandarin	6	1.3	1	0.2	5	1	24	2	8	0.9	25	1.2
Punjabi	6	1.3	5	1.1	5	1	33	2.8	5	0.6	24	1.2
Bengali	5	1.1	7	1.6	11	2.3	6	0.5	10	1.1	26	1.3
Chin., nec[5]	5	1.1	2	0.5	9	1.9	20	1.7	3	0.3	16	0.8
Filipino	5	1.1	4	0.9	2	0.4	21	1.8	1	0.1	13	0.6
Gujarati	4	0.9	7	1.6	7	1.4	9	0.8	6	0.7	9	0.4
Chaldean[4]	4	0.9	2	0.5	0	0	0	0	8	0.9	5	0.2
Sinhalese	3	0.7	0	0	10	2.1	2	0.2	0	0	11	0.5
Hindi	2	0.4	7	1.6	13	2.7	32	2.7	12	1.4	33	1.6
Nepali	2	0.4	2	0.5	7	1.4	109	9.1	2	0.2	9	0.4
Tagalog	2	0.4	4	0.9	4	0.8	34	2.8	4	0.5	15	0.7
Cantonese	1	0.2	6	1.4	11	2.3	18	1.5	18	2	47	2.3
Tamil	1	0.2	5	1.1	9	1.9	8	0.7	8	0.9	12	0.6
Pashto	1	0.2	4	0.9	1	0.2	0	0	2	0.2	5	0.2
Other	46	10.1	37	8.5	52	10.7	139	11.6	70	7.9	193	9.4
	456		436		486		1200		881		2053	

[4] Neo-Aramaic

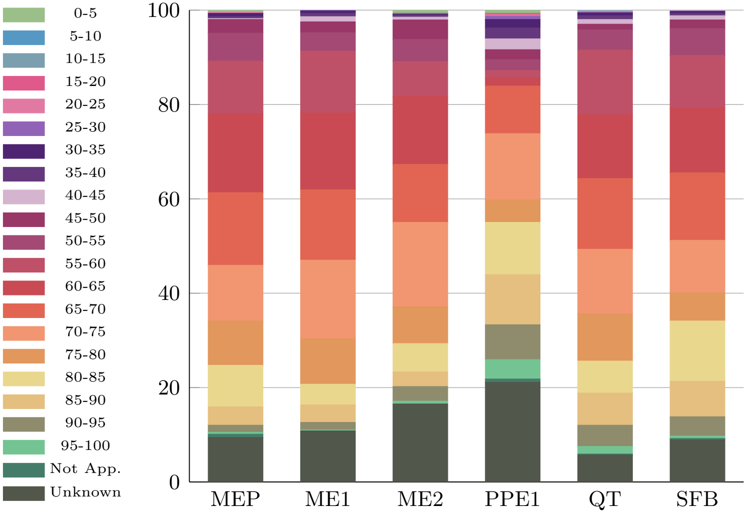
[5] Chinese languages other than Cantonese, Hakka, Hokkien, Mandarin, Teochew and Wu (e.g. Hsiang, Kan). Source: ABS.

WSU context: ATAR

This ATAR breakdown is displayed graphically on the next page (but, to be honest, I don't think the graphic does a better job of telling the story... low ATARs in engineering, marginally higher ATARs in nursing, science and business).

ATAR	MEP		ME1		ME2		PPE1		QT		SFB	
	n	%	n	%	n	%	n	%	n	%	n	%
0 – 5	2	0.4	0	0	3	0.6	11	0.9	0	0	1	0
5 – 10	0	0	0	0	0	0	0	0	1	0.1	0	0
10 – 15	0	0	0	0	0	0	0	0	0	0	1	0
15 – 20	0	0	0	0	0	0	3	0.3	0	0	0	0
20 – 25	1	0.2	0	0	0	0	4	0.3	2	0.2	0	0
25 – 30	0	0	1	0.2	1	0.2	8	0.7	1	0.1	3	0.1
30 – 35	3	0.7	2	0.5	1	0.2	21	1.8	5	0.6	9	0.4
35 – 40	2	0.4	3	0.7	2	0.4	28	2.3	7	0.8	10	0.5
40 – 45	1	0.2	5	1.1	3	0.6	28	2.3	9	1	19	0.9
45 – 50	13	2.9	10	2.3	20	4.1	25	2.1	11	1.2	37	1.8
50 – 55	27	5.9	17	3.9	23	4.7	27	2.3	38	4.3	117	5.7
55 – 60	51	11.2	57	13.1	36	7.4	19	1.6	121	13.7	230	11.2
60 – 65	76	16.7	71	16.3	70	14.4	20	1.7	119	13.5	282	13.7
65 – 70	70	15.4	65	14.9	60	12.3	121	10.1	132	15	293	14.3
70 – 75	54	11.8	73	16.7	87	17.9	168	14	121	13.7	228	11.1
75 – 80	43	9.4	42	9.6	38	7.8	58	4.8	88	10	123	6
80 – 85	40	8.8	19	4.4	29	6	133	11.1	60	6.8	262	12.8
85 – 90	18	3.9	16	3.7	15	3.1	127	10.6	60	6.8	155	7.5
90 – 95	7	1.5	7	1.6	15	3.1	89	7.4	40	4.5	85	4.1
95 - 100	2	0.4	1	0.2	3	0.6	49	4.1	14	1.6	10	0.5
Not Applicable	3	0.7	0	0	0	0	8	0.7	2	0.2	6	0.3
Unknown	43	9.4	47	10.8	80	16.5	253	21.1	50	5.7	182	8.9

WSU context: ATAR %



WSU context: ATAR cumulative %

The WSU ATAR cutoff for engineering and nursing degrees in 2016 was around 80 (science was around 75).

ATAR cum. %	MEP	ME1	ME2	PPE1	QT	SFB
0 – 5	0.4	0	0.6	0.9	0	0
5 – 10	0.4	0	0.6	0.9	0.1	0
10 – 15	0.4	0	0.6	0.9	0.1	0.1
15 – 20	0.4	0	0.6	1.2	0.1	0.1
20 – 25	0.7	0	0.6	1.5	0.3	0.1
25 – 30	0.7	0.2	0.8	2.2	0.5	0.2
30 – 35	1.3	0.7	1	3.9	1	0.7
35 – 40	1.8	1.4	1.4	6.3	1.8	1.2
40 – 45	2	2.5	2.1	8.6	2.8	2.1
45 – 50	4.8	4.8	6.2	10.7	4.1	3.9
50 – 55	10.7	8.7	10.9	12.9	8.4	9.6
55 – 60	21.9	21.8	18.3	14.5	22.1	20.8
60 – 65	38.6	38.1	32.7	16.2	35.6	34.5
65 – 70	53.9	53	45.1	26.3	50.6	48.8
70 – 75	65.8	69.7	63	40.3	64.4	59.9
75 – 80	75.2	79.4	70.8	45.1	74.3	65.9
80 – 85	84	83.7	76.7	56.2	81.2	78.7
85 – 90	87.9	87.4	79.8	66.8	88	86.2
90 – 95	89.5	89	82.9	74.2	92.5	90.4
95 - 100	89.9	89.2	83.5	78.3	94.1	90.8
Not Applicable	90.6	89.2	83.5	78.9	94.3	91.1
Unknown	100	100	100	100	100	100

WSU context: ATAR cum. % (restricted)

ATAR cum. % (restricted)	MEP	ME1	ME2	PPE1	QT	SFB
0 – 5	0.5	0	0.7	1.2	0	0.1
5 – 10	0.5	0	0.7	1.2	0.1	0.1
10 – 15	0.5	0	0.7	1.2	0.1	0.1
15 – 20	0.5	0	0.7	1.5	0.1	0.1
20 – 25	0.7	0	0.7	1.9	0.4	0.1
25 – 30	0.7	0.3	1	2.8	0.5	0.3
30 – 35	1.5	0.8	1.2	5	1.1	0.8
35 – 40	2	1.5	1.7	8	1.9	1.3
40 – 45	2.2	2.8	2.5	11	3	2.3
45 – 50	5.4	5.4	7.4	13.6	4.3	4.3
50 – 55	12	9.8	13.1	16.5	8.9	10.6
55 – 60	24.4	24.4	21.9	18.5	23.5	22.9
60 – 65	42.9	42.7	39.2	20.7	37.9	38
65 – 70	60	59.4	53.9	33.5	53.8	53.7
70 – 75	73.2	78.1	75.4	51.4	68.4	66
75 – 80	83.7	88.9	84.7	57.6	79	72.5
80 – 85	93.4	93.8	91.9	71.8	86.2	86.6
85 – 90	97.8	97.9	95.6	85.3	93.5	94.9
90 – 95	99.5	99.7	99.3	94.8	98.3	99.5
95 - 100	100	100	100	100	100	100
$\bar{x}$	67.44	67.22	67.88	72.63	69.44	69.8
s	12.4	11.02	12.98	18.69	12.96	12.82

WSU context: Previous fail count

How could an ME2 student have failed the unit seven times without first having failed it six times?

(Perhaps they failed it six times in years prior to 2016?)

PFC	MEP		ME1		ME2		PPE1		QT		SFB	
	n	%	n	%	n	%	n	%	n	%	n	%
0	351	77	334	76.6	304	62.6	1143	95.3	758	86	1656	80.7
1	77	16.9	71	16.3	118	24.3	56	4.7	102	11.6	324	15.8
2	23	5	18	4.1	41	8.4	1	0.1	19	2.2	62	3
3	5	1.1	6	1.4	14	2.9	0	0	2	0.2	11	0.5
4	0	0	4	0.9	7	1.4	0	0	0	0	0	0
5	0	0	3	0.7	1	0.2	0	0	0	0	0	0
7	0	0	0	0	1	0.2	0	0	0	0	0	0
	456		436		486		1200		881		2053	

Consensus view on equity?

The question as to whether there is a consensus view among researchers about what defines equity in maths education is easy to answer: *there isn't one.*

But there are some areas of common ground. For example:

- equity is not equality. Students are not being treated equitably if they are merely afforded equal access to learning opportunities, high quality teaching and resources, and are achieving equal outcomes to those of their peers;
- equity seeks to overcome false perceptions about the presence of predispositions in students, or the absence of entitlements, that prevent them from succeeding in maths (assumptions about 'ability at birth', genetic or cultural inhibitors to mathematical understanding etc.); and
- equity focuses on pedagogical, curriculum and policy reform whose aim is to correct imbalances in opportunity for relatively powerless (underrepresented, marginalised, disadvantaged, oppressed etc.) students.

Notice how only one of these directly references *maths.*

What distinguishes equity in *maths* ed.?

In developing her three-point definition of equity in maths education, Gutiérrez makes explicit mention of such maths-related ideas as:

- ‘dominant mathematics’, and the problematic notion that the goal of equity is to inculcate all students into this mathematical ‘orthodoxy’;
- the progression from traditional[6] to reform[7] to critical[8] perspectives on maths education; and
- assumptions about the value of maths in society and what purposes it serves (and for whom), the extent to which these influence curriculum design, and the freedom students have – and the support they are given in – critiquing the ethical and political dimensions of ‘maths in the world’.

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[6] Rigorous, formal, teacher-driven.

[7] Open-ended, inquiry-based, collaborative, socially inclusive.

[8] Challenging of mathematical and social norms, interested in questions of structure and power.

What distinguishes equity in *maths* ed.?

With respect to the last point Gutiérrez notes that "...students can learn to read the world using mathematics, but depending on the goals of instruction, the world they are encouraged to read may remain politically neutral".

She goes on to give an example of a learning activity that would allow students to explore the geometry and spatial relations in the "buildings and artifacts that surround them in their city or town".

Such an activity would inspire the students to "collect data and make inferences about how tall and large such buildings and artifacts are in relation to themselves, using concepts such as estimation, measurement, ratio, proportion and volume".

But it would leave unexamined questions about "whose interests are served by the buildings and the structures that surround them" (p. 150).

Not quite storming the Bastille

Gutiérrez's judgement that equity in maths education can only be achieved, ultimately, by way of a broader reordering of power relationships in society does not mean that she wants to storm the Bastille and overthrow the dominant paradigm (!).

"...we must coordinate (a) efforts to get marginalized students to master dominant mathematics with (b) efforts to develop a critical perspective among all students about knowledge and society in ways that ultimately address (c) a positive relationship between mathematics, people, and equity throughout areas of the globe" ([6] p.148).

Maths for minority language students

A study by Gorgorió and Planas ([5]), which looks at the challenges faced by migrant[9] maths learners in a Catalan-speaking region of Spain, asks the question: how proficient must a student be in the dominant (classroom) language in order to succeed in their mathematical learning?

They note that in framing the study, their starting point was to "consider the cultural contribution of ethnic minorities and different social groups as a source of richness to be maintained and shared. The research team did not see cultural and linguistic differences as a 'problem to be solved', but as a potentiality" (p. 10).

[9] Whose languages of "greatest day-to-day use and facility" include Arabic, Tamazigh, Tarifit, Urdu, Punjabi, Tagalog and (Latin American) Spanish.

Maths for minority language students

Gorgorió and Planas assert that while the language of maths might be universal, the language of *doing maths* is highly variable across cultures.

They give an example of a 15-year-old girl, Ramia, who despite her "communicative competence (in) the Catalan language on daily matters... had problems understanding the register[10] of language of her mathematics teacher" (p. 18).

Doing maths for this student involved, in the first instance, accessing the specific language conventions and meanings used by her teacher to describe the problems and concepts they were working on.

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[10] This idea of a *mathematics register* is referred to frequently in the literature. For example, Halliday notes that "We can refer to a 'mathematics register', in the sense of the meanings that belong to the language of mathematics (the mathematical use of natural language, that is, not mathematics itself), and that a language must express if it is used for mathematical purposes. ... It is the meanings, including the styles of meaning and modes of argument, that constitute a register, rather than the words and structures as such. We should not think of a mathematical register as solely consisting of terminology ([7], p.65).

Maths for minority language students

A second example from the same paper highlights more prosaic difficulties encountered by minority language students in maths classrooms.

When the following problem is put to the class, a Pakistani student, Aftab, questions the meaning of the word 'will' (the teacher explains that it is a "present the father gives to his children"):

> A farmer has 3 sons. In his will he gives his sons 17 cows. The oldest one must receive 1/2 of the cows, the second 1/3 and the third 1/9. How many cows will each of them receive?

This is followed by a slightly dramatic exchange:

> Jossua: Is the father there at the moment?
> Teacher: Why do you need to know that?
> Jossua (working on the idea of a 'present'): If the father is still alive, then he will need some cows or maybe he can buy more cows...
> Raima (working on the idea of a 'will'): The father is dead!
> Aftab (shouting angrily): Why do you want to kill him?! What has he done to you?!

Maths for minority language students

Healy and Powell ([8]) consider the effects of multilingualism on students' cognitive development.

> School children whose cultural and linguistic backgrounds differ from the institutional culture and language of schools often confront cognitive obstacles that are invisible and incomprehensible to others, and are viewed as a disadvantage in mathematics classrooms (Garcia & Gonzalez, 1995) (p. 80).

> Internationally, mathematics education researchers have paid increased attention to how multilingualism relates positively to cognitive development, flexibility, and the promotion of academic achievement in learners (Adler, 2001; Gorgorió & Planas, 2001; Moschkovich, 1999; Setati, 2002; Setati & Adler, 2000). However, instructional environments may prejudice the participation and performance of multilinguals when they do not invite and encourage them to use their rich linguistic resources for mathematical sense making (p. 81).

Maths for minority culture students

In describing the challenges of teaching maths in culturally diverse classrooms, Ladson-Billings ([10]) considers three 'dimensions of multicultural education':

- Content integration ("...the ways in which teachers, scholars, and researchers include and infuse data and examples from diverse cultural groups into their work. In the mathematics curriculum, that infusion might include statistical data that describe the disparity among the life chances of different cultural groups, or the differences between male and female test score in mathematics achievement" (p.128))
- Knowledge construction (in the typical classroom "students are presented with knowledge with facts not to be questioned. They are not challenged to ask, 'Whose knowledge?' in their quest to understand the world. The subject-matter fields they are required to study are established and codified. They do not understand their role as inquirers about the nature of that knowledge, much less their role as creators of knowledge" (p. 129).)
- Equity pedagogy ("...the opportunities that *all* children have to benefit from classroom instruction" (p.130).)

Maths for minority culture students

Ladson-Billings gives an example of a problem that vexed a group of ‘inner-city African American youngsters’ in a high school maths class:

> It costs $1.50 to travel each way on the city bus. A transit system “fast pass” costs $65 a month. Which is the more economical way to get to work, the daily fare or the fast pass?

“The white, middle-class suburban youngsters who read this problem suggested that the daily fair was cheaper”, reasoning that “at $1.50 each way, a worker would pay $3 a day on approximately 20 work days a month” (p. 131).

The African American students did not arrive at such a simple solution. They wanted to know ‘how many jobs are we talking about’; they suggested that in their car-free families, where public transport is used for more than merely commuting, the “20 days the nine-to-five suburban commuter might use the bus is not the same as the 30 or 31 days a month” they might use it (p. 132).

Maths for Indigenous students

In their paper *Enhancing quality and equity in mathematics education for Australian indigenous students* ([9]), Howard et al. call for mathematics intervention programs that “address a number of criteria related to the social, cultural and community contexts of the Indigenous learners and their families, as well as the particular mathematical characteristics of the material to be learned”.

The authors cite Boethel ([1], p.14) in stressing that these programs “need to address the ‘lack of congruity between the student’s home environment or culture and the school’s culture’” (p. 376).

Maths for Indigenous students

In offering comment for an ABC article[11], Aboriginal mathematician Christopher Matthews (who heads the Aboriginal & Torres Strait Islander Mathematics Alliance, and who has developed an approach to maths teaching and learning that features dance and storytelling) notes that "Maths and science are very much seen, from an Aboriginal point of view, as a white fella thing".

The article notes that Matthews "decided to help his people learn maths when he observed how often maths is relied on to make environmental decisions affecting Aboriginal land", and quotes him as saying that "We need the capacity to engage in this decision making and to review the scientific papers".

[11] http://www.abc.net.au/news/2016-08-15/closing-the-maths-gap-with-story-and-dance/7700656

Maths for girls/women

In her article *Redfining the "girl problem in mathematics"* ([3]), Campbell comments on the persistent gender differences in maths achievement and participation. She notes that efforts to deal with this problem need to "shift away from changing girls toward changing how mathematics is taught, and how girls are treated when it is" (p. 225).

She further notes that the

> emphasis on girls not on society works for only so long. As successful change agents in business have found, changing one component of a system can cause short-term but not long-term change. If you change a girl so that she 'loves math', but then you put her back in the same environment and situations that caused her to hate mathematics in the first place, she will revert to hating mathematics" (p. 226).

Awareness of context

Sullivan et al. ([12]) give an example of a classroom activity that involves use of a poster of a police line-up (the lesson being about height estimation and the concept of mean height). One of the teachers they interviewed about this activity commented on the appropriateness of the ‘context’ of this task:

> Dad’s off in gaol or someone else has been arrested in the community, so they know about line-ups. They know about the police, they know about the justice system by what’s happening to them. So you could use it if it wasn’t that sensitive. It comes down to knowing their backgrounds and the sensitivities for the children that you’re teaching (p. 114).

Referring to the same activity, another teacher observed that they

> found it difficult to make the link. Sometimes when you use something like a picture of criminals as your stimulus and people might come from a background where a picture of criminals may remind them of their friends in jail or whatever, it makes it difficult for you to focus on the actual topic. The teacher is asking the students to estimate heights and it’s not really related to the socio-political context of the picture of the criminals. Whereas in (the school subjects) English and Drama you may be able to address the issues raised by this picture. But that picture is like a red herring (p. 116).

Maths for low SES students

The big picture on the issue of low SES students' access to mainstream, even advanced, mathematics and the opportunities that flow from excelling in the discipline, is summed up in a (late 80s!) statement by the (American) National Research Council in their report *Everybody counts* ([4]):

> Because mathematics holds the key to leadership in our information-based society, the widening gap between those who are mathematically literate and those who are not coincides, to a frightening degree, with racial and economic categories. We are at risk of becoming a divided nation in which knowledge of mathematics supports productive, technologically powerful elite while a dependent, semiliterate majority, disproportionately Hispanic and Black, find economic and political power beyond reach (p. 14).

Maths for low SES students

Brown et al. ([2]) draw together socioeconomic status and language proficiency in noting that:

> We suggest that poverty is closely intertwined with discourse, which in turn, affects academic communication between teachers and students of different socioeconomic strata (p. 394).

Maths for low SES students

A slightly narrower focus considers how curriculum and pedagogy might be adjusted to better suit the learning needs, preferences, dispositions etc. of socially or economically disadvantaged students.

Some researchers (and teachers participating in research projects) claim that open-ended, inquiry-based learning is less suited to low SES students than middle-class students. Other researchers appear to contradict this claim.

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