MINISTRY OF EDUCATION
TE TĀHUHU O TE MĀTAURANGA

Briefing Note: Best evidence in action exemplar highlights Pacific expertise for ambitious mathematics

To:	Hon. Jenny Salesa, Associate Minister of Education		
CC:	Hon. Chris Hipkins, Minister of Education		
Date:	9 July 2019	**Priority:**	Low
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Purpose of Paper

The purpose of this paper is for you to:

Note that a best evidence in action exemplar *Ambitious mathematics for young Pacific learners: Dr Jodie Hunter demonstrates algebraic thinking for tivaevae* is being released.

Note that this resource highlights the potential of the Wellbeing Budget allocation of $7.2 million for the *Developing Mathematical Inquiry Communities* (DMIC) intervention for Pacific learners.

Note that the *DMIC* research and development approach to capacity building, well-implemented, lifts mathematics achievement, develops positive cultural identity and reduces peer bullying.

Recommended Actions

The Ministry of Education recommends you:

Agree that this Briefing Note be proactively released.

Cathryn Ashley-Jones
Acting Deputy Secretary
Evidence, Data and Knowledge

09 / 07 / 2019

Hon Jenny Salesa
Associate Minister of Education

22/8/19

Pacific Excellence Developing Mathematical Inquiry Communities (DMIC) - New best evidence in action exemplar

1. A new best evidence in action video series demonstrates Dr Jodie Hunter teaching algebraic thinking for tivaevae to activate educationally powerful connections for Year 3 and 4 learners at Russell School in Porirua East. This new feature for the Developing Mathematical Inquiry Communities (DMIC) intervention is on Education Counts[1].

2. This resource demonstrates for teachers and leaders how to activate educationally powerful connections to the lives, experiences and identities of learners in a meaningful, non-tokenistic way. Feature content is provided in an Annex to this report.

3. This resource highlights the potential of the Wellbeing Budget allocation of $7.192 million for the scale up for optimal implementation of the *Developing Mathematical Inquiry Communities* intervention for Pacific learners.

New Investment in DMIC Improving Education Outcomes for Pacific Learners

4. Developing Mathematical Inquiry Communities (DMIC) was the first exemplar selected in the Iterative Best Evidence Synthesis (BES) Programme[2] for its impact on achievement, wellbeing and cultural identity[3].

5. Both Cook Island New Zealand leaders of the DMIC capacity building (Professor Roberta Hunter and Dr Jodie Hunter) won awards for their doctoral theses from the Mathematics Educational Research Group of Australasia (MERGA). DMIC scale up received the MERGA 2018 Research Award for raising Pasifika and Māori Success[4].

6. DMIC professional capability building to scale is a challenging research and development driven process that optimally involves leaders, teachers, teacher aides, parents, Pacific communities and Iwi partners.

7. The new Government investment matters. A 2003 OECD review of expenditure on research and development in education warned of the risks of New Zealand's low investment in educational research and development:

   'At the same time New Zealand invests far less in research and development of any kind than other developed countries and has far lower R & D personnel per million population than Australia or Western European countries … New Zealand is successful educationally, but is, by R & D standards, not becoming a knowledge economy'. [5]

8. The new exemplar adds to the evidence on-line of the Russell School (Porirua East) implementation exemplar that demonstrates maths improvement in the classes of high implementing teachers over two years (as measured on standardized Progressive Achievement Tests).

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[1] https://www.educationcounts.govt.nz/bes/tivaevae

[2] Developing Mathematical Inquiry Communities https://www.educationcounts.govt.nz/topics/bes/developing-mathematical-inquiry/introduction

[3] *Alton-Lee, A. (2017) 'Walking the talk' matters in the use of evidence for transformative education.* Invited paper for the International Bureau of Education - UNESCO Project: Rethinking and repositioning curriculum in the 21st century: A global paradigm shift. Ministry of Education, Wellington: New Zealand. https://www.educationcounts.govt.nz/topics/BES/useful-links-and-publications/Alton-Lee-Walking-the-talk-matters-in-the-use-of-evidence-for-transformative-education-invited-paper-UNESCO-2017.pdf

[4] Mathematics Education Research Group of Australasia (MERGA) Maths Award for raising Pasifika and Māori success. (2018). Retrieved from http://www.massey.ac.nz/massey/about-massey/news/article.cfm?mnarticle_uuid=B9D62444-09A0-4AEA-A253-A27866DA271C

[5] *OECD (2003). Knowledge management: New challenges for educational research. Paris: OECD. (p. 89).*

That exemplar focuses on critical factors for implementation success including the role of in-class mentors supporting changes in teaching practice[6]. A New Zealand Council for Educational Research report on achievement at Russell school concluded:

'*Pasifika learners did, on average, score lower than their cohort average. There is variation on how wide these gaps started, but they all tightened over the two year period. By the end of 2016, these gaps were negligible across all cohorts. This could not be said at the start of 2015*'.[7]

Understanding the Developing Mathematical Inquiry Communities Pedagogy

9. The DMIC approach has a 'low floor, high ceiling' approach; where the children begin mathematical reasoning with small numbers so everyone can succeed; then have the opportunity to collaboratively problem solve with mathematical challenges that stretch all learners.

10. Four short videos filmed at Russell School demonstrate the DMIC pedagogy:

    a. **The Launch**: introduces the children to the mathematical problem and the technical language they need to understand and solve the problem. The problem is based around the Cook Islands tivaevae. Cook Island students recognise the tivaevae and become experts for the lesson. Their classmates respect and benefit from their knowledge.

    b. **Group Work**: focuses on the children's thinking, problem solving and mathematical talk. Crucial to the success of group problem solving are the collaborative problem solving skills required for this ambitious mathematics approach. These skills are taught explicitly through the DMIC Mathematics Participation and Communication Framework. These skills reduce bullying.

    c. **Sharing Back**: Dr Jodie Hunter reminds the children of the mathematical and real life problem they are solving as they transition back to the whole class context – this reminds the children of the purpose, maximises engagement and keeps them focussed on the mathematics. All the children have the opportunity to hear the different generalisation strategies of all three groups, and importantly realise that each generalisation works.

    d. **The Connect**: a whole class teacher-directed discussion designed to follow up on the 'So what?' question for mathematics that works for real life problems. Dr Jodie Hunter uses The Connect to enable the children to generalise from the pattern at a symbolic level.

[6] https://www.educationcounts.govt.nz/topics/bes/school-leadership-for-improvement-in-primary-mathematics-education-russell-school-best-evidence-in-action-implementation-exemplar).

[7] Stringer, B. *2015-2016 PAT: Mathematics achievement and progress for a school participating in Developing Mathematical Inquiry Communities (DMIC): Russell School.* New Zealand Council for Educational Research: Wellington.

Support from the Profession

11. NZEI Te Riu Roa worked in partnership with the Iterative Best Evidence Synthesis (BES) Programme on the demonstration stewardship implementations of DMIC in Porirua East and through a Ngāi Tahu bequest in Christchurch. DMIC has been featured in NZEI's professional journal in 2018: *Stunning results from culturally responsive maths – Ako*[8]

12. We will be liaising with NZEI to support wider reach; they have asked that this exemplar be made available to as many teachers as possible through a range of communication strategies.

Communications

13. This is regarded as a low risk release. We are preparing communications messages to support this release. These will be provided to your office ahead of the release.

Proactive Release

14. It is intended that this Education Report is proactively released as per your expectation that information be released as soon as possible. Any information which may need to be withheld will be done so in line with the provisions of the Official Information Act 1982.

[8] https://akojournal.org.nz/2018/07/24/stunning-results-from-culturally-responsive-maths/

Annex one: Best evidence in action exemplar content

The exemplar can be viewed at the link below. Copy the url into a web browser and then access the draft page by entering the username and password provided. The feature can be accessed through inserting the link into the browser and using the passwords.
https://www.educationcounts.govt.nz/bes/tivaevae Username: systemp Password: systemp1.

Ambitious mathematics for young Pacific learners: Dr Jodie Hunter demonstrates algebraic thinking for tivaevae

Introduction/Whakataki

In this best evidence in action video feature, Dr Jodie Hunter demonstrates mathematics teaching that activates educationally powerful connections for Pacific learners

Activate educationally powerful connections to learners' knowledge, experiences, identities, family, whanau, aiga, fono and communities

Whakatere hono akonga torokaha, akonga to kaha

This demonstration lesson was carried out at Russell School, Porirua East. Find out more about the impact and leadership of this work from the perspective of the Russell School principal, board, teachers, in-class mentors, parents and children.

While the focus of this exemplar is on the mathematics, DMIC was selected as the first BES Exemplar because the pedagogy, well-implemented, not only develops mathematics proficiency for all students, but also reduces racism and bullying and increases student belonging; particularly for Pacific, Māori and new immigrant learners.

This video series follows the Developing Mathematical Inquiry Communities lesson structure. The pedagogy is consistent with the findings of best evidence syntheses.

The lesson begins with a teacher-directed Launch, moves into Group Work followed by each group Sharing Back with the whole class. Crucial to the effectiveness of this pedagogy is The Connect that is made to the big mathematical ideas - in this case the emerging algebraic thinking for these Years 3 and 4 learners.

Dr Jodie Hunter demonstrates algebraic thinking for tivaevae

- 01 The Launch
- 02 Group Work
- 03 Sharing Back
- 04 The Connect

Belonging and Wellbeing. See more about impact here...

Reductions in Bullying

The early change data on student bullying rates across the three Porirua East Schools for the first year of DMIC implementation in 2015 showed marked improvement.

The Trends in International Mathematics and Science Study in 2014/15 found that in only two countries was bullying significantly more frequent than in New Zealand for Year 5 students. The early change data in these three Porirua East schools showed reductions in bullying associated with the DMIC intervention: from 23.5% to 10.4% of students reporting they were made fun of or called names at least once a week, from 15.1% to 5.5% of students reporting they were left out of activities at least once a week, and from 20.5% to 7.4% of students reporting being hit, kicked or hurt by other students at least once a week.

Shifting Unconscious Bias: Inclusion and Belonging

There was change also for students' sense of belonging at school. Baseline data for the three Porirua East schools indicated that there were children who, in mathematics, 'never' or 'hardly ever' felt good to be Māori, or Samoan, or their own (other) culture. This started changing. For example, in the Year 1 post-testing, Māori, Samoan, Cambodian and Iraqi students in Porirua East explained:

- *"I feel proud in my maths lesson today by carrying my family with me."*
- *"I felt bad 'cause people tease my culture... (in maths now) I feel normal."*
- *"To be Samoan today in maths was awesome."*

The percentage of students who never or hardly ever felt good to be their culture dropped from 8.6% to 3.3% over the seven-month early implementation period.

See the video on perspectives from the school community on Russell School: The Difference

Related Pages/Videos

INTRODUCTION

VIDEO 1 THE LAUNCH

VIDEO 2 GROUP WORK

VIDEO 3 SHARING BACK

VIDEO 4 THE CONNECT

Ambitious mathematics for young Pacific learners: The Launch

Introduction/Whakataki

Dr Jodie Hunter asks Years 3 and 4 students what the image of a tivaevae is. Cook Islands students recognise the tivaevae. These children become experts for the lesson, able to share their experiences of how tivaevae are made and when tivaevae have special significance. The tivaevae is 'an amazing piece of art'. Because an image of a tivaevae has been used, children who do not have direct experience of tivaevae are able to quickly connect to the lesson context and learn from the knowledge of their classmates.

> Implementation Alert
>
> What works? Activating educationally powerful connections to the lives, experiences and identities of learners.
>
> What does not work? 'Allocating identities' to learners. See Professor Roberta Hunter explain more in the Geometry - Connections: Tapa - Slapo - Ngatu section.

'So, it's got really clever maths in that'

The problem is that there is a tivaevae pattern on a cushion, but the group of Mamas need to know how many leaves will be required for a large quilt.

The launch introduces the children to the mathematical problem and the technical language they need to understand and solve the problem. The Launch prepares them to move from images to numbers.

Dr Hunter draws the children's attention to the mathematical nature of the 'growing patterns' sewn into the tivaevae.

DMIC mathematics problems are designed to engage children at progressive levels of difficulty so the problem starts with the 1st position of the growing pattern but also challenges the children to problem solve at progressive levels of challenge for ambitious mathematics. How many leaves will be needed for different positions from positions 1, 2 & 3, 5 & 7? Describe how many leaves it would have for the 76th position on the tivaevae?

The DMIC approach uses a range of strategies to engage a wide range of children in the teacher-directed discussion. So all children are prepared to actively participate in the group problem solving tasks. The children have been challenged to take on the role of 'Pattern Detectives' using numbers to solve the problem. The collaborative problem solving task has been launched.

Related Pages/Videos


INTRODUCTION


VIDEO 1 THE LAUNCH


VIDEO 2 GROUP WORK


VIDEO 3 SHARING BACK


VIDEO 4 THE CONNECT

Ambitious mathematics for young Pacific learners: Group Work

Introduction/Whakataki

The teacher completes the launch and initiates the group work by ensuring that every group is clear about the problem. Each group has to grapple with the challenge to solve the problem.

The focus is now on their thinking and problem solving. But crucial to the success of group problem solving are the collaborative problem solving skills required for this ambitious mathematics approach.

Through the DMIC approach children are taught how to productively talk, group norms and rules for communication, and participation that give students voice and confidence and enable effective group work. Find out more about the Mathematics Participation and Communication Framework here. Pacific values of respect and care for each other are operationalised in this way.

For many children mathematical argumentation is worrying in case they are seen to be 'not polite' so the children are facilitated in ways to engage in 'friendly arguing' using mathematical reasoning.

Because the DMIC approach has a 'low floor, high ceiling' approach the children begin with small numbers so everyone can succeed. There are four leaves at the centre and growing patterns of two leaves on each side in the 1st position. But generalizing to the 76th position is a challenge that will stretch all learners. The interface of the collaborative problem solving and skilled teacher-directed discussion provides a way to realise the ambitious goal for the lesson.

The three groups of children each come up with different generalisations to explain the growing patterns. Each generalisation works.

Throughout the mathematics lesson the importance of the tivaevae context reaffirms for all of the children that complex mathematics is embedded into Pacific cultures, in this case Cook Islands Māori culture. Ambitious mathematics is part of Pacific identities. This is not tokenism.

Related Pages/Videos


INTRODUCTION


VIDEO 1 THE LAUNCH


VIDEO 2 GROUP WORK


VIDEO 3 SHARING BACK


VIDEO 4 THE CONNECT

Ambitious mathematics for young Pacific learners: Sharing Back

Introduction/Whakataki

The groups have completed their task and are now required to report back and to listen to each other's problem solutions.

Again Dr Jodie Hunter reminds the children of the mathematical and real life problem they are solving as they transition back to the whole class context. In this way she reminds everyone of the purpose, maximises engagement and keeps the children's thinking focussed on the mathematics. Throughout the lesson there are examples of 'cognitive activation' by Dr Hunter to keep children thinking more deeply about their learning without imposing answers or leaving the children to make sense of the mathematics without support.

The Sharing Back enables all the children to hear the three different generalisation strategies of all three groups and to realise that each generalisation works.

> *'I wanted them to see that you could see this pattern as growing in multiple ways because I think it's really important for children to be able to look at each other's perspectives and acknowledge that there are different ways of solving a problem and different ways of seeing things.'*

The whole class Sharing Back session prepares the children for the final crucial session in the DMIC lesson sequence. The Connect to the big mathematical ideas.

Related Pages/Videos

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Ambitious mathematics for young Pacific learners: The Connect

Introduction/Whakataki

The Connect is whole class teacher-directed discussion designed to follow up on the 'So what?' question for mathematics that works for real life problems.

Dr Jodie Hunter uses The Connect to enable the children to generalise from the pattern at a symbolic level.

> *The symbolic level requires students to replace words with symbols such as letters to express the generality of the rule.*

She asks the children to identify what was the same in each group's answer. The children identify the four leaves in the middle of the pattern as a constant no matter how big the pattern grows.

Then she challenges the children to identify another way of saying 8+ 8+ 8+ 8. So the children see multiplication - "8 times" - as another way forward. She takes the children through to a rule that accounts for the constant (4) and for the linear growing pattern.

Dr Hunter asks the class to help her grandmother to work out how many leaves to make for a giant quilt.

A rule for the pattern would be 'times 8 + 4'. Then Dr Hunter explains that they can use a letter to stand for any position number. So the letter 'm' is used to mean any position number. That's how you would find the answer for any position number.

Dr Hunter then asks the children try it out for different position numbers using the new rule m x 8 + 4.

Then Dr Hunter presents the children again with her grandmother's question for the "120th" position and asks every child to talk to the child next to them to check out the rule so that they can answer the question.

The lesson ends with a Cook Islands child answering the question for the whole class '120 x 8 + 4' and the other students agreeing with his answer.

Find out more

Hunter, J. & Miller, J. (2018). Using a contextual Pāsifika patterning task to support generalisation. In J. Hunter, P. Perger, & L. Darragh (Eds.), *Making waves, opening spaces (Proceedings of the 41st annual conference of the Mathematics Education Research Group of Australasia)* pp. 408-415. Auckland: MERGA. Original Source: *Making waves, opening spaces (Proceedings of the 41st annual conference of the Mathematics Education Research Group of Australasia)* from https://www.merga.net.au/. Paper is used with permission.

Miller, J. & Hunter, J. (2017). Young culturally diverse students' initial understandings of growing patterns. In B. Kaur, W. Ho, T. Toh, & B. Choy (Eds.), *Proceedings of the 41st Conference of the International Group for the Psychology of Mathematics Education*. (Vol. 3): Singapore: PME.

Hunter, J.M.R. (2013). *Developing early algebraic reasoning in a mathematical community of inquiry*. Doctoral Thesis, Plymouth University, UK. Retrieved from https://pearl.plymouth.ac.uk/handle/10026.1/2921. Winner of the Early Career Award, Mathematics Educational Research Group of Australasia.

Alton-Lee, A. (2017). Making the total matters in the use of evidence for transformative education. Invited paper for the International Bureau of Education - UNESCO Project: *Rethinking and repositioning curriculum in the 21st century: A global paradigm shift*. Wellington, New Zealand: Evidence, Data and Knowledge, Ministry of Education.

Count on it: Kids can love maths

Senior Lecturer at the Institute of Education at Massey University, Dr Jodie Hunter talks to Kathryn Ryan, Radio NZ about her work in Niue and South and West Auckland schools looking at maths in everyday living and culture.

The Massey University Developing Mathematical Inquiry Communities team won the Mathematics Educational Research Group of Australasia Award for Māori and Pacific Success 2018

PHOTO: TOM LOWRIE (MERGA PRESIDENT) WITH DR JODIE HUNTER, TREVOR BILLS, PROFESSOR BOBBIE HUNTER AND JANETTE BOBIS (MERGA VICE-PRESIDENT - RESEARCH) JULY 2018

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