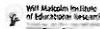


Scoping the meaning of critical in mathematical thinking for ITE

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Setting the scene

- Strong current political interest in children's and adults' reading, writing (literacy) and mathematics (numeracy) learning
- These agendas overlap in Initial Teacher Education
 - Preservice teachers:
 - Are preparing to become teachers of children
 - Are learners themselves
 - May have uneven skills – 'spiky' profiles

Our motivation

- A three year TLRI project looking to understand and develop pre-service teachers' mathematical thinking by working across the breadth of their ITE programme
- Underpinned by a view that mathematical thinking is involved in:
 - All curriculum learning areas
 - Working with student achievement data
 - Administration and management tasks
- Also, underpinned by a view that mathematical thinking in action involves:
 - Competence
 - Confidence
 - Critical thinking

Broader context of mathematics education

Mathematics in our lives

- Plays a large role in daily local and global life
- May be difficult to detect
- Has "formatting power"

21st century citizenship

- Multileveled, multidimensional, global
- Increasingly diverse societies
- Cultivation of justice, fairness and equality
- Classrooms as sites of democratic practice

Focus for this paper

- Understanding and defining the meaning of 'critical'
- Literature review of policy and research focused on 'critical' or 'criticality'
 - Critical social theory
 - Critical literacy
 - Critical mathematics, critical numeracy
 - New Zealand Curriculum

Given that many schools serve increasingly diverse communities, have responsibility for educating students in continuously changing digital and communication technologies, and address escalating pressure to lift and sustain measurable standards on high stakes, it is harder, but more important than ever, to keep equity frameworks in the foreground.

Bloome & Green, 2015, p. 21

Critical social theory

- Critical thinking is a disciplined process
- Involves conceptualising, applying, synthesizing and/or evaluating information as a guide to belief and action
- Associated with dispositions, specific actions and judgement
- Commitment to social and political practice of participatory democracy
- Willingness to be open to consider alternative perspectives, integrate new or revised perspectives and foster criticality in others

e.g. Sciven & Paul, Kompf & Bond, Raistlums

Critical in literacy education

- Literacy is socio-cognitive, technologically mediated practices using sign systems to interpret and convey meaning
- Text is not neutral, it is ideological
- Agency and taking action – interrogating the text, unpacking the messages, becoming informed about the issues, taking action and promoting social justice
- The teaching and learning of literacy are not culturally or politically neutral endeavours

e.g. Kress & Jewitt, Luke, Street, Vasque et al, Cho

Critical in mathematics education

- **Critical numeracy** (Paulos; Hogan; Willis; Watson)
People know mathematics and can apply mathematics in contexts in questioning ways
- **Critical mathematics** (Skovsmose; Barwell & Suurtamm)
Mathematics and its uses have social effects and ethical consequences
- **Ethnomathematics** (D'Ambrosio; Barton)
Mathematics and its purposes are socially, culturally and historically located
- **Critical mathematical literacy** (Frankenstein)
Mathematics is a tool to interpret and challenge social inequities

The 'sociopolitical turn' - Gutierrez

The challenge is not only to produce competent mathematicians and mathematics users but to promote 'the growth of students as competent, caring, loving and lovable people'.

Noddings, 1993, cited in Atweh & Brady, 2009, p. 269

A socially response-able mathematics education enables students to function as effective citizens in the world; to understand how the world works in order to change some aspects of it and, beyond this, to create the world a new way.

Atweh & Brady, 2009

Critical in the New Zealand Curriculum

- Vision statement
- Values statement
- Principles
- Key competencies
- Learning areas
 - Mathematics and statistics – "explore relationships in quantities, space, and data and learn to express these relationships in ways that help them to make sense of the world around them"
 - Science -- "participate as critical, informed, and responsible citizens"
 - Technology -- "be discerning consumers who make a difference in the world"

Our synthesis

Critical in mathematical thinking means:

- **Critical awareness**
 - Seeing mathematical thinking in oneself
 - Seeing hidden mathematics
- **Critical reflection**
 - Thinking about the social uses of mathematical concepts
 - Questioning the effects of the uses of mathematics on people's lives
 - Thinking and questioning within a democratic, social justice orientation
- **Critical action**
 - Seeing oneself as a values-based actor
 - Identifying alignment/non-alignment of values and practices
 - Taking values-based action

Implications for ITE

ITE needs to support pre-service teachers to:

- Understand the mathematics – be competent and confident
- Be attuned and alert to and understand the mathematics of political, economic and everyday activities
- Understand the politics of mathematical knowledge – how numbers are used in the allocation and non-allocation of resources and in categorisation
- Understand themselves as actors and as agentic in local and global contexts where mathematical thinking is in play

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