K-2 *Make it Count* Students' Views of Mathematics[1]

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Data from an attitude survey administered to students in grades K–2 from four schools participating in the *Make it Count* project are reported in this paper. Few differences were found in the attitudes and beliefs of the Indigenous and non-Indigenous participants. The relevance of these findings for students' longer term mathematics performance is also considered.

Introduction and Background Information

Reports that Australian Indigenous[2] students, on average, perform well below their non-Indigenous peers on traditional measures of achievement are prevalent. "At both Year 4 and Year 8 in TIMSS[3] 2007, non-Indigenous students scored at a substantially higher level than Indigenous students – 91 score points at Year 4 and 70 score points at Year 8" (Thomson, 2010, p. 79). Examination of the Australian 2009 Programme for International Student Assessment [PISA] results also reveals a substantial difference between the average performance of Indigenous and non-Indigenous students on the mathematical literacy assessment component (Thomson, De Bortoli, Nicholas, Hillman, & Buckley (2011, p. 189).

An excerpt from a report published under the auspices of the Queensland government draws on data from the National Assessment Program Literacy and Numeracy [NAPLAN] tests to compare the performance of Indigenous and non-Indigenous students. Although the distribution of Indigenous students varies by state, the Queensland data offer a useful guide to the national situation.

> An analysis of the 2008 NAPLAN data indicates that there is a gap at Year 3. The gap for reading on average is 62 and for numeracy it is 54. The gap persists through all year levels. ... The difference in mean scale scores between Indigenous and non-Indigenous students approximates to two years of schooling for reading (Years 5 and 7; Years 7 and 9) and for numeracy (Years 7 and 9). (Department of Education and Training, Queensland government, n.d.)

Inspection of other NAPLAN data, for example performance on items common to the 2009 NAPLAN Year 3 and Year 5 tests, yields a similar picture. Australian Aboriginal or Torres Strait Islander students in Year 5 performed, on average, at approximately the level of the national Australian average for students in Year 3 for six of the 10 items (and slightly better than, but nevertheless well below, the national Australian average for students in grade 3 for the remaining four items).

Presenting performance differences between selected groups of students – evocatively termed 'gap gazing' (Gutiérrez, 2012) – can be counter-productive and reinforce stereotyping. "In its most simplistic form, this approach points out there is a problem but fails to offer a solution.... (T)hat it is the analytic lens itself that is the problem, not just the

[1] We gratefully acknowledge the support of Christine Payne and her colleagues for their assistance in the collection of these data

[2] In this context, "Indigenous" refers to students who identify as either Australian Aboriginal or Torres Strait Islanders

[3] Trends in International Mathematics and Science Study

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absence of a proposed solution" (Gutiérrez, 2012, p. 31) might be a further consideration. The latter point is addressed in some detail by Jorgensen and Perso (2012) who argue:

> the assessed curriculum through NAP (the National Assessment Program of which NAPLAN is an essential part) is not equitable for all Australian students. This type of assessment can privilege select groups of student whilst marginalizing others ... largely due to the fact that these tests require literacy in the dominant language and consequently are linguistically biased in spite of the best efforts of producers to ensure otherwise. (p. 119)

In the Australian context, multiple explanations have been proposed for the reported differences in performance between Indigenous and non-Indigenous student groups (e.g., De Bortoli & Thomson, 2010; Jorgensen & Perso, 2012). Contextual factors regularly invoked to explain between, and indeed within, group differences and cited as possible target areas for fruitful interventions commonly include the home and school learning environment, students' learning strategies and preferences, and affective factors such as students' attitudes and beliefs. With respect to the last set, De Bortoli and Thomson (2010) reported that "Indigenous students who believe in their academic ability and who can confidently complete mathematics tasks are more likely to perform at a higher level on the mathematical literacy scale" (p. 88). However, according to Hughes and Hughes (2010), "Indigenous students themselves often have confused expectations.... Even in mainstream schools, differences in expectations of Indigenous attendance and performance are picked up by the students" (p. 17). Low expectations, they and many others (e.g., Sarra, 2011) argue, can be self-fulfilling and lead to low educational outcomes.

The Study

We report data from an attitude survey administered to students in grades K[4]–2 from schools participating in the *Make it Count* [MiC] project (Make it Count[5], n.d.). The instrument administered was designed to explore whether or not differences are found in the attitudes to mathematics of young Indigenous students and their non-Indigenous classmates. Given the age of the sample, only a limited number of items were included in the survey instrument. Relevant information was read out to the students, additional teacher support to complete the survey was given as needed, but all written responses were made by the students themselves. Core components of the survey are described later, as part of the presentation of results.

Aims

For the K-2 students in the study, the specific questions listed below capture the aims:

- What are the views of Indigenous students about mathematics and related issues?
- Are there differences in the attitudes of Indigenous and non-Indigenous students?
- Can any inferences be drawn from the attitudes of Indigenous students about mathematics and related issues and their performance in mathematics?

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[4] Kinder. The term Prep is used instead in some Australian states

[5] *Make It Count* is a project of The Australian Association of Mathematics Teachers (AAMT) Inc., funded by the Australian Government as part of the *Closing the Gap initiative*.

Theoretical Model Informing the Study

Reference has already been made to factors found to influence mathematics learning outcomes for students – both Indigenous and non-Indigenous. These comprise both personal and environmental factors. Representative of the set typically considered important is Rothman and McMillan's (2003) listing in their longitudinal survey of Australian Youth: "variables believed to be important influences on achievement in literacy and numeracy ... (include) variables relating to students (gender, Indigenous background, language background, home location), their parents (education level, occupation, birthplace), attitudes toward school, aspirations and self-concept" (p. v). The elements included mirror those found in models of gender differences in mathematics learning (see, e.g., Leder, 1992; Wigfield & Eccles, 2000).

The Sample

The sample comprised 321 students in grades K-2 at four schools. Of these, 89 (46 boys and 43 girls) were Indigenous and 205 (95 boys and 110 girls) were non-Indigenous. Indigeneity and Grade level were not recorded for, respectively, 26 and three students – leaving a useable pool of 292 students. Sample details, by grade, are shown in Table 1.

Table 1

K-2 Students Who Completed an Attitude/Beliefs-about -Mathematics Survey.

Grade	Kinder	Grade 1	Grade 2	Total
Indigenous	31 (30%)	28 (33%)	29 (28%)	88 (30%)
Non Indigenous	72 (70%)	56 (67%)	76 (72%)	204 (70%)
Total	103	84	105	292

The participating schools were involved in *Make it Count* [MiC], a "four-year project to develop an evidence base of practices that improve Indigenous students' learning in mathematics and numeracy" (Make it Count, n.d). Explicit reference is made on the website of each of these schools to special programs available to Indigenous students and their parents. For example: "our school is committed to working with Aboriginal parents and community members in developing personalised plans for our Aboriginal students"[6]. To ensure that approximately one-third of the sample comprised Indigenous students, only a representative selection of the schools' non-Indigenous K-2 students were involved.

The Instrument

The survey was administered towards the end of the 2011 school year and comprised both multiple choice and open-ended items. Information sought from the students included their names, whether they were male or female, whether they were Indigenous, and whether they were in Kinder, Grade 1 or Grade 2. Core items covered: students' self report of their mathematics achievement; liking of mathematics – their own and that of significant "others" in their environment; liking of reading; perceptions about mathematics; its long term usefulness; and perceptions of mathematics lessons. Students' expectations of being able to solve two mathematics problems were also sought.

"Colour in the face that shows how you feel" was the response format for the multiple choice items. Five faces were shown ranging from smiling broadly to frowning deeply.

[6] Reference not provided, to retain the school's anonymity

Responses were coded from 1-5 with 1 = deeply frowning face to 5 = broadly smiling face. Because of the limited group sizes, particularly of the Indigenous sample, responses were recoded into three groups comprising categories which represented responses such as: like/like very much; neutral; dislike/dislike very much. The content of the survey can be inferred from the presentation of the results. As already indicated, some of the students completed the survey with teacher assistance.

Analyses

The frequency distributions of the responses to the items were examined for the full sample, by Indigeneity and, when appropriate, by grade level. Pearson chi-square tests were conducted to examine possible differences in group responses. Effect sizes (φ) for the statistically significant differences were also calculated. Because of the relatively small sample sizes of the various subgroups, differences found are often most appropriately interpreted as indicative of a trend.

Results

To conform with paper length constraints, reporting of results is limited to selected but representative items. The results are presented under two headings: beliefs about mathematics, and performance in mathematics. The data are presented for the full sample, unless the content of the question makes inclusion of the Kinder group inappropriate.

Beliefs about Mathematics

Liking of reading and mathematics – "this year"

The students' responses to this question are shown separately for Indigenous and non-Indigenous students in Tables 2 and 3 respectively.

As can be seen in Tables 2 and 3, the majority of students, both Indigenous and non-Indigenous, liked mathematics and reading. The high proportions of Grade 2 students (Indigenous: 93%; non-Indigenous: 87%; overall: 89%) who indicated that they liked mathematics or liked it very much is noteworthy. The differences by grade level in the liking of mathematics were statistically significant for the (larger sample of) non-Indigenous students ($\chi^2_4 = 14.33$, $p < .01$, $\varphi = .27$), but not for the Indigenous students. The differences in the liking of reading by grade level were not statistically significant for the group as a whole ($\chi^2_4 = 8.98$, $p = .06$), nor for Indigenous or non-Indigenous students.

Table 2
Indigenous Students (in %): Liking of Reading and Mathematics by Grade Level

Activity	Mathematics			Reading		
Rating	Kinder	Grade 1	Grade 2	Kinder	Grade 1	Grade 2
Like very much/ like	74%	75%	93%	74%	96%	83%
Neutral	7%	11%	3%	16%	4%	7%
Dislike/ Dislike very much	19%	14%	3%	10%	–	10%
Total Number of Students	31	28	29	31	27	29

Table 3
Non-Indigenous Students (in %): Liking of Reading and Mathematics by Grade Level

Activity	Mathematics			Reading		
Rating	Kinder	Grade 1	Grade 2	Kinder	Grade 1	Grade 2
Like very much/ like	68%	90%	87%	74%	88%	86%
Neutral	10%	7%	4%	14%	5%	7%
Dislike/ Dislike very much	23%	4%	9%	13%	7%	8%
Total Number of Students	71	56	76	72	56	76

How much does your best friend like mathematics?

There were no appreciable differences in the responses of the two groups to this item, with about 80% of students in Grades 1 and 2 in both groups indicating that their best friend liked mathematics, or liked it a lot.

Circle the words (12 words are shown) which best show how you feel when you are doing mathematics

There were no obvious differences in the responses of the two groups – Indigenous and non-Indigenous students. In both groups a higher proportion circled more positive than negative words. For example, just over 70% and 60% of students in both groups circled "happy" and "clever" respectively, compared with just over 10% and around 20% who circled, respectively, "don't care" and "bored". Words about which the two groups differed included "don't understand" and "excited", with a higher proportion of Indigenous students circling both these words: negative and positive descriptors respectively.

Is mathematics important for grown-ups?

The differences in the rating by grade level of the importance of mathematics for adults for the sample as a whole was not statistically significant ($\chi^2_4 = 9.02$, $p = .06$). About two-thirds of both groups considered mathematics to be important for adults (Indigenous group: 65%; non-Indigenous group: 67%). Beliefs about the importance of mathematics for adults seemed to decrease with grade level for the Indigenous but not for the non-Indigenous group – see Table 4. At Grade 2, a relatively high proportion (one-third) of Indigenous students seemed uncertain about the long term importance of mathematics. Differences in the rating by grade level were statistically significant for the non-Indigenous group ($\chi^2_4 = 13.57$, $p < .01$, $\varphi = .26$) but not for the smaller group of Indigenous students.

Table 4
The Importance of Mathematics for Adults (entries in %)

Is mathematics important for grown-ups?	Indigenous			Non-Indigenous		
Grade	K	Gr 1	Gr 2	K	Gr 1	Gr 2
Yes	71%	69%	55%	67%	60%	71%
No	13%	19%	10%	22%	7%	9%
Don't know	16%	12%	35%	12%	33%	20%
Total number of students	31	26	29	69	55	76

How will you use mathematics when you are grown up?

The responses from both groups were fairly limited. This was understandable given their age. As noted in the frequency data on the children's views of the importance of mathematics for adults, there also appeared to be a difference in the responses from the

Indigenous and non-Indigenous students in grade 2. A few students were unsure (2 Indigenous, 6 non-Indigenous) how they would use mathematics when they grew up; two male Indigenous students said they would not use mathematics (e.g., "No, no"). Both groups identified work as one place they would use mathematics (4 Indigenous, 7 non-Indigenous). Sample responses:

- To work out my money if I'm a shopkeeper (Indigenous, male)
- To figure out how much stuff to sell (non-Indigenous, female)
- If I work in an office I might use it a lot (non-Indigenous, male)

In general, however, the non-Indigenous students identified a wider range of ways that they might use mathematics when they grew up. Money was a common theme, as was for further study, and for counting/calculating or measurement. Examples included:

- To help me do my homework (male)
- Count money, count, calculate numbers (male)
- To learn more stuff and be very smart (female)
- Buy food, pay bills, to know the clock time (female)

Other representative responses from Indigenous students included:

- Do it on your own (male)
- Sometimes (female)
- When I'm bored (female)

Beliefs about Mathematics Performance

How good were you at mathematics last year?

For this item, the responses from the students in Kinder are not included. Of the remaining students, those in Grades 1 and 2, the majority thought they were excellent or good at mathematics (Indigenous sample: 84%; non-Indigenous sample: 82%). Few students considered themselves to have been below average or weak: 2% of Indigenous students and 6% of non-Indigenous students. There were no statistically significant differences by Indigeneity or by grade level.

How sure are you that you can do this question? You do not have to work out the answer.

Two questions were shown: the first would require missing numbers to be filled in; the second would require students to draw the same number of spots on the second wing of a butterfly and "write the number facts to match").

Again, the responses to these items from the students in Kinder were excluded. No appreciable differences in the responses of Indigenous and non-Indigenous students were found. A high proportion (>90%) of both groups indicated that they could do the first and easier problem; a slightly lower proportion (≈80%) that they could do the second problem.

Tell us what happens when you are doing mathematics in school.

The students were asked to describe what happens when they are doing mathematics in school. It was clearly evident that they engage in a broad range of activities at all grade levels. They wrote about: counting activities; playing games; using blocks, playdough, the whiteboard, worksheets, and books; cutting, pasting, and tracing; painting and drawing, reading and writing; and activities involving the four operations. Indications of enjoyment accompanied several of the descriptions. There was no discernible difference in the descriptions proffered by Indigenous and non-Indigenous students.

Summary of Findings for Attitudes and Beliefs about Mathematics

All of the K-2 students from whom data were gathered attended schools involved in the *Make It Count* intervention program in 2011. Positive attitudes to mathematics were evident, particularly among the grade 2 students. Neither the quantitative nor the qualitative data revealed any clear patterns of response differences among Indigenous or non-Indigenous students. However, among the grade 2 students there were some subtle differences, in both the quantitative and qualitative items, about the role that mathematics was thought to play for adults. It seemed that Indigenous students were not as aware as non-Indigenous students of the variety of ways mathematics might impact on adult life.

Relevance to Mathematics Performance: A Glimpse into the Future?

Practical considerations prevented an achievement test being administered to the students. Whether the similarity in attitudes and perceptions about mathematics of the Indigenous and non-Indigenous groups will be accompanied by parity in the groups' scores in the 2012 Year 3 NAPLAN numeracy test deserves close attention. Until then, currently available Year 3 NAPLAN scores from the participating schools serve as a crude measure of the numeracy performance of students closest in age (and school experience) to those involved in the survey. Relevant data for 2008-2011 are shown in Table 5.

Table 5
Year 3 NAPLAN Mean Numeracy Scores for Four Schools, 2008-2011

School A		School B		School C[1]		School D	
Mean	Difference[2]	Mean	Difference	Mean	Difference	Mean	Difference
2008 (National mean = 397)							
348	49	311	86	364	33	382	15
2009 (National mean = 394)							
363	31	299	95	342	52	372	22
2010 (National mean = 395)							
343	52	310	85	359	36	382	13
2011 (National mean = 398)							
363	35	349	49	329	69	413	-15

[1] This school participated in the MiC program for the first time in 2011

[2] Mean national NAPLAN score – mean school NAPLAN score

The data in Table 5 reveal that at three of the schools (A, B, & D), the gap between the Year 3 students' mean NAPLAN score and the national mean score was less in 2011 than in 2008 and 2010. The students in Year 3 at these schools had participated in the MiC program in previous year(s). The NAPLAN achievement data do not distinguish between the performance of Indigenous and non-Indigenous students. Thus, we cannot tell whether the improvement in performance is greater for one or other of these groups. School C joined the MiC program in 2011 and does not yet have a sustained period of MiC linked activities. Its NAPLAN scores do not reflect the pattern of improvement shown for the other three schools. Students who were in Year 3 in 2011 had not been exposed to the MiC program. Although NAPLAN data are only one (partial) measure of achievement and participation in the MiC program may not fully explain the improvement in the NAPLAN scores for schools A, B, and D, the changes in the scores are, nonetheless, noteworthy.

Final Comment

An important, and positive, finding from the present study was that few differences were found in the attitudes and beliefs of the Indigenous and non-Indigenous K-2 students from the four schools participating in the MiC project. The perceived applicability of mathematics in the world of adults was, however, a provocative exception – a dimension worthy of further focus. The similarities are particularly notable given that previous research findings reveal that there is a positive correlation between attitudes/beliefs and achievement, and that national NAPLAN data reveal a large gap between the performance of Indigenous and non-Indigenous students at each grade level. The aim of the MiC is to find evidence of teaching and learning strategies that work with Indigenous students. Data from the present study suggests that the work done in the participating schools may be well on the way to meeting this aim. It will indeed be interesting to see if the 2012 NAPLAN data for the grade 3 students from these schools – in grade 2 at the time the data reported in this paper were gathered – will reflect the positive indicators noted in the present study.

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