Narragunnawali
Reconciliation in Schools
and Early Learning

NARRA GUNNA WALI

Resource Guide

Mathematics

The information and resources contained in this guide provide a platform for teachers and educators to consider how to effectively embed important ideas around reconciliation, and Aboriginal and Torres Strait Islander histories, cultures and contributions, within the specific subject/learning area of Mathematics. Please note that this guide is neither prescriptive nor exhaustive, and that users are encouraged consult with their local Aboriginal and Torres Strait Islander community, and critically evaluate resources in engaging with the material contained in the guide.

Please be aware this guide may contain references to names and works of Aboriginal and Torres Strait Islander people that are now deceased. External links may also include names and images of those who are now deceased.

RECONCILIATION AUSTRALIA

Background, and Introduction to, Aboriginal and Torres Strait Islander Mathematics

"In Australia, mathematical systems have been developed over tens of thousands of years to create intricate kinship systems ensuring genetic vigor... Weight systems were based not on numbers, but on patterns of natural objects such as shells… Geometry was used in calculating time according to the angles and position of the sun, moon and stars at different times, governing predictions about seasons and weather… Although in many Australian Indigenous cultures numbers had no names beyond three, large-scale quantifying was still used in records and calculations through patterns and diagrams on rocks, trees, bark and message sticks… Many language groups in New South Wales developed base five number systems. Calculators for this were developed based on one-to-one correspondence, using materials such as honky nuts (like a disposable abacus system), and served to perform calculations of addition, subtraction, multiplication and division." – Dr Tyson Yunkaporta, Senior Lecturer

It is important to appreciate that, while this guide focuses as much on Aboriginal and Torres Strait Islander peoples, perspectives and mathematics conventions since colonisation, mathematics has been an integral part of Aboriginal and Torres Strait Islander cultures for thousands of years, and continues to play an integral part in cultural life to this day. As suggested through the opening quote from Dr Tyson Yunkaporta, it is also worth pointing out that, while this guide has been distinguished according to the distinct Subject/Learning Area of Mathematics, traditional Aboriginal and Torres Strait Islander mathematics also has a very intricate and important interrelationship with other subject/learning areas such as Languages, Science, Technologies, and Humanities and Social Sciences—Geography. It is for this reason that, in many ways, through "removing words, concepts and structures from their Aboriginal context and putting them into a European box called mathematics… [one can inevitably lose] much of the full significance of their meaning and… [not do] justice to the intricacy and complexity" of the Aboriginal and Torres Strait Islander contexts and cultures to which they are tied[1]. Mathematics is, in this way, not simply an 'objective' subject area—with little connection to people and their world views or experiences—as it is so often portrayed. Rather, it is very much a social construct, involving abstracted natural patterns and symbolic expressions of relationships.[2] It is a cultural practice, and the symbols and language of mathematics itself are cultural products.[3]

For Australia's Aboriginal and Torres Strait Islander peoples, mathematics has not necessarily been primarily concerned with *quantities* or *numbers*, but has instead been intensely focused on *relationships* of all kinds, including relationships between the range of elements of the known physical as well as socio-cultural environment.[4] The Australian Aboriginal and Torres Strait Islander Mathematics Alliance has consolidated resources around the links between traditional Aboriginal and Torres Strait Islander kinship and mathematics, for example, recognising how the use of rotation and symmetry in diagrammatic representations of kinship relationships of

[1] Cook, M. (1990) *Seeing Yolgnu, Seeing Mathematics*, Bachelor, NT.
[2] Morris, C. & Matthew, C. (2011) *Numeracy, mathematics and Indigenous learners: Not the same old thing*, http://research.acer.edu.au/cgi/viewcontent.cgi?article=1102&context=research_conference
[3] Ibid.
[4] Rudder, J. (n.d.) *Ethnomathematics in Australia: Introduction*, Australian Institute of Aboriginal and Torres Strait Islander Studies, Canberra, http://aiatsis.gov.au/collections/collections-online/digitised-collections/ethnomathematics-australia/introduction

Central and Western Desert people indeed connects to the expression of culture, relationships and mathematics simultaneously. As another example, culturally distinct geometric symbols in Aboriginal and Torres Strait Islander artworks sometimes help to facilitate an important maths-as-storytelling dynamic, often representing and communicating aspects of the natural landscape and the Dreaming stories that are tied to them.

Accordingly, the Western concept of ‘mathematics’ is by no means the only one, and it is important to appreciate the value of traditional, and continuing, Aboriginal and Torres Strait Islander conceptualisations and conventions that pertain not only to the mathematical sphere, but also the social, cultural, linguistic, scientific and geographic spheres with which it intersects.

Timeline of Key Dates in the Contemporary History of Aboriginal andTorres Strait Islander Mathematics

This timeline chronologically lists some of the key dates in the more recent history of Aboriginal and Torres Strait Islander mathematics, and/or with regard to the relationship between mathematics and reconciliation more generally.

- **60,000+ years ago:**
  - Aboriginal and Torres Strait Islander communities across Australia have maintained longstanding conventions and conceptualisations pertaining to mathematics for tens of thousands of years.

- **1909:**
  - Based on mathematical and scientific understandings, David Unaipon designed and patented an enhanced hand piece for sheep-shearing.

- **1967:**
  - The Australian Government held a momentous referendum (the 1967 Referendum) on May 27, during which more than 90% of Australian voters chose 'Yes' to count Aboriginal and Torres Strait Islander people in the Census, as well as for Aboriginal and Torres Strait Islander votes to be counted in state and federal elections alike. This date is significant to mathematics and reconciliation, not so much in terms of recognising how Aboriginal and Torres Strait Islander peoples count (traditional enumeration systems), but insofar as improving how they are counted.

- **2008:**
  - Reconciliation Australia's first biennial Australian Reconciliation Barometer survey was carried out and released. The Barometer makes effective use of mathematics to quantify data and provide statistical analysis of the attitudes of non-Indigenous and Aboriginal and Torres Strait Islander Australians, and progress made towards achieving reconciliation.

- **2009:**
  - The Australian Association of Mathematics Teachers (AAMT) began managing the Make it Count project, which was first established to support eight clusters of schools throughout regional and urban Australia to improve mathematics outcomes of Aboriginal and Torres Strait Islander students.

- **2011:**
  - Reconciliation Australia released its first annual RAP Impact Measurement Report, which uses mathematics to quantify data and provide statistical analysis of the collective results of the workplace Reconciliation Action Plan program, since its inception in 2006.

- **2012:**
  - The AAMT convened the *Numeracy, Mathematics and Indigenous Learners* national conference, which brought together classroom practitioners to showcase their learnings and teachings. A Blueprint calling for best teaching of mathematics for Aboriginal and

Torres Strait Islander learners was generated from the conference, prompting a series of further relevant symposiums to be held around the country.

- **2014:**
  - With the support of the BHP Billiton Foundation, the CSIRO launched its Indigenous STEM Education Project, which aims at increasing participation and achievement of Aboriginal and Torres Strait Islander students in science, technology, engineering and mathematics.
- The Aboriginal and Torres Strait Islander Mathematics Alliance (ATSIMA) is established.

- **2015:**
- Following support for the development of an Alliance focused on improving opportunities for Aboriginal and Torres Strait Islander mathematics students, and that could effectively connect mathematics-related industry and business to educators, the Aboriginal and Torres Strait Islander Mathematics Alliance (ATSIMA) deadly task force met for the first time on 10 April.

- **2016:**

- The CSIRO launched its inaugural Indigenous STEM Awards, which includes a specific Student Maths Achievement Award.

- **2017:**

- Dr Chris Matthews receives the inaugural Indigenous STEM Professional Award for innovative work engaging Indigenous students in science and mathematics.

Aboriginal and Torres Strait Islander Mathematicians

The list below provides the names of several Aboriginal and Torres Strait Islander mathematicians, past and present. You may notice that some of these mathematicians have also played important roles pertaining to the STEM field more widely[5].

- Adam Hooper (mathematics interest areas: mathematical education)
- Dr Cass Hunter (mathematics interest areas: mathematical modelling)
- Dr Chris Matthews (mathematics interest areas: applied mathematics, mathematics education)
- Ivan Slater (mathematics interest areas: accountancy)
- Professor Mark Rose (mathematics interest areas: mathematics education)
- Professor Peter Radoll (mathematics interest areas: mathematics education)

[5] See the Science, and Technologies—Design & Technologies and Digital Technologies, resource guides for a list of Aboriginal and Torres Strait Islander people who have made important contributions within these wider STEM subject areas.

Aboriginal and Torres Strait Islander Mathematics Institutions/Programs

The following list includes several Aboriginal and Torres Strait Islander mathematics institutions or programs, or wider institutions and programs that nevertheless have a focus on Aboriginal and Torres Strait Islander peoples and perspectives within the subject area of mathematics. Note that, given the relationship between mathematics and the wider STEM field, some of the listed institutions and programs also relate to Science and Technologies—Design & Technologies and Digital Technologies subject areas[6].

- Aboriginal & Torres Strait Islander Mathematics Alliance (ATSIMA)
- Australian Association of Mathematics Teachers Make it Count with Indigenous Learners (including the Make it Count with Indigenous Learners community)
- CSIRO Indigenous STEM Education Project
- Indigenous Accountants Australia
- STEM.I.AM
- Queensland University of Technology YuMi Deadly Centre/YuMi Deadly Maths
- Tasmanian Department of Education Aboriginal Education Unit Improving Numeracy for Indigenous Secondary School Students (INISSS) Project
- What Works. The Works Program: Numeracy

[6] See the Science and Technologies—Design & Technologies and Digital Technologies resource guides for lists of institutions and organisations that include those more specifically tied to either of these three subject areas.

Aboriginal and Torres Strait Islander Mathematics Events/Celebrations

The list below features a number of Aboriginal and Torres Strait Islander mathematics events or celebrations. Some of these events or celebrations may also have relevance and importance to the STEM (Science, Technology, Engineering and Mathematics) field more widely.

- Aboriginal and Torres Strait Islander Mathematics Alliance (ATSIMA) Conference
- CSIRO Aboriginal and Torres Strait Islander Student STEM Achievement Awards (including the specific Student Maths Achievement Award)
- CSIRO Indigenous STEM Awards
- Queensland Department of Education Peter Doherty Awards for Excellence in STEM Education (including the Outstanding Aboriginal and Torres Strait Islander Senior STEM Student Awards)

Other Online Guides/Reference Materials

- Aboriginal and Torres Strait Islander Mathematics Alliance (2017) *Resources*, http://atsimanational.ning.com/resources

- Australian Association of Mathematics Teachers (2011) *Make It Count: Mathematics and Indigenous Learners,* https://mic.aamt.edu.au/

- Australian Government Department of Education, Science and Training (DATE) *What Works. The Works Program: Core Issues 4—Numeracy*, http://www.whatworks.edu.au/upload/1250830936111_file_4Numeracy.pdf

- Australian Institute of Aboriginal and Torres Strait Islander Studies (2017) *Ethnomathematics in Australia: Contents*, http://aiatsis.gov.au/collections/collections-online/digitised-collections/ethnomathematics-australia/contents

- Board of Studies Teaching & Educational Standards NSW (2008) *Numeracy development: Mathematics in Indigenous contexts site*, https://ab-ed.bostes.nsw.edu.au/go/resources/numeracy-development

- Catholic Education Office of Western Australia (2012) *Growing Enriched Cultural Knowledge in Our Schools (GECKOS): Number*, http://geckos.ceo.wa.edu.au/secondary/mathematics/Pages/number.aspx

- Excellence & Equity in Mathematics (XE) (2017) *About [xe.edu.au]*, http://xe.edu.au/about/

- Government of Western Australia Department of Education (2016) *Aboriginal Education: Mathematics*, http://www.det.wa.edu.au/aboriginaleducation/apac/detcms/aboriginal-education/apac/lesson-plans/mathematics.en?cat-id=9192344

- Morris, C. (n.d.) *Aboriginal learners and maths: Mathematics Education,* https://atsimaths.wordpress.com/the-australian-curriculum-mathematics/

- NSW Board of Studies, Teaching and Educational Standards (2004) *Quirindi Mathematics in Indigenous Contexts 2004 Focus Day*, https://ab-ed.bostes.nsw.edu.au/files/Quirindi_Handbook.pdf

- Paige, K. et al. (2016) *Strengthening Indigenous Participation and Practice in STEM: University Initiatives for Equity and Excellence*, http://natsihec.edu.au/wp-content/uploads/2016/08/UniSA-XE-Strengthening-Indigenous-Participation-and-Practice-in-STEM-2016.pdf

- Queensland Studies Authority (2013) *Aboriginal and Torres Strait Islander histories and cultures resources: Mathematics*, https://www.qcaa.qld.edu.au/downloads/aust_curric/ac_ccp_atsi_cultures_maths.pdf

- Queensland Studies Authority (2011) *Culture and mathematics,* https://www.qcaa.qld.edu.au/downloads/approach2/indigenous_res_culture_and_maths.pdf

- Queensland University of Technology (2016) *YuMi Deadly: YDM-CCP teacher resources*, http://ydc.qut.edu.au/resources/YDM-CCP-teacher-resources.jsp

- Sarra, Grace (2011) Indigenous mathematics: Creating an equitable learning environment, http://research.acer.edu.au/cgi/viewcontent.cgi?article=1118&context=research_conference

Reflective Questions for Mathematics Staff and Students

- How have Aboriginal and Torres Strait Islander histories and cultures influenced mathematics in Australia, and what active role do these histories and cultures play today?
- Choose to research an Aboriginal or Torres Strait Islander mathematician. What is the importance of his or her contributions to the subject area of mathematics on either a local or (inter)national scale?
- In what ways does mathematics represent a social construct and cultural practice, and not simply an 'objective' area of study or practice?
- What is the relationship between Aboriginal and Torres Strait Islander mathematics and STEM (Science, Technology, Engineering, Mathematics) subject areas more widely? Why are these relationships important?
- What is the relationship between Aboriginal and Torres Strait Islander mathematics and Aboriginal and Torres Strait Islander languages (as well as the cultures and geographies to which these are simultaneously tied)? Why is this relationship important to understand?
- Compare one or more Aboriginal and Torres Strait Islander counting systems (you might like to consider the often cited Wotjobaluk enumeration system as a starting place) to non-Indigenous counting systems. How are they similar and how are they different? What do the similarities and differences help to tell us about the distinct cultures to which the systems are tied?
- As well as understanding how people count, it is also worth appreciating how people are counted. What is significant about the 27th May 1967 when it comes to counting Aboriginal and Torres Strait Islander people in the Census?
- Reading the Australian Bureau of Statistics' Enumeration procedures for Aboriginal and Torres Strait Islander peoples as a stimulus, what improvements can you identify could be made to the ways in which Aboriginal and Torres Strait Islander peoples are counted in the Australian Census?
- How might your school or early learning centre contribute to the celebration of Aboriginal and Torres Strait Islander mathematics, and mathematicians?
- (How) Can embedding Aboriginal and Torres Strait Islander histories and cultures into the study and practice of mathematics help to foster reconciliation?