

Bridging Worlds: Developing Indigenous Mathematics Curriculum

IndigMEC2 Conference

Second Indigenous Mathematic Education Conference

Guovdageaidnu/Kautokeino, 14th – 16th October 2024

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Content of today's talk

Factors Impacting Indigenous Mathematics Curriculum Development

- *Ideology, Politics, Sociocultural Context, Nature of Knowledge*

Emergence of Māori-medium schooling in 1980s

- *Revitalize Language, Traditions, and Ancestral Knowledge*

Development of curriculum 1990s

- *Centrally Managed System Tied to Funding and Power*
- *Issues Inaugural Development of Mathematics Curriculum*

Re-developments in 2006 and 2024

- *New opportunities*

Key factors: Indigenous Mathematics Curriculum Development

Views on the nature and purpose of schooling

Ideology/Politics

Maths education policy/strategy

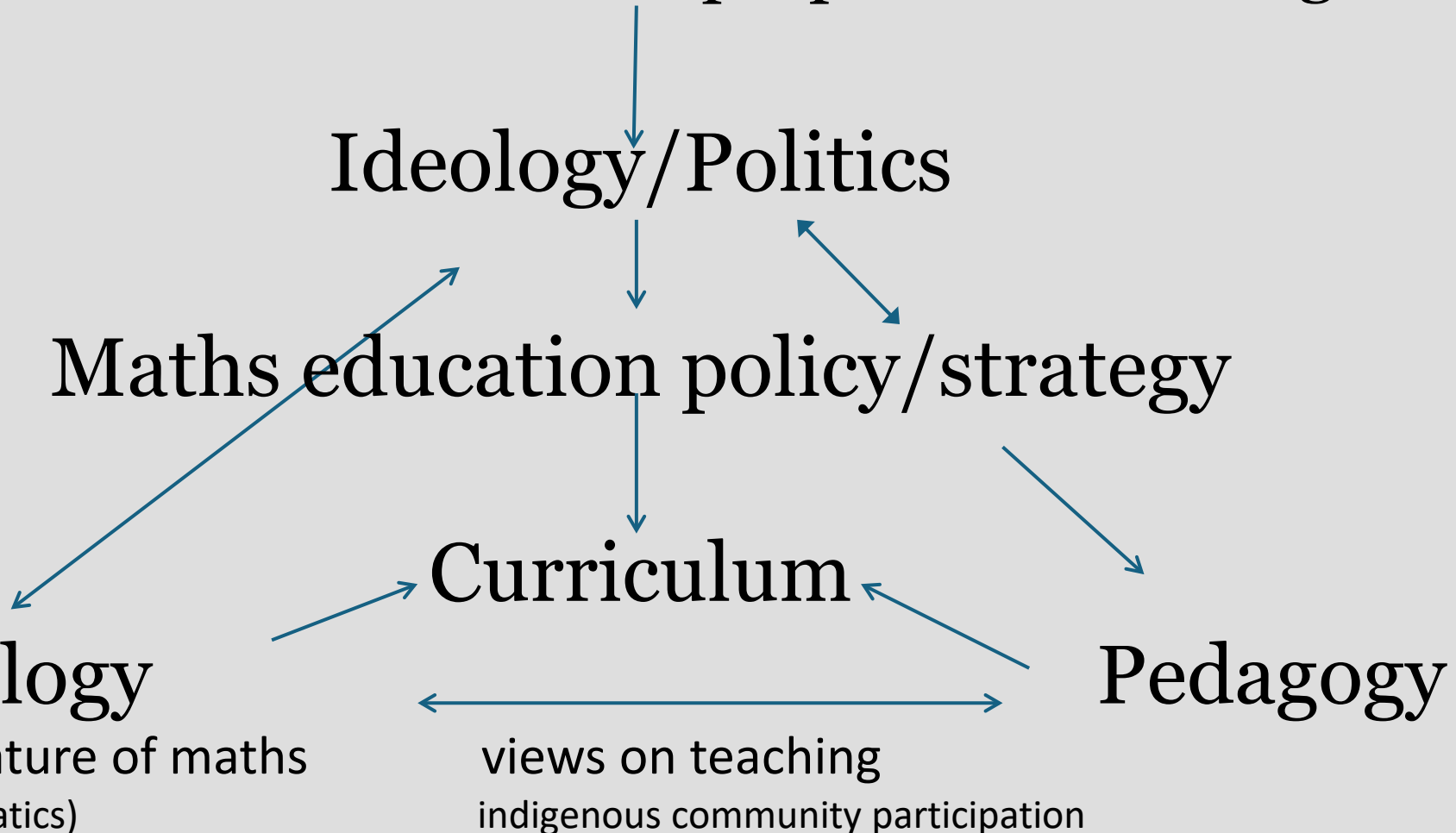
Curriculum

Pedagogy

Epistemology

Views on nature of maths
(ethnomathematics)

views on teaching
indigenous community participation





Different Ideologies influencing our Curriculum

- **Socialization Function:** Education helps replicate society and culture, promoting citizenship-
- **Vocational Function:** a belief there's a strong connection between math education and the country's economic success.
- **Economic Function:** linked to a country's economic performance. International tests often used to measure educational and political success.
- **Transformative Function:** aims to inspire change for a fairer society and a better world
- **Empowerment Function:** empower learners and the community, validating their experiences and traditional knowledge systems, cultural values and community needs and seeks to nurture the whole person—intellectually, emotionally, and spiritually



Politics of Mathematics Education- Who owns the curriculum?

A teacher in a public school is an employee of the *district*, which is an educational entity of the *state*.

It is the *state, the governor, the legislature (the state dept. of education or state board of education)* which has ultimate responsibility over the curriculum.

What about the role of the indigenous community? How are their aspirations and goals reflected in the curriculum?



Politics of Mathematics Education- Whose mathematics?

Functional mathematics: Using math concepts and skills to solve real-world problems

Abstract mathematics: study of mathematical concepts without necessarily applying them to real-world scenarios, emphasizing theoretical frameworks and structures.

Textbook mathematics: curriculum found in educational textbooks, which usually emphasizes procedures and problem-solving techniques

Indigenous/Ethnomathematics: mathematical practices, concepts, and knowledge systems developed and utilized by specific cultural or indigenous groups, highlighting the diversity of mathematical thought across different societies

A combination of the different foci?



Politics of Mathematics Education- who designs it

- How a curriculum is structured and what it contains are political decisions
- The language of the curriculum
- The curriculum is determined as much by what it omits as what it contains- thus political



Politics of Mathematics Education- nature of knowledge

Use of knowledge is political

- maths knowledge can be used in order to influence society

Epistemological

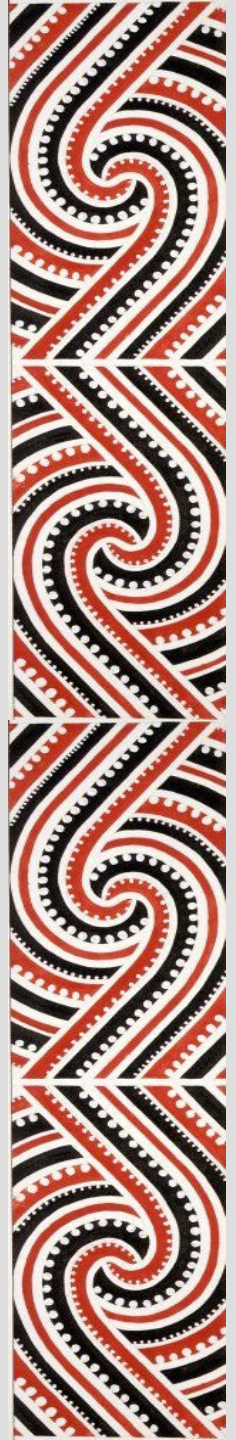
- Indigenous knowledge often involves holistic approaches, where understanding comes from interconnectedness and relationships rather than isolated analysis.
- Indigenous knowledge is often embedded in specific languages and cultural contexts.

Ontological Issues

- Many indigenous knowledge systems incorporate spiritual beliefs and cultural practices.
- For many indigenous groups, knowledge is inextricably linked to the land and their identity.

Case Study: Development of Māori-medium mathematics curriculum 1995-2024

- state's intentions can be interpreted at a political/economic level
- Māori aspirations can be interpreted from a cultural level –the renaissance and maintenance of our language, knowledge and culture
- Ideological tensions exist

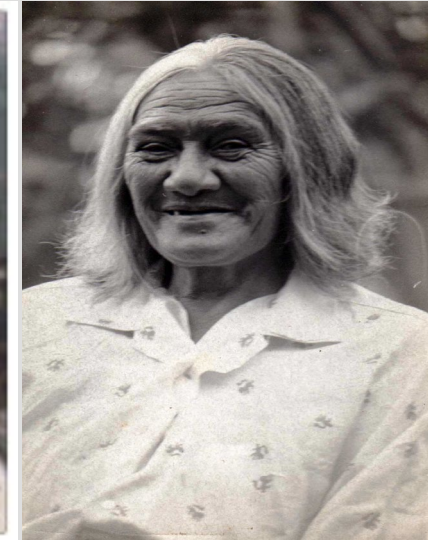
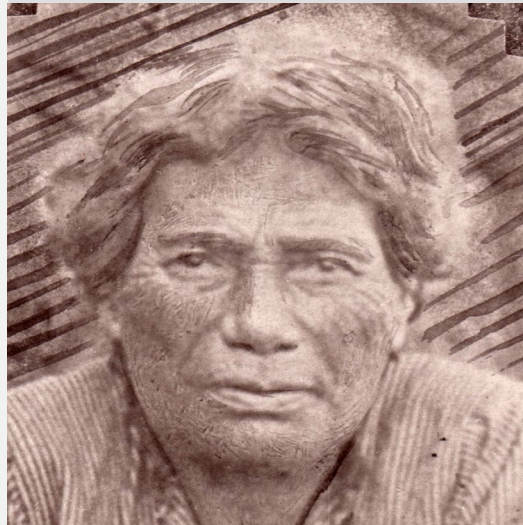


Māori Language and society

- An Eastern Polynesian language
- Sister languages include Hawaiian, Tahitian, Rarotongan, Marquesan and Rapanui
- One language – many dialects
- Grouped around families, sub-tribes and tribes



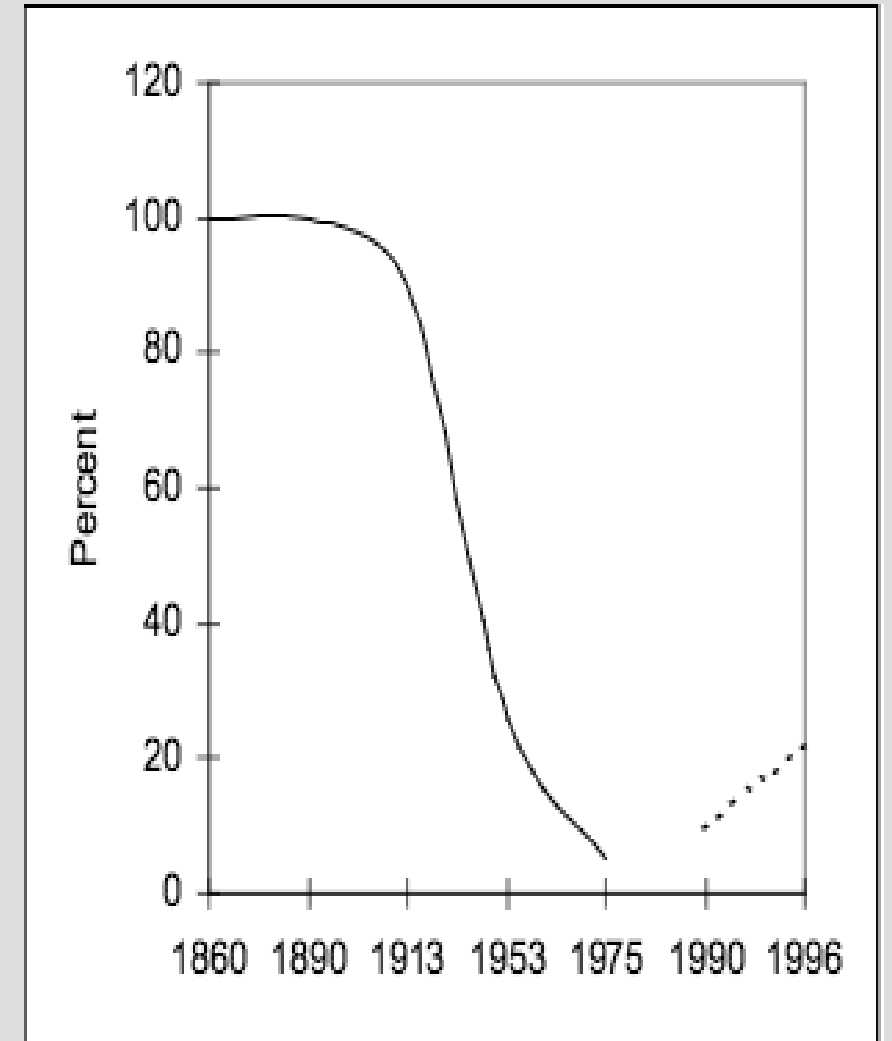
Te Whanau a Apanui



Background: Māori-medium schooling

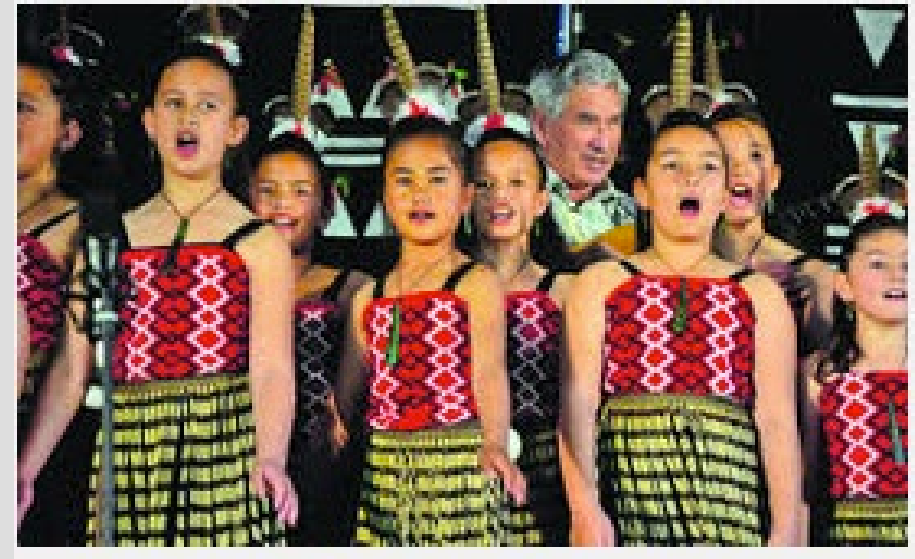
Socio-cultural

- Māori – Indigenous people of NZ
- Colonization by British: 1800-1970s
- English only schooling policy
- Considerable language shift
- Cultural marginalization
- Māori considered an endangered language late 1970s



Revitalisation of *te reo Māori* pathways in education: primary, secondary and tertiary

- 1 July 2023 there were 25,824 students enrolled in various forms of Māori-medium education



Māori-medium students generally out performing Māori students in mainstream



Education & Curriculum Reform 1990s

New paradigms influencing educational policy, such as developing curricula.

- Given some delimited authority to develop a Māori-medium mathematics curriculum-now being a legislative requirement
- However, Māori-medium mathematics had to mirror English language version

Different Ideologies influencing our Curriculum

- Neo-Liberalist (1984>>>>
- Free markets. NZ competing in overseas markets
- Knowledge society
- Teacher and school accountability
- Acts of Parliament incl Māori Language Act 1987

Māori-medium Maths Curriculum

Measurement/Geo Number/Algebra Statistics

Strands

ngā whenu

Te Ine me te
Āhuahanga

Te Tau me te
Taurangi

Te Tauanga

Years

Interweaving strands

ngā āhuatanga
kōtuiti i ngā
whenu

ngā tauira me ngā pangā

to reo matatini o te pāngarau

1-13

Sub strands

ngā tino wāhanga
o ngā whenu

- Te Ine
- Te Hanga
- Te Wāhi me te Ahunga
- Te Panoni

- Te Mātauranga Tau
- Ngā Rautaki Tau
- Te Tauira me te Pānga

- Te Tūhuratanga Tauanga
- Te Tūponotanga

te whakamahinga o te pāngarau

Positives for Māori-medium education

- State mandate for teaching in the medium of Māori
- Systematic development of mathematics register, corpus of terms, dictionaries etc funded by Ministry of Education
- State required to provide teacher professional & resource development
- Ongoing development of teachers' use and understanding of Māori-medium maths language
- Teacher's increasing content and pedagogical knowledge (by Western maths knowledge)
- Establishing learning networks & communities of practice






Positives for Māori Community

Social Justice, Linguistics rights imperative

- Cultural knowledge and, language and revival
- Māori language & culture at centre of children's education
- Emergence of private Māori owned resource development, translation and PLD companies



Strategies to elaborate the Māori language to teach mathematics post 1990s

Required considerable register and corpus development(Corpus planning)- Maori language had been excluded from schooling over 100 years

- No transliterations (changing phonology), e.g. *numa* for number
- Adding prefixes and suffixes, e.g. *wehe* means to divide becomes *wehe(a)*-division
- Changing the meaning of existing words. e.g. *tango*- take up, take away, remove becomes *subtract*
- Functional shift e.g. adjective becomes noun –*koeko means tapering to a point becomes 'cone'*
- Calquing creating words from translation of common or original meaning e.g. chordê – *aho*

Strategies to elaborate the Māori language to teach mathematics post 1990s

- Compounding existing words, e.g. *hanga* means shape and *rite* means alike, thus *hangarite* means symmetrical
- Resurrection of old words, e.g. *ine* traditional word for measure had fallen out of use
- Reduplication, *tārua* means to repeat, *tāruarua* means repetitive
- Creation of metaphors, e.g. *kauwhata* now word for graph. Traditional meaning, 'a stage or frame for hanging things on



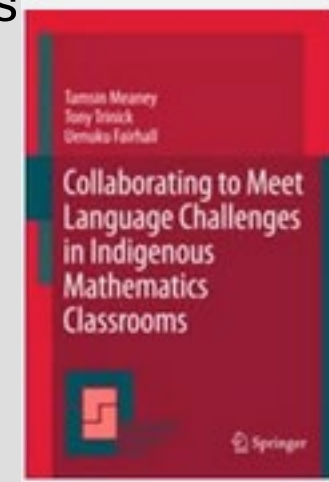


Pedagogical Implications

- By the 1980s small pool of proficient speakers
- Most teachers L2 speakers
- Māori-medium mathematics language restricted to schooling
- Teachers simultaneously learning the language, the content and the craft of teaching
- Challenge of re-introducing ethnomathematical practices into classroom

Conflicting Goals & Issues

- Indigenous versus “national–mainstream” education
- Epistemological-the place of traditional knowledge in a national curriculum document.
- Community negotiated vs. national curriculum (leads to issues ~ national assessments)
- Role of mathematics- mathematics as *praxis*
- Preparing students for the world of work and/or life?
- What does all of this mean for **teaching and learning** in schools?



Linguistic/Cultural Issues

Ongoing contestation

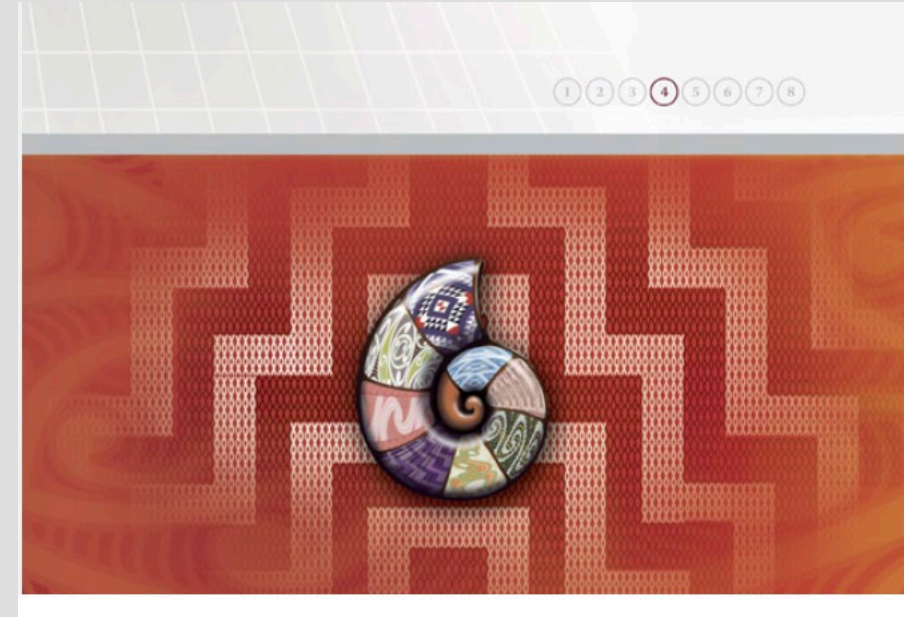
- Standardisation vs. dialects
- Primary focus was on revitalising language – more challenging to resurrect cultural knowledge and practices in urban schooling
- Symbiosis or language/ Cultural Change; new grammar, new registers: becoming more like English – language changes that imply cultural change?
- The place of traditional Māori Knowledge in the curriculum - ethnomathematics debate
- Is it ‘necessary’ or beneficial to learn mathematics in Māori at higher levels?



Revised curriculum 2006-8

Third Way ideology

- more inclusive
- Ministry of Education
 - more accommodating of difference
 - new models of engagement
- Bottom-up vs top-down
- Developers a collective
- Inclusive of elders and community
- Collective developed philosophical base
- Māori expertise & politicizing grown





2006-8 Curriculum

Design

- One over arching curriculum framework, rather than stand alone curriculum
- Standardization of vocabulary across subjects
- Less proscriptive & more supportive of language acquisition & revitalization goals
- Curriculum that better reflects Māori world view

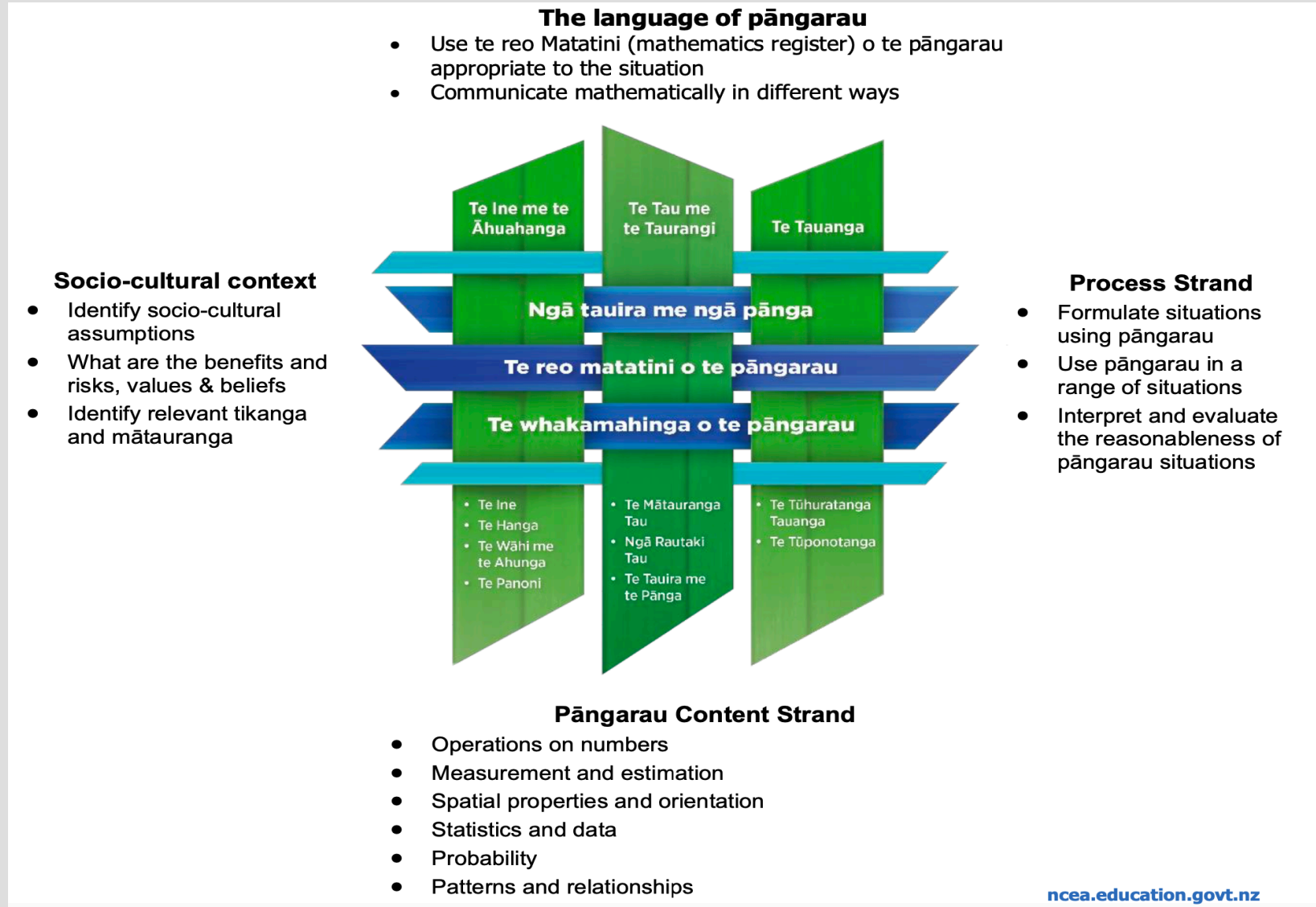
Spatial Orientation –Te Ika a Maui



North-Tail of the fish –down
Murihiki, raro

Head of the fish- up south, runga

Re development 2024-25: Indigenising the Curriculum





Designing a Mathematics Curriculum for Indigenous people

Design: The nature of the elements/components and the manner in which they are organized. This will be influenced by national or local curriculum

- Who should be involved in the development and level of participation
- Determine aims & objectives;
- Subject or student/family centred?
- How are traditional mathematics practices considered?
- Selection of knowledge, skills, dispositions and values to be taught
- How are these influenced by teaching and learning pedagogy?
- How is content to be organized e.g. in subject areas, levels and how prescriptive?
- Unpacking of content and linking to learning experiences and culture of our students