

Strengths based mathematics learning for diverse students: Providing equitable opportunities to learn mathematics

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Statistics

- International comparative surveys (TIMSS and PISA) indicate substantial disparities in achievement between ethnic groups.
- National achievement monitoring indicated 11% of Pasifika and 26% of Maori achieving at curriculum standards in maths at Year 8 (NMSSA)

Why do we have disparity in our classrooms?

- Schooling practices often reflect the cultural capital of dominant cultural groups.
 - Contexts of tasks
 - Differing values (individualism, competition)
 - Classroom practices (ability grouping)
- Lived reality of everyday life of diverse learners differs in significant ways.
- We need to attend to the cultural perspectives of diverse learners to achieve equity

Challenging the status quo about who can be successful in maths and what it means to do maths



Developing Mathematical Inquiry Communities (DMIC)

- Research and practice based.
- 130 schools and 1780 teachers in 10 regions in New Zealand. Three schools in Pacific Island nations – Niue, Cook Islands.
- Focus on “ambitious” mathematics teaching
- Draw on culturally sustaining pedagogy



School-based Action Plan

Clusters of schools (teachers and leadership) in high-poverty areas.

- Professional development workshops
- In-class dynamic mentoring
- Video reflections
- School-based collaborations
- Lesson study cycles
- Parent meetings

The Team

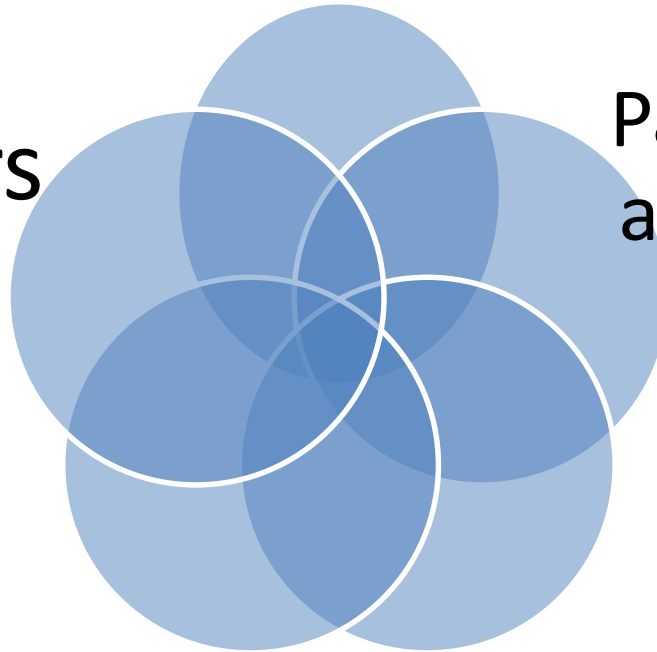
Teachers/
students

Researchers

Parents/whānau
and Community

School
Leaders

Mentors



We need to address deficit perceptions of learners

Teacher: These children come to school with no maths.

Sose: It feels like I'm a different person from a Samoan person... because whenever I'm learning maths I think I'm a Palagi person... because whenever I'm doing maths I can't remember I'm Samoan.

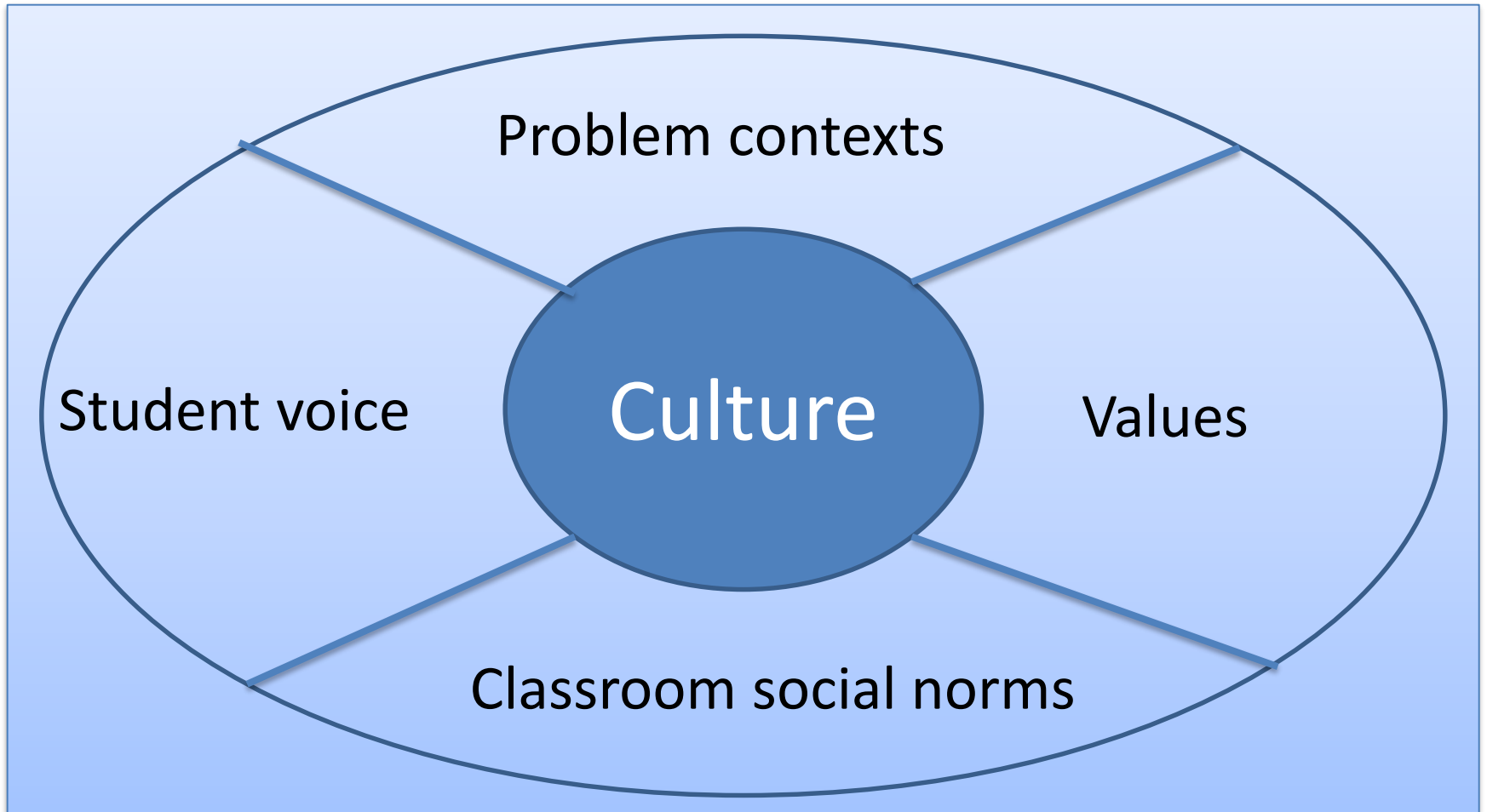
Principal: All of those things that we probably thought that our kids couldn't do but we weren't giving them the opportunity to do that.

How do we do this?

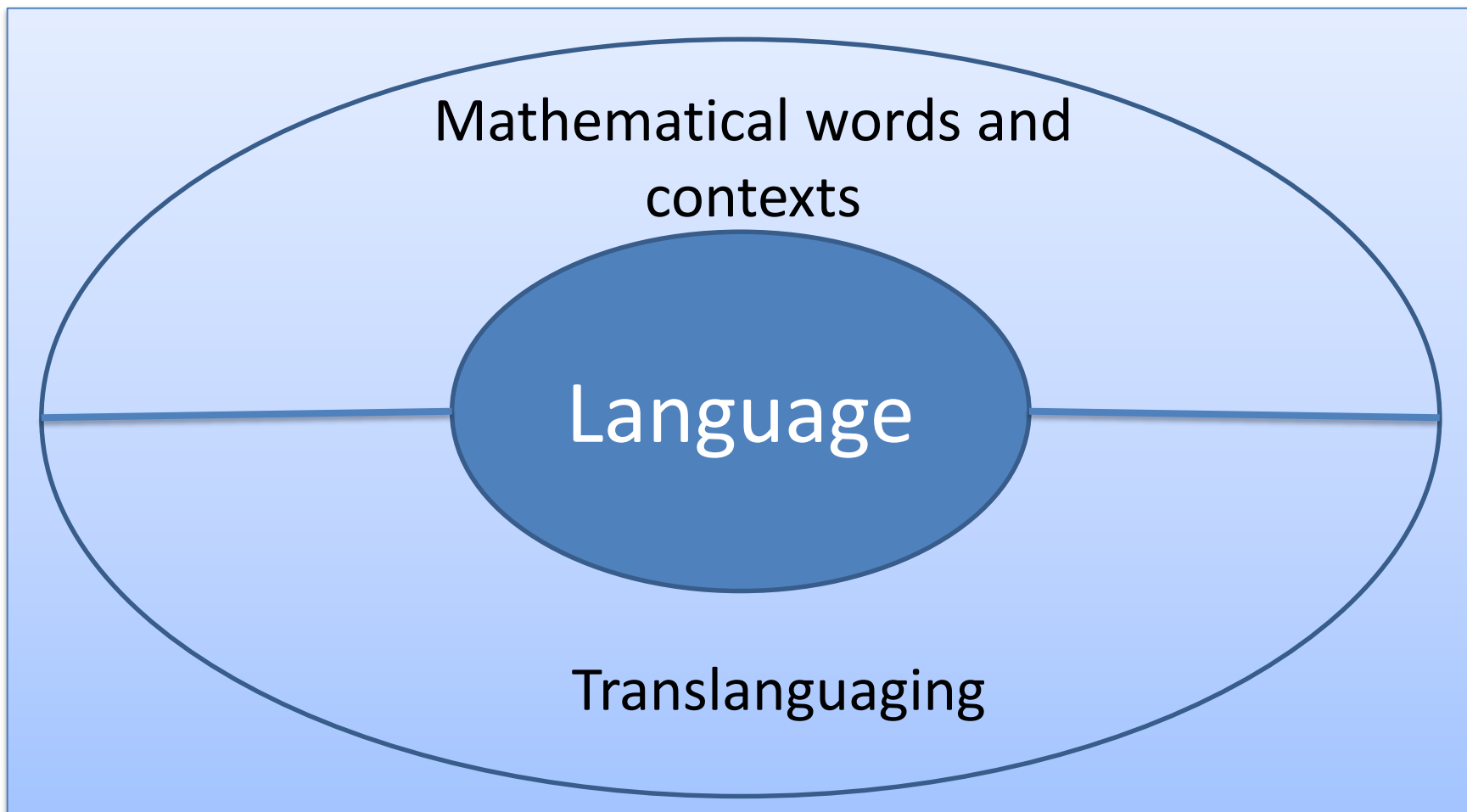
It is hard to shift views of student capability unless they have opportunities to engage in different types of activity

- Redefine what it means to ‘do’ mathematics
- Provide multiple opportunities for students to demonstrate their strengths in multiple ways
- Remove notions of ability. All students can learn mathematics.

Culturally sustaining pedagogy



Culturally sustaining pedagogy



Tasks

New Zealand Numeracy project material

- There are eight farm animals on the farm. How many different ways could the farmer split the animals between the two paddocks?
- There are five frogs on a lily-pad and two more frogs join them. How many frogs are there altogether?

Transforming task design

- Complex challenging problems written around home and cultural activities
- Draw on family and community funds of knowledge through parent meetings
- Forge powerful connections with families, communities and iwi in the school community

School in Christchurch: Predominantly Pakeha and Maori students

- School holiday travelling (time, distance, speed & velocity)
- Pocket money chores and tasks.
- Recreational sport/gaming (distance, time, speed, velocity)
- TV - Netflix & TV guide (analogue & digital time)
- Cooking & Baking
- Marae and the patterns of the whare nui. Laying out mattresses, tables and chairs for a lot of people, activities
- Digging for pipi and mussels (shell fish) and cooking them
- Paper round (how far and fast, how many folded)
- Minecraft (counting blocks to build with)
- Repairing Go-Kart (nuts & bolts, how long the drift was, how fast)
- Lego building (finding right size of blocks)
- Scootering (learning to do 180, 360, half pipes)
- Skiing (time to complete a ski run)
- Wrestling (time, holding down)

School in Niue: Pasifika students

- Collecting limes off Nena's lime tree to sell.
- Picking leaves, umu preparation (wood, rocks)
- Planting talo shoots from the baskets (50-70 shoots in each basket). Talo takes 7-9 months to mature. ½ hour to plant 1000 shoots. 1 hour to plant 2000-2500.
- Preparing Sunday lunch/umukai, amount of food cooked in the umukai, number of plates distributed to neighbours, measurements etc.
- Making traditional recipes (takihi, ota).
- How many coconuts (fua niu pakupaku) to make coconut cream (gako niu)?
- Pocket money and jobs
- Making traditional necklaces (e.g. 5 hihi and 1 puka (black beads))
- Fishing. Flying fish, 1 score = 20, 1 fish per person for dinner, 10 flying fish + \$20-\$25, counting kaloama (1 x score = fish), weighing, how many baits
- Gathering sea food, weighing and calculating..
- Cultural sports, tika (measuring distance) unga (crab) races
- Cricket, games, numbers of runs, score, catches.
- Show day and spending money

Teachers learning from students and parents

The children love maths now. They love being able to reason, justify and progress through problem solving. They feel a sense of achievement because I have started using problems they have to work hard with and cannot finish quickly. Before I never did because I thought, they would not enjoy maths. The other challenge for me is knowing these students. I thought I did but now I know that I know very little about the maths in their lives at home.

Looking for mathematics in cultural activities and artefacts

Tivaevave

Cook Island quilts made by groups of women for special occasions (e.g., wedding, 21st birthday, hair-cutting ceremony, unveiling).



What mathematics do you see?



Tivaevae

Tivaevae



A group of Mamas are working on a tivaevae design.

This is the 1st position.



How many leaves does it have?

This is the 2nd position.



How many leaves does it have?

This is the 3rd position.



How many leaves does it have?

Can you continue the pattern?

How many leaves would it have for the 7th position?

Can you describe what the pattern would like for the 76th position?

What is the growing pattern rule?

Tivaevae

Ambitious mathematics for
young Pacific learners:

Dr Jodie Hunter demonstrates
algebraic thinking for tivaevae

Iterative Best Evidence Synthesis [BES] Programme Hei Kete Raukura
Evidence, Data and Knowledge Group



Transforming task design: Leadership voices

Deputy principal: What teachers are also adept at doing is repositioning those experts in their class so if for example, they're doing a problem based around white Sunday they might say to the children who knows about white Sunday? They then become the experts and share their knowledge with the rest of the class. It repositions them, they've got all the knowledge, the teacher doesn't have the knowledge the children do. They can share the concepts and ideas around an event or something that they've experienced in their lives, or have knowledge about.

Transforming task design: Teacher voices

Teacher: When the problem is about them, they have a grasp and a foundation for the discussion and we can then expand the maths. It's not until they make those connections, they realise the real life situations they are involved in that maths links in. Until we started to bring these types of problems they didn't make those links and they saw maths as something they did at school that was not relevant.

Transforming task design: Student voices

- *Josef*: The maths is about us, about the community. The problems relate to our cultures and celebrations which makes it more understandable.
- *Luana*: It makes it easier for us to learn...like the ula lole (lolly necklace) problem because most of us have made it before and we can see it and have a picture in our minds so we can see how it's proportions and ratios like one chocolate to three fruit burst.
- *Grace*: When the problems are about us you can see that maths is real and it's useful.....not just something random you do at school.

Core Values

What are your core values? How do these play out in the classroom?

- Reciprocity
- Inclusion
- Leadership
- Family
- Respect
- Relationships
- Love
- Service
- Spirituality
- Belonging



Using core Pasifika Values

Draw on notions of whanau and collectivism to support group work.

Mr J: When we do maths, there are two responsibilities.

Students: Make sure you understand the maths.

Mr J: What is the second responsibility?

Students: Make sure everyone understands the maths.

Using core Pasifika Values

Mr J: What type of group are we?

Tin: We are a family.

After the teacher asks for the word for family in different Pacific languages (e.g., Samoan, Tongan, Cook Island Maori), he then asks:

Mr J: What do families do?

Students: Take care of each other and help each other.

Using core Pasifika Values



Drawing on values: Student voices

Sally: It's about sharing your knowledge with your group members.

Kali: If someone hasn't got it, we spend time practising and going over a problem, helping each other and our solutions before presenting.

Fia: We don't just think about ourselves – we help others to get on-track.

Sally: So no one is left out. So we know that everyone is learning.

Tini: We feel more successful if our whole group gets it.

Introducing mathematical practices

- Developing a mathematical explanation
- Justifying thinking
- Constructing arguments
- Generalising a mathematical idea
- Representing mathematical thinking using pictures, material, and numbers
- Using mathematical language

Introducing mathematical practices

The introduction of these practices can cause dissonance for students.

Disagreement:

I don't do that because I don't want to hurt their feelings

It is hard for me to disagree, I don't want to be like superman but I am still learning to say it in a nice way rather than a 'Oh you got that really wrong,' kind of way.

Questioning:

Shy, scared because we're not used to it. We don't usually get up and say stuff to people

Drawing on values as a strength can shape the introduction of mathematical practices

Sione: Respect is real important. When you have respect you can have friendly arguments and you argue about the maths so it's not "nah you're wrong" or "you're dumb eh", it's like "I don't agree with your maths and this is what I think" or "you have to convince me".

Grace: You can have friendly debates about maths and then you have to justify your answer. And then if you made a mistake you learn from your mistake.

Drawing on values shapes pro-social skills: Teacher voices



Drawing on values shapes socio-mathematical norms: Student voices

Mere: They have to justify their answer and why they disagree. They have to try and convince us.

Tina: If we have different answers we justify until we come to an agreement. We have to make sure everyone has got it.

Drawing on values shapes socio-mathematical norms: Student voices

Laisa: We use pen and paper and write or draw whatever we like to help each other.

Mere: If you are asking questions you are getting a better understanding of what you're doing. Also, if you paraphrase you are getting a better understanding of what the problem is about so you're building your knowledge and get deeper thinking.

Translanguaging

- Many Pasifika learners are English as an additional language learners.
- Key to our work is drawing on the idea of a second language as a strength for learners.

Translanguaging: Leaders voice

Associate principal: Teachers have been quite explicit about telling the children that it's okay to use your first language, it's a normal part of your learning, to talk in your first language if that's what makes you more comfortable. Quite often you'll see little groups where the children are very adept at switching between languages as they're talking about the strategies that they're using. Or as they're feeding back to the rest of the groups in the class. It just happens naturally and I think the really important thing is that teachers allow it to occur, as they see it necessary for children to have a broader understanding of what they're learning about.

Our work with teachers in schools

- Raises student achievement.
- Maintains high expectations and levels of challenge.
- Build pro-social skills.
- Forge inclusive and respectful learning cultures.
- Equip students to be adaptive, flexible, and open to other's perspectives.



Mathematics is part of Pasifika culture



Last thoughts

When the teaching and learning of mathematics is not decontextualized nor considered 'culture-free', our evidence shows that Maori and Pāsifika students develop positive mathematical dispositions and a strong cultural identity.

“My culture is in everything I do. It is in everything I do and it is always supposed to be in everything I do.”

Follow-up

If interested please watch videos about our work from the Ministry of Education, NZ

<https://www.educationcounts.govt.nz/topics/bes/developing-mathematical-inquiry/introduction>

Inā kei te mohio koe ko wai koe, I
anga mai koe I hea, kei te mohio koe,
kei te anga atu ki hea



If you know who you are and where you are from, then
you will know where you are going