Understanding high mathematics ability in Indigenous students

STEM Education Conference

Building STEM capability in Schools

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Understanding high mathematics ability in Indigenous students

**Overview**

1. Understanding “intelligence”, “disadvantage” & “invisible high ability child”.

2. Finding the invisible high ability child (if such a child exists).

3. Bridging the (pedagogical) gap.
Research context
Intelligence

What traits affect our ability to solve problems with cognitive content?

Mental acuity
Habits of mind
Attitudes
Knowledge and information
Speed of information processing
Memory

Contentious statement (via questions)

Question 1 Describe what lies just outside the atrium (or vomitorium) of this building.
Contentious statement (via questions)

*Question 1* Describe what lies just outside the atrium (or vomitorium) of this building.

*Question 2* What are the relationships (if any) between peripheral vision acuity, curiosity, myopia, near work, excessive use of ICT, and various measures of high ability?
Contentious statement (via questions)

**Question 1** Describe what lies just outside the atrium (or vomitorium) of this building.

**Question 2** What are the relationships (if any) between peripheral vision acuity, curiosity, myopia, near work, excessive use of ICT, and various measures of high ability?

**Question 3** To what extent does STEM education (say) further disadvantage those children who are already disadvantaged, and privilege those who are already privileged?
Intelligence (and measures of intelligence)

The Flynn Effect

The relationship between technological language, abstract language and concepts, and the Flynn Effect.


“Disadvantage”

A background of so-called disadvantage can mean many things:

low socio-economic status

(forced) cultural minority status [cf. historical trauma]

refugee or immigrant status

rural, remote and isolated communities

the juvenile justice system

living with an impairment or learning difficulty

difficult family environment

   [single parent, substance abuse, psychopathology]
The Great Gatsby Curve (Krueger, 2012)

Reflects “intergenerational income elasticity” –

the likelihood that a person will inherit their parents’ relative position of income level; that is,

disadvantage tends to be maintained, if not exacerbated, from one generation to the next.
Invisible high ability children

High ability student who is underachieving

a student whose school performance is below some measure of his or her high potential.

Invisible high ability children

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a student whose school performance is below some measure of his or her high potential.

*Invisible high ability student*

a student whose measured potential is less than his or her actual potential and who also underperforms in the classroom.

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Invisible high ability student

a student whose measured potential is less than his or her actual potential and who also underperforms in the classroom.

Many high ability children from backgrounds of so-called disadvantage are at-risk of being invisible high ability children.

Identifying invisible high ability children

**Problem 1** What does “high potential” mean, and how should we identify it?

[Borland, Re-thinking gifted education; Geake’s method; Martin’s Philosophy]
[Experience tells me, no identification, no change to status quo …]
Identifying invisible high ability children

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Identifying invisible high ability children

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[Borland, Re-thinking gifted education; Geake’s method; Martin’s Philosophy]
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**Problem 2** Given the definition of “invisible gifted child”, does such a child exist?

**Problem 3** If the invisible high ability child exists, to what extent might it be possible to identify them?
Identifying invisible high ability children

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**Problem 2** Given the definition of “invisible gifted child”, do they exist?

**Problem 3** If there are invisible high ability children, to what extent might it be possible to identify them?

**Problem 4** Identification must imply educational action. What action will begin to address the disadvantage?
Current identification methods

School performance (achievement tests, NAPLAN, etc.)

Verbal IQ tests

Non-verbal “culturally fair” IQ tests (RSPM, NNAT)
Current identification methods

School performance

Verbal IQ tests

Non-verbal IQ tests (RSPM, NNAT)

but, results highly correlate with school performance; hence

Dynamic assessment
Current identification methods

School performance

Verbal IQ tests

Non-verbal IQ tests (RSPM, NNAT)

but, results highly correlate with school performance; hence

Dynamic assessment

but, low self-efficacy, forced choice dilemma, fear of failure; hence

Chaffey’s (2002) *Coolabah Dynamic Assessment*
Current identification methods

*Dynamic assessment with metacognitive intervention*

*Coolabah Dynamic Assessment*

*Wii Gaay*

*Lighthouse*

*Subhaga daruwan*

(Ariyaratne, 2008; Merrotsy, 2008, 2013)
Current identification methods

Dynamic assessment with metacognitive intervention

Coolabah Dynamic Assessment

Wii Gaay

Lighthouse

Subhaga daruwan

… But, too expensive to be widely adopted!

(Ariyaratne, 2008; Merrotsy, 2008, 2013)
A holistic approach … (Merrotsy, 2013)

1. Health & well-being (e.g. *Otitis media*; trachoma; abuse).

2. Breuer-Weuffen Differentiation Test, fine motor skill development (Stöger et al., 2008; Martzog, 2010).

3. WRRT, rate of reading (Wilkens et al., 1996).


5. Manipulative material (Merrotsy, various dates).

6. CogState, cognitive ability & cognitive state (Cairney & Maruff, 2007; Cairney, 2008).
Breuer-Weuffen Differentiation Test

Bush Track

Name:
Class:
Time:
Breuer-Weuffen Differentiation Test
A holistic approach ...

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Creativity test, figural fragments

Example 1: remote Aboriginal community
Creativity test, figural fragments

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A holistic approach …

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Manipulative material
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(Kannevsky, 1990; Merrotsy, 2015)
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CogState

- Developed by Menzies School of Health, Northern Territory
- Assessment of cognitive ability and cognitive state
- Validated tests of memory, attention & executive function
- Languages: Aus, Eng, US, German, Dutch
  [otherwise only brief translation of rules is enough]
- Low cost, little training needed
- Effective with people who have never used a computer
- ~ 20 minutes to administer (one-on-one)
Recent and current findings

1. ~ 5% poor fine motor skills, average achievement, but some signs of high ability [? invisible high ability children?].

2. ~ 5% significant change in rate of reading.

3. Figural fragments & Manipulative material are both highly effective with (at least some) (invisible high ability) Aboriginal children and youth.

4. CogState validity with high ability students strong.

5. CogState is identifying (at least some) invisible high ability students.
Recent and current findings

6. The model “appears” to identify high ability students from backgrounds of disadvantage at a similar proportion to gifted students from the wider population.

The model appears to offer a suitable and accessible means of identifying invisible gifted children and youth.
Bridging the pedagogical gap

1. Build cultural & social capital
   
   [& health & well-being; mother tongue]

2. Community and school level programs
   
   [community literacy, flexibility, & choice]

3. Programs for individual students
   
   [self-efficacy, literacy & numeracy & ICT skills, mastery, vicarious experience, creative problem solving, metacognition, peer relationships, change teacher attitudes and classroom practice]
Bridging the pedagogical gap I

Example 1: Build cultural & social capital

*GrimeStoppers*


*Books*

Aboriginal language books
Bridging the pedagogical gap II

Example 2: School level programs

Aboriginal communities – rural and remote:

• One Laptop Per Child
• iPads (e.g. SiP project)
• Leadership programs

Image: [http://one.laptop.org/](http://one.laptop.org/)
Bridging the pedagogical gap II

Example 3: Community level programs

*STEM Plus*
First languages & English botanical project
Language, science, technology, mathematics, geography, history, literacy, numeracy, leadership, problem solving, social and emotional development, and much more …
Mixed media
Assistive technology (voice to text, predictive text & personal dictionaries)
(Steve New, Remote WA; Reg O’Connor, Texthelp)
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