Educational Outcomes of Young Indigenous Australians

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This research was funded by the
National Centre for Student Equity in Higher Education

NILS

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Table of contents

Tables

Figures

Executive summary

Improved educational outcomes are seen as a key lever for addressing the disadvantage faced by Indigenous Australians. Poor educational outcomes have been observed at all levels of education, from early childhood through to tertiary education. While the increase in school retention rates of Indigenous Australians in recent years is encouraging the more critical issues are whether there have been improvements in educational performance at earlier years for Indigenous students and the extent to which educational performance at say, year 10, is flowing through to education outcomes such as year 12 completion.

By tracking two cohorts from the Longitudinal Survey of Australian Youth (LSAY) – the first aged 15 in 2006 and the second in 2009 - we can look at a number of key issues:

- The size of the gap between the Indigenous and non-Indigenous in education performance at the end of compulsory education, as captured by academic performance at age 15 from the Programme for International Assessment (PISA). As well as looking at the size of the gap we can also assess the extent to which it is explained by differences in socio-economic status and other background characteristics.

- Whether there has been any improvement in academic performance at age 15 across the two cohorts among Indigenous students.

- The extent to which educational outcomes for Indigenous students are affected by the final years of schooling, given academic performance at age 15. This is important from a policy perspective by allowing us to disentangle the influence of earlier education to that of the latter years of secondary schooling.

The data used in this project come from the Longitudinal Survey of Australian Youth (LSAY), including both the 2006 and 2009 student cohorts. The first wave of each LSAY is the PISA survey. One of the advantages of PISA scores is that they allow overtime direct comparisons and between-cohort comparisons. The subsequent waves of LSAY allow us to follow the students throughout their compulsory education and beyond. The latest wave of LSAY was released in 2013 for the 2012 wave of both cohorts. The 2009 cohort has (mostly) left school in the last LSAY observation window.

This makes it the first year when a full comparison between the 2006 and 2009 cohorts can happen. The data allow us to conduct a full set of comparisons between Indigenous students and non-Indigenous students in the two cohorts up to their choice of tertiary education.

Our methodology tackles the sequential nature of students' education pathways by first modelling PISA scores, and then modelling a series of subsequent educational outcomes conditional on PISA, namely:

- School dropout and year 12 completion

- Intention to attend University

- ATAR request

- University participation

- VET participation

The approach we take in modelling PISA is a multi-level one capturing individual background characteristics and school level characteristics, including an estimate of (unobserved) 'school quality' (identified through a random coefficient in the model). This approach allows us to decompose the difference in the average PISA score between Indigenous and non-Indigenous students into a component attributed to differences in personal characteristics, a component due to differences in school characteristics, and a component due differences in 'returns', that is differences in the coefficients of the characteristic variables. It is the differences in these 'returns' that capture the specific disadvantage associated with being Indigenous, over and above socio-economic and other background characteristics. A policy aim would be to reduce the differences in returns to zero, such that the PISA scores for Indigenous students are the same as non-Indigenous students, after controlling for background characteristics.

We take a similar approach to modelling the subsequent educational outcomes, but with the difference that we also condition on academic achievement at 15 (i.e. PISA). An issue here is that PISA itself is an outcome variable (endogenous) and therefore its inclusion can lead to bias in the coefficients. Our approach is to control for this endogeneity by using the expected PISA score rather the observed score.

Our key findings are that:

- There are very substantial differences between the academic performance at age 15 of Indigenous and non-Indigenous students. Part of this difference can be attributed to differences in socio-economic status and other background variables, and to differences in schools which Indigenous Students attend. However, a sizable gap remains between the academic performance at age 15 of Indigenous and non-Indigenous students which is not explained by these factors.

- There was, at best, a very modest improvement in the academic performance of Indigenous students at age 15 between the 2006 and the 2009 cohorts, once we control for background characteristics of the students. The more sophisticated model used provided an estimate of around three points in the PISA literacy scale (the raw difference between non-Indigenous and Indigenous scores across the two cohorts was around 73 points).

- There is no significant difference between the subsequent educational outcomes of Indigenous and non-Indigenous students *once we control for academic achievement at age 15*. This finding is robust across all our educational outcome variables. The finding that Indigeneity does not play a role in exacerbating educational disadvantage in the final years of secondary schooling is very encouraging.

An additional finding is that the relatively high VET participation of Indigenous students turns out to be not such a good news story as first thought. In fact Indigenous students are less likely to attend VET than their non-Indigenous counterparts, once background characteristics and school attended are accounted for.

These findings have important policy implications. First, they suggest that the orthodox view that educational disadvantage should be addressed early in the education process is correct. That is, the greatest scope for improvement in educational outcomes for Indigenous students post-school comes from improved educational performance during the early and middle levels of school. And those improvements would be very substantial if the academic achievement at age 15 of Indigenous students were raised to that of non-Indigenous students.

The other policy implication is that current programs over the latter years of secondary school have been successful at ensuring that Indigenous students do not suffer further disadvantage relative to their non-Indigenous counterparts, but have been largely ineffective in remediating earlier disadvantage. Thus, on the basis of this analysis at least, it is suggested that the preponderance of effort in addressing Indigenous educational disadvantage should be before the final years of schooling.

As an aside, the analysis suggests that programs which can address the lower academic achievement of low SES students, and the poorer performance of some schools will benefit Indigenous students particularly, for the simple reason that the Indigenous student population is over represented among the lower SES and the poorer performing schools. For example, if Indigenous students were distributed across schools in the same way as non-Indigenous students then we would expect to see an improvement in year 12 completion and in the proportion participation in university immediately after year 12 of around two percentage points.

There is still a long way to go before the gap between Indigenous and non-Indigenous educational outcomes is closed, and the very modest reduction in the gap at age 15 between the two cohorts is disappointing. However, the benefit in reducing the size of the gap at age 15 on subsequent education outcomes remains very substantial. If performance of Indigenous students at age 15 could be increased to that of their non-Indigenous counterparts (that is increasing the academic achievement at age 15 of low SES Indigenous students to that of low SES non-Indigenous students, for example) according to our analysis there will be a significant flow through to improved educational outcomes: a reduction in the drop-out rate of 15 percentage points, an increase in the proportion requesting an ATAR of 29 per cent, and an increase in the proportion participating at University immediately after leaving school of 22 percentage points.

1. Introduction

Improved educational outcomes are seen as a key lever for addressing the disadvantage faced by Indigenous Australians. Poor educational outcomes have been observed at all levels of education, from early childhood through to tertiary education. However, there have been some improvements in educational participation and achievement in recent years with, for example, the year 12 apparent retention rate increasing from 38.0% in 2002 to 51.1% in 2012 for Indigenous students (Karmel et al, 2014). Similarly, the year 10 apparent retention rate for Indigenous students has increased to 98.4% in 2012, very close to the 100% rate for other students. While this is encouraging – although the level of education has not been standing still within the non-Indigenous population - apparent retention rates are very crude indicators of educational achievement. The more critical issues are whether there have been improvements in educational performance at earlier years for Indigenous students and the extent to which educational performance at say, year 10, is flowing through to education outcomes such as year 12 completion and the proportion of students going on to university or vocational education and training, and the proportion obtaining a tertiary qualification (especially certificates III/IV, diplomas and degrees).

By tracking two cohorts from the Longitudinal Survey of Australian Youth (LSAY) – the first aged 15 in 2006 and the second in 2009 - we can look at a number of key issues:

- The size of the gap between the Indigenous and non-Indigenous in education performance at the end of compulsory education, as captured by academic performance at age 15 from the Programme for International Assessment (PISA). As well as looking at the size of the gap we can also assess the extent to which it is explained by differences in socio-economic status and other background characteristics.

- Whether there has been any improvement in academic performance at age 15 across the two cohorts among Indigenous students.

- The extent to which educational outcomes for Indigenous students are affected by the final years of schooling, given academic performance at age 15. This is important from a policy perspective by allowing us to disentangle the influence of earlier education to that of the latter years of secondary schooling. The orthodox wisdom is that investments in initial education - particularly early childhood and primary education - are the most beneficial. We need to understand the extent to which academic performance at, say age 15, is being translated into higher year 12 completion rates, and higher tertiary education participation and more (and higher level) qualifications. If improvements in PISA among Indigenous students are not leading to improvements in subsequent outcomes, then this would indicate serious issues for the latter years of secondary schooling. That is, we can assess the 'value added' of the last years of schooling for Indigenous students relative to their non-Indigenous counterparts

The data used in this project come from the Longitudinal Survey of Australian Youth (LSAY), including both the 2006 and 2009 student cohorts. The first wave of each LSAY is the PISA survey. It is a rich dataset which includes over 14,000 students and about 350 schools. It records student characteristics and study and home environment as well as their school characteristics including school type, composition, climate, student/teacher ratio, issues relating to teacher/students absenteeism, socioeconomic status, remoteness, autonomy in making decisions on budgets, hiring and so on.

One of the advantages of PISA scores is that they allow both direct comparisons and between-cohort comparisons. The subsequent waves of LSAY allow us to follow the

students throughout their compulsory education and beyond. The latest wave of LSAY was released in 2013 for the 2012 wave of both cohorts. The majority of the 2009 cohort in the last LSAY observation window would be one year after completing year 12[1].

This makes it the first year when a full comparison between the 2006 and 2009 cohorts can happen. The data allow us to conduct a full set of comparisons between Indigenous students and non-Indigenous students in the two cohorts up to their choice of tertiary education. We can further extend this analysis by estimating (in a counterfactual sense) the extent to which further improvements in academic achievements of Indigenous students at age 15 can be expected to lead to better educational outcomes after year 12.

Our methodology tackles the sequential nature of students' education pathways by first modelling PISA scores, and then modelling a series of subsequent educational outcomes conditional on PISA, namely:

- **School dropout**: The propensity to drop out of school before completing Year 12 and without engaging into further education above Certificate 2 at any point during the observation window of the data.

- **Year 12 completion**: Year 12 completers are those students who completed year 12, whether they later engage or not in further education. This outcome is similar to 'school dropout' but its definition is more restricted.

- **Intention to attend University**: Students have stated their intention to engage in University education or not at age 15. This indicator is interesting as it gives us some knowledge about the state of mind of the students along the education pathway, although there is a sizable gap between the intention and actual participation.

- **ATAR request**: The question is whether or not students request an ATAR score. This is an indication of whether the student is serious in considering going to university during year 12. The ATAR request occurs during year 12.

- **University participation**: This variable looks at the participation at university in 2009 for the 2006 cohort and 2012 for the 2009 cohort. Thus it captures the proportion going to university immediately after completion of school. It does not capture those who attend university at a later age.

- **VET participation**: This variable is analogous to the university participation variable, but looking at the proportion of students attending VET (at the certificate III level of higher) in 2009. Raw participation numbers suggest that participation in VET is relatively high for Indigenous persons, and Nguyen (2010) found that Indigenous students with high ATARs were more likely to attend TAFE than university relative to their non-Indigenous counterparts. As for the university participation outcome it does not capture those who undertake VET at a later age.

We had hoped also to have looked at individual ATAR scores. Unfortunately, this information is not well populated and there are too few observations for models distinguishing Indigenous and non-Indigenous students to be meaningful.

[1] The LSAY cohorts are aged based and therefore capture students who are ahead or behind the modal group in terms of school year.

The approach we take in modelling PISA is a multi-level one capturing individual background characteristics and school level characteristics, including an estimate of (unobserved) 'school quality' (identified through a random coefficient in the model). This approach allows us to decompose the difference in the average PISA score between Indigenous and non-Indigenous students into a component attributed to differences in personal characteristics, a component due to differences in school characteristics, and a component due to differences in 'returns', that is differences in the coefficients of the characteristic variables. It is the differences in these 'returns' that capture the specific disadvantage associated with being Indigenous, over and above socio-economic and other background characteristics. A policy aim would be to reduce the differences in returns to zero, such that the PISA scores for Indigenous students are the same as non-Indigenous students, after controlling for background characteristics.

We take a similar approach to modelling the subsequent educational outcomes, but with the difference that we also condition on academic achievement at 15 (i.e. PISA). An issue here is that PISA itself is an outcome variable (endogenous) and therefore its inclusion can lead to bias in the coefficients. Our approach is to control for this endogeneity by using the expected PISA score rather the observed score.

The structure of the paper is as follows. In the next section we provide a brief review of the literature to provide context. We then provide some descriptive statistics of the differences between Indigenous and non-Indigenous students based on the raw sample. This is followed by the presentation of the models of academic achievement at age 15, which includes a decomposition of the differences in academic performance between Indigenous and non-Indigenous students. Section three presents the results for the subsequent educational outcome variables. We conclude with a brief discussion.

The appendix contains the full model results.

Our major findings are:

- that there are very substantial differences between the PISA scores of non-Indigenous students and Indigenous students. Part of the difference can be explained by differences in the background characteristics (such as socio-economic status) and schools attended.

- that educational outcomes of Indigenous and non-Indigenous students are statistically the same once we control for PISA and other characteristics; Indigeneity plays no further role in contributing (or remediating) educational disadvantage.

- our modelling suggests that there was only a very minor improvement in the PISA scores of Indigenous students between the two cohorts.

The broad conclusion is that educational disadvantage of Indigenous students needs to be addressed earlier rather than later in schooling; educational disadvantage of Indigenous students at say age 15 flows through directly to poorer educational outcomes later. This is not to say that programs aimed at educational disadvantage in the latter years of secondary schooling have no role to play. Rather on the available evidence they may have ensured that relative disadvantage does not increase, but they have not remediated the earlier disadvantage.

2. Context

Despite the initiatives of governments at all levels in the last 20 years, Indigenous people remain the most educationally disadvantaged group in Australia. While there have been some absolute improvements over time in respect of certain aspects of education with this group, improvement has been slow.

We begin with the study by Malin and Maidment (2003), which examined Indigenous education participation at all stages of education (preschool, primary, secondary, university, TAFE and special schools) in 1967 and 2001.[2]

Table 1: Indigenous education participation estimates, 1966-2001

	1967		2001	
Total population	130,130	-	410,003	-
Preschool	2,164	(2%)	10,404	(3%)
Primary	19,306	(14%)	78,943	(20%)
Secondary	2,596	(2%)	36,522	(10%)
University	9	(.007%)	6,414	(1.5%)
TAFE	111	(.09%)	58,046	(14%)
Special schools	119	(0.09)	-	-

Source: Table 2 from Malin and Maidment (2003).

Malin and Maidment (2003) found that there were significant improvements in participations at all levels of education from 1967 to 2001 (Table 1). Despite the increases in education participation among Indigenous people, the gap remained high between Indigenous and non-Indigenous Australians in 2001 (see Table 2), and the gaps became larger with higher education levels.

Table 2: Gaps between Indigenous and non-Indigenous student outcomes, 2001

Aspect of schooling	Indigenous	Non-Indigenous	Gap
3-4 year old enrolment at preschool	48%	57%	9%
Attendance rates: primary & secondary school	87%	95%	8%
Meeting Year 3 literacy & numeracy benchmarks	75%	93%	18%
Meeting Year 5 literacy & numeracy benchmarks	62%	89%	27%
Year 10-12 apparent retention rate	44%	76%	32%
Achieved tertiary entrance score	19%	53%	34%

Source: Table 3 from Malin and Maidment (2003).

More recent data show that the gap remains large and in some ways has not declined. For example, from the 2011 Census we see that while the proportion of the Indigenous population with year 12 or equivalent had increased by 4.7% points since 2006, the proportion of the non-Indigenous population had increased by 6 percentage points (Table 3).

[2] There is a considerable literature on educational disadvantage faced by Indigenous students. We have selected a small number of studies to paint a broad picture. See also Biddle et al. 2004, Bradley et al 2007; Gray et al 2000; Hughes and Hughes 2012; Hunter and Schwab 1998 and 2003; Leigh and Gong 2009; Rothman et al 2005; Schwab 1999; James et al 2008.

Table 3: Persons aged 15–64 by Indigenous status and highest year of school completed, 2006 and 2011 (%)

	Indigenous		Non-Indigenous	
Education level	**2006**	**2011**	**2006**	**2011**
Year 12 or equivalent	20.2	24.9	49.5	55.5
Year 11 or equivalent	11.3	12.5	11.5	11.0
Year 10 or equivalent	29.0	29.7	24.4	21.7
Year 9 or equivalent	13.4	12.4	6.4	5.4
Year 8 or below	12.7	9.2	4.0	2.9
Did not go to school	1.6	1.1	0.6	0.6
Not stated	11.9	10.3	3.6	3.0
Total	100.0	100.0	100.0	100.0

Note: Based on counts that are not adjusted to estimated resident population. Derived from 2006 Census of Population and Housing (ABS 2006) 2011 Census of Population and Housing (ABS 2011).

Source: Karmel et al (2014), Table 2

These data show the difficulty of reducing the gap in the educational outcomes; while we have seen absolute improvements in the educational performance of Indigenous people, the general levels of education have been increasing in the non-Indigenous population.

As can be seen from Table 4, school retention has been increasing in the Indigenous population, and this gap has been narrowing. While in 2002 the apparent retention of Indigenous students to year 10 was appreciably less than for the non-Indigenous population, by 2012 it had virtually caught up and was close to 100%. Significant gaps though remained at year 11 retention and year 12 retention.

Table 4: Apparent retention rates[(a),(b),(c)], full-time students by Indigenous status, 2002 and 2012

	Indigenous students	Other students	Indigenous students	Other students	Percentage point difference	
	2002	**2002**	**2012**	**2012**	**2002**	**2012**
7/8 to 9	97.8	99.8	100.3	100.8	–2.0	–0.5
7/8 to 10	86.4	98.5	98.4	101.4	–12.1	–3.0
7/8 to 11	58.9	88.7	77.2	94.8	–29.8	–17.6
7/8 to 12	38.0	76.3	51.1	81.3	–38.3	–30.2

(a) Apparent retention rates are the percentage of full-time students of a given cohort group who continue from the start of secondary schooling to a specified year level. The term 'apparent' is used because the retention rate does not account for students repeating a year of school or migrating in or out of the Australian school student population or between states/territories.

(b) Relatively small changes in student numbers can create large movements in apparent retention rates calculated for small populations.

(c) In 2008, Year 7 became the last year of primary school in Queensland, South Australia and Western Australia. It is the first year of secondary school in New South Wales, Victoria, Tasmania, Northern Territory and the Australian Capital Territory.

Source: Karmel et al (2014), Table 4

While increases in school retention among the Indigenous population are encouraging, there remains the question of academic achievement. The most direct data on this come from the various national tests of reading, writing and numeracy.

Table 5 displays the 2008 National Assessment Program Literacy and Numeracy (NAPLAN) results in reading, writing and numeracy for Indigenous and non-Indigenous students, documented in FaHCSIA (2009). The percentages of students at or above the national minimum standard for years 3, 5, 7 and 9 are displayed. They show very substantial academic achievement gaps between Indigenous and non-Indigenous students at each of the four year levels.

Table 5: Percentage of students at or above the national minimum standard, 2008 (%)

		Indigenous	Non-Indigenous	Gap
Year 3	Reading	68.3	93.5	25.2
	Writing	78.8	96.4	17.6
	Numeracy	78.6	96.0	17.4
Year 5	Reading	63.4	92.6	29.2
	Writing	69.7	93.9	24.2
	Numeracy	69.2	94.0	24.8
Year 7	Reading	71.9	95.4	23.5
	Writing	67.9	93.2	25.3
	Numeracy	78.6	96.4	17.8
Year 9	Reading	70.7	94.2	23.5
	Writing	59.7	88.8	29.1
	Numeracy	72.5	94.8	22.3

Source: Figure 5 in FaHCSIA (2009).

Table 6 displays the statistics for Indigenous students by remoteness, which helps understanding of where the education underperformance of Indigenous students comes from. Not surprisingly, the achievement for Indigenous students is considerably lower in remote areas. For students in very remote Australia, a majority of them could not pass the national minimum standard in reading, writing and numeracy. The academic achievements of Indigenous students from metro areas were better than Indigenous students from provincial, remote or very remote areas. However, these metropolitan students still consistently performed below their non-Indigenous counterparts in education. The effect of geography is dwarfed by the influence of other factors; for example, Hunter and Schwab (1998) point to role of the local social and family environment.

Table 6: Percentage of Indigenous students at or above the national minimum standard by remoteness, 2008 (%)

		Metro	Provincial	Remote	Very remote
Year 3	Reading	78.6	76.2	53.9	30.5
	Writing	86.9	86.2	69.0	45.0
	Numeracy	85.9	85.5	70.4	47.5
Year 5	Reading	74.4	71.0	47.8	21.7
	Writing	79.7	76.0	58.1	31.6
	Numeracy	78.5	75.7	56.3	32.9
Year 7	Reading	83.0	79.6	56.6	28.0
	Writing	78.7	73.8	54.0	28.5
	Numeracy	87.0	83.9	67.8	46.4
Year 9	Reading	78.4	75.3	57.4	29.0
	Writing	67.9	62.6	44.4	23.8
	Numeracy	78.9	76.2	60.4	38.2

Source: Figure 5 in FaHCSIA (2009).

The poorer test results of Indigenous students are not surprising, but of more interest is whether the gap in performance has been closing. Table 7 displays the related results from 1999 to 2006 for Indigenous students and all students in years 3, 5 and 7 (Long and North 2009). There are two obvious findings: (i) Indigenous students significantly lagged behind all students in academic performance; and (ii) the higher the year level of education, the lower the percentages of students achieving the national benchmarks. Perhaps the more important

issue is the extent of improvement in reading and numeracy among Indigenous students. Here we find the picture is a little patchy. There has been a clear improvement in year 3 and 5 reading and numeracy between 2000 and 2006, but by no means was the improvement consistent. For example, a higher proportion of Indigenous students achieved the year 5 benchmark in 2004 than in 2006. In year 7 the results are more dispiriting, with no sustained improvement among the Indigenous population in numeracy, and an apparent decline in reading between 2004 and 2006.

Table 7: Percent achieving national reading and numeracy benchmarks by year level and Indigenous status, 1999-2006 (%)

		1999	2000	2001	2002	2003	2004	2005	2006
Year 3									
Reading	Indigenous	73.4	76.9	72.0	76.7	78.8	82.9	78.0	79.7
	All students	89.7	92.5	90.3	92.3	92.4	93.0	92.7	93.0
Numeracy	Indigenous	-	73.7	80.2	77.6	80.5	79.2	80.4	76.2
	All students	-	92.7	93.9	92.8	94.2	93.7	94.1	93.0
Year 5									
Reading	Indigenous	58.7	62.0	66.9	68.0	67.7	69.4	62.8	66.3
	All students	85.6	87.4	89.8	89.3	89.0	88.7	87.5	88.4
Numeracy	Indigenous	-	62.8	63.2	65.6	67.6	69.4	66.5	66.0
	All students	-	89.6	89.6	90.0	90.8	91.2	90.8	90.3
Year 7									
Reading	Indigenous	-	-	60.1	65.3	66.5	71.0	63.8	63.2
	All students	-	-	88.4	89.1	89.4	91.0	89.8	89.2
Numeracy	Indigenous	-	-	48.6	51.9	49.3	51.9	48.8	47.5
	All students	-	-	82.0	83.5	81.3	82.1	81.8	79.7

Source: Table A15 from Long and North (2009).

Data on the educational achievement of older age groups tend to confirm this pessimistic picture. For example, De Bortoli and Thomson (2009) investigate the literacy scale of 15 year-old students, using data from the Programme for International Student Assessment (PISA). Tables 8, 9 and 10 respectively report means and standard errors for Indigenous and non-Indigenous students by gender on the reading, mathematical and scientific literary scales for three cohorts.

Table 8: Means and standard errors for Indigenous and non-Indigenous students by gender on the overall *reading* literacy scale

		PISA 2000		PISA 2003		PISA 2006	
Student group		**Mean**	**SE**	**Mean**	**SE**	**Mean**	**SE**
Indigenous	Females	467	8.7	478	6.4	451	11.6
	Males	429	9.5	413	10.9	417	9.4
Non-Indigenous	Females	549	4.5	547	2.6	534	2.1
	Males	515	4.0	508	2.7	497	3.1
OECD average	Females	517	0.7	511	0.7	511	0.7
	Males	485	0.8	477	0.7	473	0.7

Source: Table 2.3 in De Bortoli and Thomson (2009).

Table 9: Means and standard errors for Indigenous and non-Indigenous students by gender on the overall *mathematical* literacy scale

		PISA 2000		PISA 2003		PISA 2006	
Student group		**Mean**	**SE**	**Mean**	**SE**	**Mean**	**SE**
Indigenous	Females	453	11.3	446	4.9	436	10.9
	Males	445	9.1	435	8.5	448	8.4
Non-Indigenous	Females	529	5.0	523	2.7	515	2.4
	Males	541	4.0	529	2.9	529	3.2
OECD average	Females	495	0.9	494	0.8	492	0.6
	Males	506	1.0	506	0.8	503	0.7

Source: Table 3.3 in De Bortoli and Thomson (2009).

Table 10: Means and standard errors for Indigenous and non-Indigenous students by gender on the overall *scientific* literacy scale

		PISA 2000		PISA 2003		PISA 2006	
Student group		**Mean**	**SE**	**Mean**	**SE**	**Mean**	**SE**
Indigenous	Females	455	10.7	447	6.4	443	11.7
	Males	440	16.1	422	11.6	439	10.1
Non-Indigenous	Females	532	4.9	527	2.8	529	2.6
	Males	527	3.8	527	2.8	530	3.2
OECD average	Females	501	0.8	497	0.8	499	0.6
	Males	501	0.9	503	0.7	501	0.7

Source: Table 4.2 in De Bortoli and Thomson (2009).

We see that there is little evidence to suggest that the educational performance of Indigenous students at age 15 has been improving, at least between 2000 and 2006.

The lower school retention of Indigenous students and their poorer academic achievement of course flows through to post-school education. Table 11 below looks at the destinations for year 12 completers.

Table 11: Immediate post-school study destinations of Year 12 completers, 1995 and 1998 Year 9 LSAY cohorts, by Indigenous status

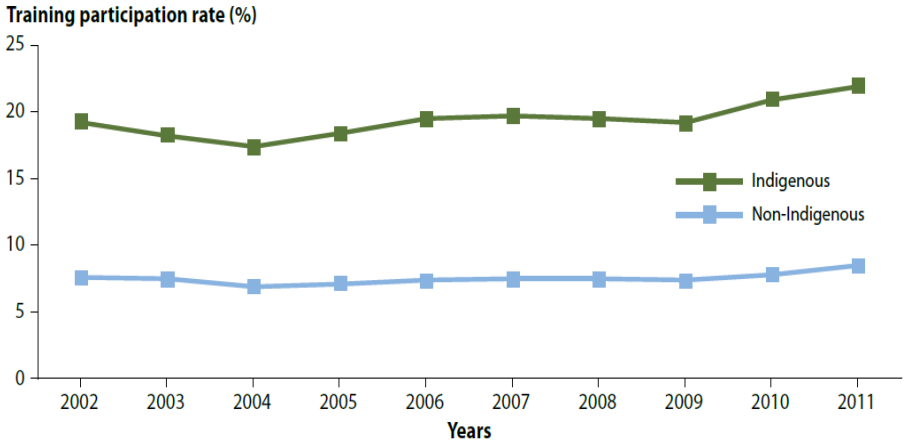
	1995 Year 9 LSAY Cohort in 1999		1998 Year 9 LSAY Cohort in 2002	
	Indigenous	**Non-Indigenous**	**Indigenous**	**Non-Indigenous**
University	36%	42%	29%	47%
TAFE	17%	16%	23%	19%
Apprenticeship/traineeship	13%	9%	15%	10%
Other study	7%	4%	0%	2%
None	28%	28%	33%	21%
Total	**100%**	**100%**	**100%**	**100%**

Source: Table 2 from ACER (2005).

A couple of points stand out from this table. The first is that the proportion of Indigenous year 12 completers going on to university is somewhat lower than for the non-Indigenous population, and the proportion going to TAFE is somewhat higher. But it must be realised that this conditions on completing year 12, and as we have seen the proportion of Indigenous students who complete year 12 is very much lower than for the non-Indigenous population.

In fact, the uptake of VET is very high among the Indigenous population, as can be seen from Figure 1.

Figure 1: Training participation rates (%) for those aged 15–64 by Indigenous status, 2002–2011



The training participation rate for those aged 15-64 is the number of individuals in this age group participating in VET as a proportion of the population of this age group.
Source: National VET Provider Collection, unpublished data reported in SCRGSP 2013.

While the training participation rate has been flat over the period covered by the graph (2002 to 2011), we see very large increases compared to earlier periods. For example, Ainley et al. (2011) maps out the very large increase in VET completions between 1996 and 2008 for Indigenous students (Table 12).

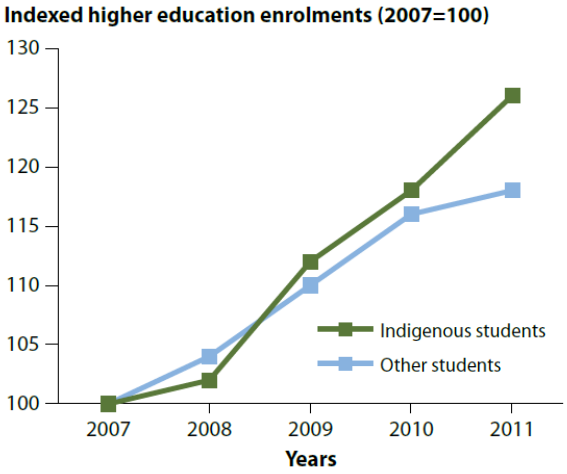
Table 12: Numbers of Indigenous and non-Indigenous students completing a VET qualification in 1996 and 2008 by state and territory ('000)

	Indigenous			Non-Indigenous		
	1996	**2008**	***% change***	**1996**	**2008**	***% change***
NSW	0.6	3.6	*549.7*	44.1	106.7	*142.2*
VIC	0.2	0.8	*403.7*	21.9	85.6	*291.3*
QLD	0.3	2.7	*699.1*	14.5	65.4	*349.9*
SA	0.1	0.8	*1423.5*	6.7	27.4	*310.9*
WA	0.1	1.6	*2426.6*	11.2	36.2	*222.1*
TAS	0.1	0.3	*400.0*	2.6	10.0	*278.5*
NT	0.1	0.8	*611.4*	0.6	2.6	*351.4*
ACT	0.0	0.1	*785.7*	2.6	7.0	*163.0*
Australia	1.4	10.8	*690.3*	104.2	340.8	*226.9*

Source: Derived from Table 5 in Ainley et al. (2011).

We also see a very large increase in the numbers of Indigenous higher education students over recent years, but against a backdrop of large increases in participation at university in the general population (Figure 2). In 2011, there were 11,807 students who identified as Indigenous (DIISRTE 2012). This comprised around 1.0 per cent of all enrolments.

Figure 2: Indexed enrolments in higher education by Indigenous status, 2007–2011 (2007=100)



Source: Derived from the Higher Education Statistics Collection (DIISRTE 2012)

While there has been a rapid increase in Indigenous students, the rate of participation is still well behind that of non-Indigenous Australians, as can be seen from Table 13.

Table 13: Participation in university by Indigenous status, age and sex, 1996, 2001, 2006 (%)

	Males			Females			All		
	1996	**2001**	**2006**	**1996**	**2001**	**2006**	**1996**	**2001**	**2006**
15 to 19 year-olds									
Indigenous	1.6	1.7	1.5	3.1	3.4	3.2	2.4	2.6	2.3
Non-Indigenous	8.9	9.7	9.4	12.8	13.7	13.2	10.8	11.6	11.3
Gap	*7.3*	*8.0*	*7.9*	*9.7*	*10.3*	*10.0*	*8.4*	*9.0*	*9.0*
20 to 24 year-olds									
Indigenous	4.0	3.9	4.7	5.6	6.7	6.9	4.8	5.3	5.8
Non-Indigenous	16.3	20.2	21.8	18.7	24.3	36.9	17.5	22.2	24.3
Gap	*12.3*	*16.3*	*17.1*	*13.1*	*17.6*	*30.0*	*12.7*	*16.9*	*18.5*
25 to 29 year-olds									
Indigenous	3.7	3.0	2.8	4.1	5.0	4.3	3.9	4.0	3.6
Non-Indigenous	6.9	8.4	8.6	6.9	8.6	9.5	6.9	8.5	9.0
Gap	*3.2*	*5.4*	*5.8*	*2.8*	*3.6*	*5.2*	*3.0*	*4.5*	*5.4*

Source: Derived from Table A21 from Long and North (2009).

The participation rates, though, only tell part of the story. First, the distribution of Indigenous students is different from the distribution of non-Indigenous students in terms of broad field of education (Encel 2000, Karmel et al. 2014). Indigenous students were more likely to be enrolled in fields like *Arts, Humanities, Social sciences, Education* and *Health*. Second the completion rate of Indigenous students is considerably lower (Table 14), although available estimates are rather dated.

Table 14: Academic outcomes, as at 1998, for students commencing undergraduate award courses in 1992 (%)

	Indigenous	Non-Indigenous
Completed an award course at the same institution	32.9	62.7
Still studying at the same institution but not yet completed a course	4.6	3.5
Not still enrolled at the same institution and not completed an award course there	62.5	33.8

Source: Derived from Table 10 in Encel (2000).

According to Encel around 62.7% of non-Indigenous students, who commenced undergraduate award courses in 1992, had completed an award course by 1998 at the same institution. However, the rate for Indigenous higher education students was only 32.9% in 1998, indicating substantial completion disparity between the completion rates of Indigenous and non-Indigenous students in higher education institutions in Australia.

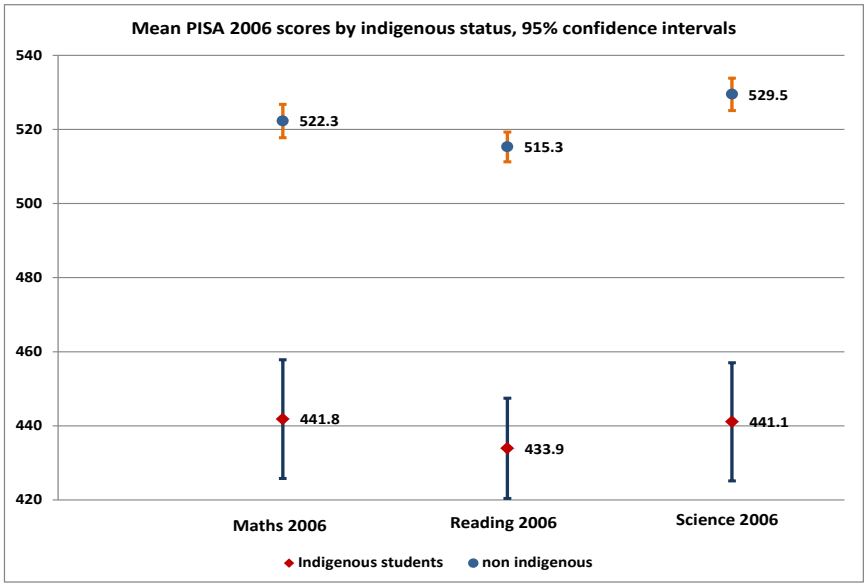
To sum up, the patterns of Indigenous education documented show that there have been improvements in educational outcomes of Indigenous Australian over recent decades. However, this is against a background of increases in the level of education among the wider community, and little evidence of sustained improvement in literacy and numeracy tests at various levels of schooling. There remain significant gaps in educational performance between Indigenous and non-Indigenous people at each stage of education, and the progress in reducing these gaps has been desultory. The optimism of McRae et al 2000 'that educational equality can be achieved, in a short period of time, through hard work and the means already at our disposal' does not appear to have been fulfilled.[3]

[3] This quote comes from the letter to the Minister of the time (David Kemp) which introduced the report 'What Works? Explorations in Improving Outcomes for Indigenous Students'.

3. Descriptive statistics

We now turn to the data used for this study. We first consider the differences between Indigenous and non-Indigenous students in terms of academic performance as measured by PISA. Figure 3 shows the data for 2006 for each of the three components – mathematics, reading and science. Note that these are population estimates based on the weights provided by PISA.

Figure 3: Mean scores in Math, Reading and Science by Indigenous status, including confidence intervals (population weighted –PISA 2006).



We see that there are substantial differences between the Indigenous and non-Indigenous students of around 80 points in each of the three components. This difference is both statistically significant (as can be seen from the confidence intervals) and of real substance; the difference is broadly equivalent to a whole level of the OECD's thresholds (see Box 1 below).[4]

Box 1: OECD thresholds for reading proficiency

Below level 1 proficiency: Reading score below 334.75

Level 1 proficiency: Reading score between 334.75 and 407.47

Level 2 proficiency: Reading score between 407.47 and 480.18

Level 3 proficiency: Reading score between 480.18 and 552.89

Level 4 proficiency: Reading score between 552.89 and 625.61

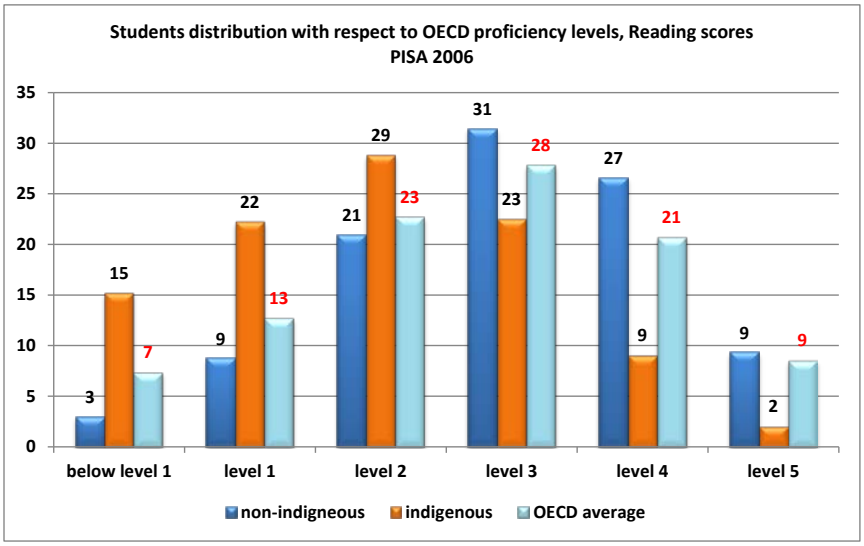
Level 5 proficiency: Reading score above 625.61

[4] For purposes of exposition we focus on the reading element, noting that the correlation between the three elements is high. The correlations over the pooled 2006 and 2009 samples are: Reading and Mathematics 0.893; Reading and Science 0.930; Mathematics and Science 0.934.

The average reading score for Indigenous students is at level 2, compared to level 3 for non-Indigenous students.

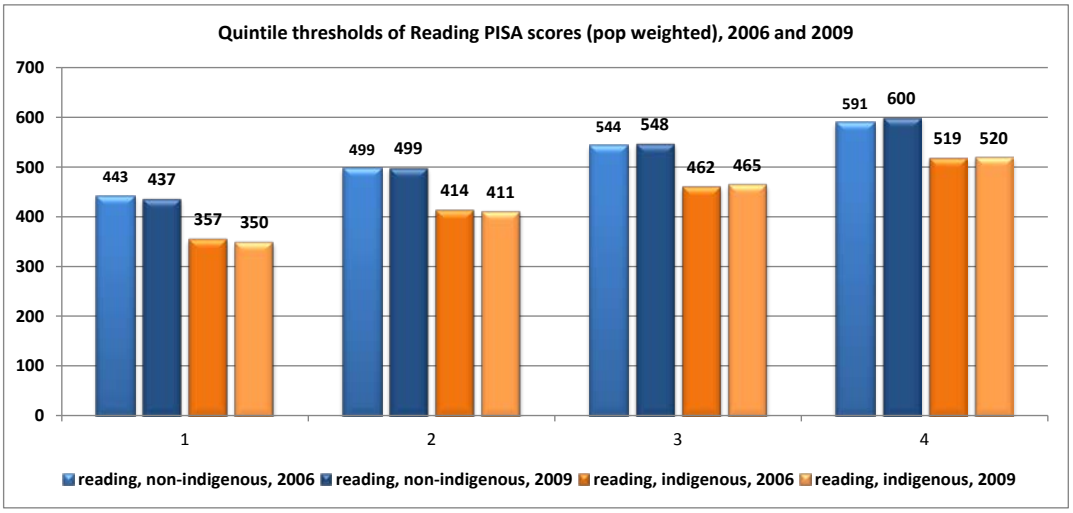
The averages obscure the variation in scores and the distributions show that Indigenous students are over represented at proficiency levels below 1, 1 and, 2, and underrepresented at levels 3, 4 and 5 (Figure 4).

Figure 4: Distribution of students according to OECD's proficiency levels, by Indigenous status, PISA 2006



The results for the 2009 cohort are very similar, as can be seen from Figure 5:

Figure 5: Quintile thresholds of Reading PISA scores by Indigenous status



Based on these population estimates it seems that there has been little change in the relativities in PISA scores between Indigenous and non-Indigenous students. This is pretty much confirmed by the multivariate analysis which we present later, where we conclude that the gap between reading performance of Indigenous and non-Indigenous students was reduced by around three points.

We now look at the various educational outcome variables.

3.1 School drop-out

Table 15 shows the frequencies and proportions of students who are recorded as dropping out of school before completing Year 12 (and without engaging into further education at the Certificate III or higher level). Large differences are observed between Indigenous and non-Indigenous students with only 18.7 per cent for the 2006 cohort (14.2 per cent for the 2009 cohort) of all non-Indigenous students dropping out, compared with respectively 37.7 and 29.4 per cent of all Indigenous students. We note that these percentages are lower in the 2009 cohort for both Indigenous and non-Indigenous students.[5]

Table 15: School dropout rates by Indigenous status, LSAY

Drop out (sample statistics) based on the students left in the sample in 2009 /2012						
	Non Indigenous	Indigenous	Total	Non Indigenous	Indigenous	Total
	No.	No.	No.	%	%	%
2006						
No	6,121	263	6,384	81.26	62.32	80.25
Yes	1,412	159	1,571	18.74	37.68	19.75
Total	**7,533**	**422**	**7,955**	**100.00**	**100.00**	**100.00**
2009						
No	5,719	264	5,983	85.79	70.59	84.99
Yes	947	110	1,057	14.21	29.41	15.01
Total	**6,666**	**374**	**7,040**	**100.00**	**100.00**	**100.00**

3.2 Year 12 completion

Table 16 show the proportions of students from each cohort who complete Year 12. Note that those who are flagged as not having completed Year 12 do not correspond to those who were flagged as dropping out of high school since we adopted a more restrictive definition of school dropout. We can see significant differences between non-Indigenous and Indigenous students in both cohorts with regards to Year 12 completion. The proportion of Year 12 completers is around 80% for non-Indigenous students and just above 60% for Indigenous students. We note that there was a modest increase in the year 12 completion rate for Indigenous students of around three percentage points.

[5] In these descriptive statistics we present sample counts. Similar tables were derived using PISA weights but these do not represent populations because of attrition in LSAY. Attrition weights are difficult to derive because we are accumulating data over multiple waves. It should be noted that the PISA weighted tables show the same patterns, and so for simplicity we restrict our presentation to the sample counts.

Table 16: Year 12 completion rates by Indigenous status, LSAY

Complete year 12 (sample statistics) based on the students left in the sample in 2009 /2012						
	Non Indigenous	Indigenous	Total	Non Indigenous	Indigenous	Total
	No.	No.	No.	%	%	%
2006						
No	1,407	160	1,567	18.68	37.91	19.70
Yes	6,126	262	6,388	81.32	62.09	80.30
Total	**7,533**	**422**	**7,955**	**100.00**	**100.00**	**100.00**
2009						
No	1,446	132	1,578	21.69	35.29	22.41
Yes	5,220	242	5,462	78.31	64.71	77.59
Total	**6,666**	**374**	**7,040**	**100.00**	**100.00**	**100.00**

3.3 Request ATAR and intention to go to university

Table 17 presents a comparison between Indigenous and non-Indigenous students with respect to intending to go to university (reported when most students are in year 10) and requesting an ATAR in Year 12. Not surprisingly, the proportion of Indigenous young people intending to go to university at year 10 or requesting an ATAR at year 12 is substantially lower than for their non-Indigenous counterparts

Table 17: Intend to go to university/ requesting an ATAR by Indigenous status, LSAY

	Non-Indigenous		Indigenous	
	sample size 2009/2012	percent of all non-Indigenous	sample size 2009/2012	percent of all Indigenous
2006				
Intend to go to university	7731	59.6	409	38.4
Request an ATAR	7533	57.5	422	31.8
2009				
Intend to go to university	7711	46.7	430	30.2
Request an ATAR	6666	60.7	374	35.6

Overall, the percentage of Indigenous students reporting that they intend to go to university in year 10 or requesting an ATAR in year 12 are well below those of non-Indigenous students. However, the reported intention of going to university does not seem to be a robust variable. It dropped substantially between the two cohorts for both Indigenous and non-Indigenous students, while the proportion requesting an ATAR increased a little for both groups. The relationship between the two variables jumps around: in 2006 the proportion of the non-Indigenous cohort requesting an ATAR was similar to the proportion reporting that they intended to go to university, while in the 2009 cohort there was a large discrepancy. Similarly, in the 2006 cohort the proportion of non-Indigenous students reporting that they intend to go to university was higher than the proportion requesting an ATAR while in the 2009 cohort the proportion was smaller. It seems in particular that reported intention to go to university at year 10 is not a particularly robust variable.

3.4 University participation

Table 18 presents the proportion of people who go to university after completing Year 12. It should be noted that these figures understate the true university participation rate because they do not include those who completed year 12 in 2009/2012 nor those who go to university after a gap.

Table 18: University participation or completion by Indigenous status, LSAY

University participation or completion (sample statistics) students left in the sample in 2009/2012						
	Non Indigenous	Indigenous	Total	Non Indigenous	Indigenous	Total
	No.	No.	No.	%	%	%
2006						
No	4,906	355	5,261	65.13	84.12	66.13
Yes	2,627	67	2,694	34.87	15.88	33.87
Total	**7,533**	**422**	**7,955**	**100.00**	**100.00**	**100.00**
2009						
No	4,023	320	4,343	60.35	85.56	61.69
Yes	2,643	54	2,697	39.65	14.44	38.31
Total	**6,666**	**374**	**7,040**	**100.00**	**100.00**	**100.00**

We note that the university participation rate increased for non-Indigenous students (34.9% to 40.0%) but declined a little for Indigenous students (15.9% to 14.4%). These changes are at variance with the earlier reported changes in the intention to go to university, confirming the 'rubberiness' of the latter variable.

3.5 VET participation

We see that, unlike all the other educational outcomes we have looked at, that there is little difference between the proportion of Indigenous and non-Indigenous students who are undertaking a certificate III or higher qualification in the reference year (Table 19).

Table 19: VET (certificate III or higher) participation or completion by Indigenous status, LSAY

VET participation (sample statistics) based on the students left in the sample in 2009/2012						
	Non Indigenous	Indigenous	Total	Non Indigenous	Indigenous	Total
	No.	No.	No.	%	%	%
2006						
No	6,067	340	6,407	80.54	80.57	80.54
Yes	1,466	82	1,548	19.46	19.43	19.46
Total	**7,533**	**422**	**7,955**	**100.00**	**100.00**	**100.00**
2009						
No	5,464	298	5,762	81.97	79.68	81.85
Yes	1,202	76	1,278	18.03	20.32	18.15
Total	**6,666**	**374**	**7,040**	**100.00**	**100.00**	**100.00**

Earlier we saw that the official NCVER statistics showed that the participation rate of the 15-64 Indigenous population in vocational education and training was substantially higher than that for the non-Indigenous population (see Figure 1). The discrepancy can be largely explained by the fact that Table 19 is restricted to certificates III or higher, and the Indigenous population is over represented in lower level qualifications.

3.6 Summary

To summarise, simple descriptive statistics show substantial differences between Indigenous and non-Indigenous students in respect of academic performance as measured by PISA. These differences carry forward in terms of educational outcomes, with Indigenous students having higher rates of drop out, lower year 12 completion, a lower rate of intending to go to university, a lower rate of requesting an ATAR, and a lower rate of participation in university immediately after school. The one educational outcome which shows a different pattern is participation in VET at a certificate III level or higher, where there is little difference between the participation of the two groups.

The changes between the 2006 and 2009 cohorts are rather ambiguous. For Indigenous students the rate of drop out decreased, year 12 completion increased, the proportion seeking an ATAR increased, and the proportion undertaking a certificate III or higher at VET increased but the proportion who intended to go to university decreased, as did the proportion actually participating in university. This pattern was the same for non-Indigenous students, with the exception that the proportion participating in university increased and the proportion participation in VET (certificate III or higher) decreased.

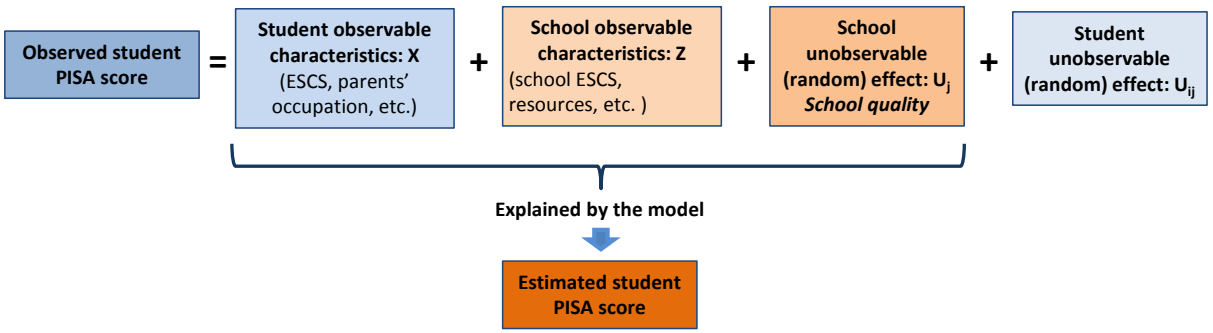
We now move onto multivariate analysis to try to understand these broad findings. In particular, we wish to measure the extent to which lower PISA scores of Indigenous students reflect background characteristics, and then how later educational outcomes are affected by PISA. Our interest here is the role Indigeneity plays in the relationship between PISA and the educational outcomes.

4. Modelling PISA scores

The purpose of the model is to establish the importance of Indigeneity in predicting PISA for both the 2006 and 2009 cohorts. Our interest is whether Indigeneity as such plays a role over and above individual characteristics (such as socio-economic status) and school characteristics, and whether there is a change in the relationship between the two cohorts.

We fit a multi-level model following Mahuteau and Mavromaras (2014), taking advantage of the PISA instrument which has a rich array of personal characteristics and school characteristics. Diagramatically, the model can be represented as:

Figure 6: Stylised multilevel model for the estimation of scores[6]



We employ this multi-level model in two ways. We first take a relatively simple approach by introducing into the model dummy variables representing Indigeneity, cohort and an interaction between the two. This provides simplistic estimates of the importance of Indigeneity and whether this has changed between the cohorts.

We use a rich array of control variables, as shown in **Box 2**.

Box 2: Control variables for modelling PISA

Basic demographics	
	Age
	Gender
Socio-economic environment for the student	
	Mother dropped out from school
	Father dropped out from school
	Father was a blue collar worker
	Mother was a blue collar worker
	Number of books in the house
	Quiet place to study in the house
Study effort	
	Minutes spent reading at home
	Minutes spent on mathematics at home
	Minutes spent on science at home
School characteristics	
	School SES (measured by ESCS)
	Minutes spent reading

[6] ESCS (Economic, Social and Cultural Status) is an index of socio-economic status derived by the Organisation for Economic Co-operation and Development.

	Minutes spent on mathematics Minutes spent on science Gender Computers per student Shortage of qualified teachers Staff to student ratio Parental pressure to set high academic standards

Our second approach is to fit full models to the Indigenous and non-Indigenous students separately rather than employ a limited number of dummy variables. This approach allows us to decompose the difference between the average PISA of Indigenous and non-Indigenous students, using standard decomposition techniques, into components reflecting differences in characteristics, and components reflecting differences in PISA for a set of characteristics (ie differences in returns). The decomposition approach is a little more complicated but provides greater insight.

4.1 Results of the simple model

Table 20 shows the coefficients of the Indigenous and cohort dummies based on the first approach.

Table 20: Multilevel regression of PISA scores by Indigenous status

Variables	Reading	Math	Science
Cohort indicator (=1 for PISA 2009)	**18.7**	**4.19**	**2.99**
	(14.4)	(14.3)	(15.0)
Indigenous student	**-42.2*****	**-37.2*****	**-44.3*****
	(2.61)	(2.43)	(2.81)
2009 cohort interacted with Indigenous status	**14.9*****	**14.8*****	**16.9*****
	(4.00)	(3.73)	(4.32)

Note: Extract of multilevel estimation of PISA scores 2006-2009. Dependent variables PISA scores in Reading, Mathematics, and Science.

We see that, after controlling for background characteristics, that Indigenous students in 2006 had lower PISA scores of around 40 points (42.2 for reading, 37.2 for mathematics and 44.3 for science). If we refer back to the raw differences (Figure 1) we see that 40 points is roughly half the crude difference. Thus it is clear that the background characteristics of Indigenous students are an important part of the story.

The one promising result from the Table 10 is that the differences between Indigenous and non-Indigenous students is somewhat lower in the 2009 cohort (and this reduction is statistically significant). This reduction in disadvantage was not observable from the raw scores. However, we see later that this change is not robust and virtually disappears with a more sophisticated specification.

4.2 Results of the decomposition

Our formulation is along the lines of Oaxaca, modified to allow us to focus on Indigenous students' characteristics, non-Indigenous students' characteristics, or a combination (see Cotton, 1988, and Reimers, 1983). For presentation purposes we start by writing the simplest of decomposition which is a special case of the more general decomposition we actually implement.

We use indices *Ind* and *NI* to denote the groups we are referring to. Using this notation, we can write the differences in scores between non-Indigenous and Indigenous students as (for

simplicity we bundle all regressors from the model into a single matrix *X* which includes both students and school characteristics):

$$Score_{NI} - Score_{Ind} = \Delta X \beta_{Ind} + \Delta\beta\ X_{Ind} + \Delta X \Delta\beta = E + C + CE \quad (1)$$

where Δ stands for the difference operator (differences between the two groups).

E stands for the endowment effect, *C* for the coefficient effect ('return to characteristics') and *CE* represents the gap arising from the interaction of endowment and coefficients. Depending on the formulation chosen, *CE* is either included into the explained part of the differences between the groups or in the unexplained component (especially when one looks at differences in terms of discrimination). This can be written as:

$$Score_{NI} - Score_{Ind} = \Delta X \beta_{Ind} + \Delta\beta\ X_{NI} = E + \left(C + CE\right) \quad (2)$$

$$Score_{NI} - Score_{Ind} = \Delta X \beta_{NI} + \Delta\beta\ X_{Ind} = \left(E + CE\right) + C \quad (3)$$

In the first decomposition, the interaction effect is included in the unexplained part while it is in the explained part in the second. Note that each of these decompositions takes one group as the reference, which is potentially an issue. As a result other formulations define a reference point which is a combination of both groups, using weights.

The decomposition that we actually implement is a more general formulation, using weights as follows:

$$Score_{NI} - Score_{Ind} = \Delta X \left(D\beta_{NI} + \left(I - D\right)\beta_{Ind}\right) + \Delta\beta\ \left(X_{NI}\left(I - D\right) + X_{Ind}D\right) \quad (4)$$

Where *I* represents the identity matrix and *D* is the matrix of weights. The Oaxaca decomposition as written in equations (2) and (3) correspond to D being either 0 or 1. We display the results of the decomposition for these two cases along with Cotton's and Reimers' decompositions corresponding respectively to a weight of 0.5 ($diag\left(D\right) = 0.5$) and a weight equal to the sample proportion of non-Indigenous students ($diag\left(D\right) = F_{NI}$) . For those two latter decompositions, the interaction effect (*CE)* is partly included in the explained and unexplained part of the score gaps according to weight used.

The decomposition for the full model of PISA (reading component) shown in Table 21.

Table 21: Summary of decomposition results, full model for PISA reading

Summary of decomposition results, full model	
Mean prediction non-Indig:	523.2
Mean prediction Indig:	449.8
Raw differential:	73.4
Due to endowments (E):	45.9
Due to coefficients (C):	36.8
Due to interaction (CE):	-9.3

We see that where we evaluate the decomposition does have some impact on how much can be explained by the differences in endowments, but does not change the overall conclusion (Table 22).

Table 22: Proportion explained of the difference between PISA reading of non-Indigenous students and Indigenous students

D	0	1	0.5	0.973	pooled model over both groups
Unexplained (U)={C+(1-D)CE}	27.5	36.8	32.1	36.5	35.2
Explained (V)={E+D*CE}	45.9	36.6	41.3	36.9	38.2
Total (R=U+V)	**73.4**	**73.4**	**73.4**	**73.4**	**73.4**
% unexplained {U/R}	**37.5**	**50.1**	**43.8**	**49.8**	**48.0**
% explained (V/R)	**62.5**	**49.9**	**56.2**	**50.2**	**52.0**

(4th column, D= relative frequency of non-Indigenous students)

We see that the differences in endowments in general dominate the differences in the coefficients, although for D close to one (essentially using the non-Indigenous population as the benchmark), the importance of endowments and coefficients are very similar.

The methodology also allows us to isolate the variables for which the differences in endowments or coefficients dominate. The complete decomposition with differences in endowments and characteristics for each variable can be found in the appendix. We have sorted the variables into blocks in an aid to interpretation of the results. For simplicity we only included the D=0 variant of the decomposition (as we saw earlier the decomposition is pretty robust in the choice of D).[7]

Table 23: Decomposition of the of the difference between PISA reading of non-Indigenous students and Indigenous students, by major groupings of variables

Variables		E(D=0)	C	CE
Constant	**Non-Indigenous**	0	49.55	0
Basic demographics		0.25	-3	-0.41
Socio economic environment for student		20.48	-16.06	-2.62
Study effort		5.29	6.24	-1.67
School characteristics		16.37	1.14	-2.88
Total for 2006 cohort		*42.39*	*37.87*	*-7.58*
Changes between 2006 and 2009 cohorts				
Constant		0.99	-10.41	-0.8
Basic demographics		-0.55	1.82	0.5
Socio economic environment for student		0.31	8.5	1.56
Study effort		-0.69	-5.19	0.48
School characteristics		3.48	4.21	-3.43
Total change between 2006 and 2009 cohorts		*4.09*	*-2.89*	*-2.19*
Total		**45.91**	**36.78**	**-9.29**

Note: the raw differential is 73.4 points

Take the 2006 cohort first. We see that differences in characteristics explain more than half of the differences in PISA scores. The general socio-economic environment is the largest explanator, explaining about 20 points of the differences in PISA scores. Differences in school characteristics also contribute substantially, around 16 points, and differences in the time spent studying make some contribution. The implication is that if Indigenous students

[7] Readers can easily calculate the other variants by taking a weighted linear combination of the three components, as in (4).

were distributed across schools in the same way as non-Indigenous students then the differences in the average PISA scores would decline by around 16 points, and if Indigenous students spent on average the same time studying as non-Indigenous students that difference would decline by another 5 points.

The decomposition, however, does not take into account the school random coefficients. While the overall mean of the random school coefficients is zero, it will be the case that Indigenous students will not be uniformly distributed across schools and therefore may be attending schools that on average have a positive or negative random coefficient (which representing idiosyncratic quality aspects which are not captured by the school level variables). We weight up the random coefficients taking into account the distribution of Indigenous students, and find that this contributes to Indigenous disadvantage to a small extent (Table 24).

Table 24: Contribution of idiosyncratic school quality (random effect) to average PISA score for reading

	Non Indigenous	Indigenous
Estimated school quality 2006	**0.278**	**-3.793**
Estimated school quality 2009	**0.336**	**-1.060**

From a policy perspective one implication is that if the performance of poor performing schools were to improve then this would disproportionately assist Indigenous students.

While differences in endowments (both individual and school) are important so are the differences in the returns. Statistically speaking, non-Indigenous students score almost 50 points (the value of the constant in the model) better than Indigenous students over and above the contribution of the explanatory variables. Interestingly, there are differences in coefficients – for example in the 2006 model Indigenous students score 16 points better than non-Indigenous students for variables relating to the socio-economic environment of the individual students. Aggregating over all the variables indicates that, holding individual and school characteristics constant, Indigenous students score around 37 points less than their non-Indigenous counterparts.

The model also allows us to look at the changes between the 2006 and 2009 cohorts. Overall, there is little change, with the change attributed to changes in the background characteristics being some 4 points, but this is offset by decline in the advantage that non-Indigenous students have, holding the characteristics constant. The change attributable to the change in characteristics is predominantly due to the change in school characteristics – it appears that the sample of schools in the second cohort was different from the first. Of more interest is the decline in the gap in educational performance due to the change in coefficients. While small (2.9 points), it is the right direction, although the narrowing of the gap is smaller than the ones derived earlier with the simpler model, in which it appeared that the differences in Indigenous and non-Indigenous PISA scores had declined by some 10 points.

One point that does emerge from this more sophisticated model is that the relationship between the overall impact of Indigeneity and the interaction with particular characteristics does not seem that robust. We see that in the 2006 cohort the constant is around 50 points but this is offset by some 16 points from the better return that Indigenous students get from their socio-economic environment. By contrast in the 2009 cohort, the overall constant drops by 10 points but Indigenous students now get a worse return (8.5 points) from their socio-economic environment. This suggests that it is unwise to over interpret these results. The bottom line is that Indigenous students are doing considerably worse than their non-

Indigenous counterparts even though we are taking into account the disadvantage that Indigenous students face in their home and school environments.

The one caveat to this conclusion is that, while the model we have used has a very rich set of individual and school characteristics, it is always possible that we have omitted important explanatory variables. For example, our background variables do not include indicators of health. It is possible, for example, that poor health is an explanation of the poor performance of Indigenous students, and that if we included health in the model that the importance of Indigeneity would decline. All we can say in this respect is we are restricted by the data available in PISA and LSAY, and at the end of the day the model provides a statistical description and not a diagnostic explanation of the performance of Indigenous students relative to non-Indigenous students.

5. Educational outcomes beyond PISA

The LSAY records student outcomes beyond their PISA year (which is at age 15 and is for most students Year 10). For the 2006 cohort, we have 6 years data after the PISA first wave. For the 2009 cohort, we have 3 years data after PISA first wave. Hence, in the 2006 cohort data, students have been followed well beyond the age when they were meant to have completed their schooling, and in some instances to the completion of their first university degree. In the 2009 cohort, students have been followed up to the time where most of them have completed high school and are potentially engaging in post-school education.

Since our research seeks to make comparisons between cohorts, we harmonise the two cohorts, restricting the use of the 2006 cohort to the knowledge gained by 2009, that is three years after PISA. We do so in order to have the same data span compared to the 2009 cohort which is limited to 3 years after PISA.

An important characteristic of the LSAY data is that it suffers from a relatively high attrition rate. In most cases, people who drop out of the survey are rarely seen again in the data. However, some attrition is reversed with some students dropping out of the data in one wave and reappearing in a later one. But the majority of attrition is not reversed. Table 25 shows the number of students who were interviewed in each wave, starting with the full PISA sample in wave 1, 14,170 for the 2006 cohort and 14,251 in the 2009 cohort. Table 25 shows the sample retention in the LSAY waves up to wave 4 which corresponds to school completion for the PISA students. We note that the 2006 cohort had lower attrition with 51.5% of the original sample being present in wave 4, while the 2009 attrition retained 45.9% of the original sample. Retention is much lower among Indigenous students with respectively 32.3% remaining from the 2006 cohort by wave 4 and 27.4% from the 2009 cohort.

Table 25: LSAY: number of observations by cohort and wave

Cohort		Non Indigenous	Indigenous	Total	Non Indigenous	Indigenous	Total
2006							
	PISA/ LSAY wave 1	13,090	1,080	**14,170**	100.0%	100.0%	**100.0%**
	LSAY wave 2	8,835	518	**9,353**	67.5%	48.0%	**66.0%**
	LSAY wave 3	7,943	437	**8,380**	60.7%	40.5%	**59.1%**
	LSAY wave 4	6,950	349	**7,299**	53.1%	32.3%	**51.5%**
2009							
	PISA/ LSAY wave 1	13,108	1,143	**14,251**	100.0%	100.0%	**100.0%**
	LSAY wave 2	8,267	492	**8,759**	63.1%	43.0%	**61.5%**
	LSAY wave 3	7,240	386	**7,626**	55.2%	33.8%	**53.5%**
	LSAY wave 4	6,228	313	**6,541**	47.5%	27.4%	**45.9%**
Pooled							
	PISA/ LSAY wave 1	26,198	2,223	**28,421**	100.0%	100.0%	**100.0%**
	LSAY wave 2	17,102	1,010	**18,112**	65.3%	45.4%	**63.7%**
	LSAY wave 3	15,183	823	**16,006**	58.0%	37.0%	**56.3%**
	LSAY wave 4	13,178	662	**13,840**	50.3%	29.8%	**48.7%**

For the purpose of the present analysis, we look at the data three years after the PISA wave (that is, we look at LSAY wave 4) and measure the school outcomes of students and, where available, also at their post-school education choices. For some individuals who drop out of the sample before the third LSAY year, it is possible to construct a pathway for some of the educational outcomes. For example, if a student drops out of school without completing school and drops out of the survey before the third LSAY year we know their schooling outcomes. This increases our sample size for some of the educational outcome variables

without introducing any additional biases. As a consequence we are able to work on a larger sample than the one that is left after attrition.

In order for the analysis of student schooling outcomes to make sense, they need to be expressed by reference to the sample of students whose history is known, not the starting PISA sample. Therefore we defined a 'reference population' as wave 4 of LSAY, that is 2009 for the 2006 PISA cohort and 2012 for the 2009 PISA cohort. Included in this reference population are students whose schooling outcomes can be observed whether they drop out or not from the LSAY sample before wave 4. Within the reference population, it is possible to determine for sure whether a student has completed a given schooling outcome or not.

The reference population comprises 7,955 students from the 2006 cohort and 7,040 students from the 2009 cohort. We note that while we were cleaning and reconstructing the post-PISA education pathways in the LSAY data we found a number of inconsistencies in the data which necessitated the removal of 129 and 133 observations from the 2006 and 2009 cohorts respectively.

Our primary interest is in determining the impact of PISA and Indigeneity on the educational outcomes, over and above the role of background characteristics such as socio-economic status. Thus our modelling strategy is to model an educational outcome – the probability of completing year 12, for example- as a function of PISA and a range of other control variables. We focus on reading ability, noting that it is highly correlated with mathematics and science performance.[8] Because of endogeneity, we use the predicted PISA for the individual (net of school quality).[9] The control variables are shown in Box 3.

[8] We preferred to use a single element of PISA – reading performance- for a number of reasons: first, a parsimonious model is preferred given the high correlation between the three PISA components; second, arguably literacy is more important in the ability to function in our society than mathematics and science; and third the school quality estimates show more variability in reading than in the other elements. We did experiment with models with all three elements, and the results in respect of the other variables were almost identical.

[9] There are two elements of predicted PISA. The first is the prediction based on the individual and school characteristics, the second is the random coefficients derived from the model.

Box 3: control variables for modelling educational outcomes

Basic demographics	
	Age
	Gender
Socio-economic environment for the student	
	Mother's education
	Father's education
	Father was a blue collar worker
	Mother was a blue collar worker
	Number of books in the house
	Quiet place to study in the house
	Student has a desk
	Internet at home
	SES status (ESCS)
PISA	
	Estimated PISA from earlier model predicting PISA reading achievement
School characteristics	
	Estimated school quality from earlier model predicting PISA reading achievement (the idiosyncratic component from the random effect)
	School SES (measured by ESCS)
	Minutes spent reading (wave 1)
	Minutes spent on mathematics (wave 1)
	Minutes spent on science (wave 1)
	Gender
	Computers per student (wave 1)
	Shortage of qualified teachers (wave 1)
	Staff to student ratio (wave 1)
	Parental pressure to set high academic standards (wave 1)
	School provides information to parents on their child's performance relative to other year 9 students
	Parental pressure to set high academic standards (wave 1)
	School provides information to parents on their child's performance relative to regional or national benchmarks
	School provides information to parents on their child's performance relative to other year 9 students in other schools
	School system (Government, Catholic, Independent)

A second model was also fitted with dummies for each State or Territory, to test for robustness, noting that the small number of Indigenous students in some states can potentially create estimation difficulties for that model. While these models are included in the appendix we do not report on them here.

In Table 26, we extract the coefficients of three variables of particular interest – the Indigenous dummy, the Indigenous*cohort dummy and the estimated PISA score. We express the coefficients as marginal effects representing the change in the probability of the educational outcome.

Table 26: Marginal effects of selected variables on educational outcomes (percentage points)

Educational outcomes	Indigenous	Cohort 2009*Indigenous	Estimated PISA
Dropping out from school	**-3.8**	**1**	**-0.2*** **
	(2.4)	(3.1)	(0.0)
Year 12 completion	**-2.9**	**3.3**	**0.1***
	(3.9)	(2.9)	(0.1)
Request an ATAR	**4.8**	**-1.5**	**0.4*** **
	(5.2)	(5.4)	(0.1)
Intend to go to university	**-2.4**	**-2.5**	**0.1**
	(5.1)	(5.2)	(0.1)
University participation	**4.1**	**-8.6**	**0.3*** **
	(5.8)	(5.4)	(0.1)
VET participation (certificate III or higher)	**-3.8**	**0**	**-0.02**
	(2.7)	(3.6)	(0.1)

Note: * signifies significant at 10% level, ** at 5%, *** at 1%. Standard errors are in parentheses.

What is striking about these results is that the Indigenous dummies are not significantly different from zero even at the 10 % level. By contrast, the coefficients on *Estimated PISA* are significant at the one percent level for dropping out of school, whether an ATAR is requested, and participation at university. The marginal effects for *Estimated PISA* are also of some consequence. Recall from our earlier decomposition that the difference between the average PISA for non-Indigenous and Indigenous students was 73.4 points. Thus the effect of the lower PISA scores of Indigenous students (on average) has a substantial impact on educational outcomes; the educational outcomes of Indigenous students are not as good as those of non-Indigenous students, despite our finding that Indigeneity as such plays no further role in predicting educational outcomes.

These models reinforce the finding that it is the earlier poor education performance that is driving the poorer educational outcomes at the end of schooling for Indigenous students. To give some idea of the role of the importance of earlier education outcomes we multiply the marginal effects on Estimated PISA by the difference between the average PISA of non-Indigenous and Indigenous students (of 73.4 points).

Table 27: Effect of the difference in PISA of 73.4 points on various outcomes (percentage change in probability)

	percentage point change in probability	
Dropping out from school	-14.7	
Year 12 completion	7.3	
Request an ATAR	29.4	
Intend to go to university	7.3	(although not significant)
University participation	22.0	
VET participation (certificate III or higher)	-1.5	(although not significant)

We see that an additional 73.4 points in PISA makes a considerable difference in later educational outcomes. For example, the probability of going to university increases by over 20 percentage points. Thus poorer performance by Indigenous students in the middle years of secondary schooling has a lasting impact; disadvantage leads to disadvantage.

While we have seen that PISA plays an important role in affecting later educational outcomes, other characteristics also play a part. By employing a decomposition analogous to the one used earlier, we get some idea of the importance of various individual and school

characteristics.[10] Table 28 summarises the decompositions. Consistent with our earlier finding that Indigeneity as such plays no direct role in educational outcomes, we see that the component attributed to differences in coefficients between the Indigenous and non-Indigenous models are not significant. By contrast the differences in the endowments are highly significant.

Table 28: Summary decomposition of the difference between the probability of school dropout (and other educational outcomes) of non-Indigenous students and Indigenous students.

	Raw difference	Contribution of differences in characteristics	Contribution of differences in coefficients
School dropout	**-15.3*** **	**-22.1*** **	**5.6**
	(1.8)	(2.9)	(3.7)
Year 12 completion	**15.4*** **	**14.5*** **	**1.2**
	(1.9)	(2.7)	(3.6)
Request an ATAR	**21.2*** **	**25.5*** **	**-3.7**
	(2.3)	(2.2)	(3.0)
Intend to go to university	**17.4*** **	**16.3*** **	**2.1**
	(2.3)	(2.3)	(3.3)
Participation at university	**19.7*** **	**20.1*** **	**-0.6**
	(2.3)	(1.5)	(2.2)
Participation at VET (certificate III or higher)	**0.7**	**-5.4** **	**4.9**
	(1.9)	(2.5)	(3.2)

For example, the probability of a non-Indigenous student dropping out from school is 15.3 percentage points less that the probability of an Indigenous student. The contribution of differences in coefficients is not significant, indicating that the difference can be totally attributed to the differences in the characteristics of Indigenous students.

We now explore the contribution of the differences in characteristics in more detail. Rather than show the contribution for each variable we group them together, with the aim of isolating the importance of the socio economic environment of the individual, the importance of school and the importance of PISA.

[10] The standard Oaxaca decomposition is based on a linear model. The probit analysis analogue is based on a similar idea to that of the marginal effects derived from the probit regression coefficients. That is the impact of a change in the coefficients or characteristics is weighted by the density evaluated at an average set of characteristics.

Table 29: Contribution of differences in characteristics to the differences in educational outcomes between non-Indigenous and Indigenous students.

	School dropout	Year 12 completion	ATAR request	Intend to go to university	Participation at university	VET participation
Cohort 2009	-0.1	0.0	0.0	-0.1	0.0	-0.1
Total demographics (age and sex)	0.0	0.0	0.2	-0.2	0.1	0.1
Total socio-economic environment	-3.0	4.9	3.7	3.7	3.0	-1.8
Estimated PISA score (fixed part)	-18.4	7.3	21.0	9.4	14.7	-1.9
Total school characteristics	1.1	2.4	0.7	3.4	2.3	-2.4
Total characteristics effect	-22.1	14.5	25.5	16.3	20.1	-5.4
Total characteristics effect (sum of rows)	-20.5	14.6	25.6	16.1	20.2	-6.1
Raw gap	-15.3	15.4	21.2	17.4	19.7	0.7

Note: the total characteristic effect differs from the sum of the components because of the non-linearity of the model

Not surprisingly the cohort and demographics contributions are trivial – the Indigenous and non-Indigenous samples are very similar in terms of gender and age. Similarly the cohort contribution is trivial – it would only play a role if somehow the differences between the educational outcomes of non-Indigenous and Indigenous students had changed significantly between the cohorts.

By contrast, the differences between Indigenous and non-Indigenous students in respect of the socio-economic environment, the schools attended, and estimated PISA scores largely explain the differences in the educational outcomes. However, it is the differences in average PISA scores that dominate. For example, the much lower rate of participation at university (19.7%) of Indigenous students is largely explained by the differences in PISA with this element explaining 14.7% points. The contribution of the socio-economic environment is of some substance, but much smaller (3.0% points) as is the contribution of the school attended (2.3% points).

All this points to the critical importance of the early education experience; if the difference in education performance at year 9 between Indigenous and non-Indigenous students could be eliminated such that their performance was the same for given socio-economic background, then the differences in later educational outcomes would be very small indeed. The relatively small contribution of the differences in schools attended indicates the difficulty of remediating the earlier disadvantage.

This is a positive finding, in the sense that the gap between the educational outcomes of Indigenous and non-Indigenous students does not widen once we control for PISA scores. This compares with the findings of Leigh and Gong (2009) that the gap does widen throughout school although their findings were in respect of primary school performance.

One point of interest from this analysis is the singularity of the participation in VET, although we note that our definition includes only those studying at the certificate III level or higher. In raw scores there is very little difference between the participation of Indigenous and non-Indigenous students. However, the decomposition suggests that a priori we would have expected Indigenous VET participation to have been higher than that for non-Indigenous students because Indigenous students on average come from a socio economic environment, and from schools that are conducive to higher VET participation (1.8 and 2.4

percentage points respectively). The fact that the overall difference in participation is approximately zero suggests that in fact Indigenous students are less likely to attend VET than their non-Indigenous counterparts, once these background characteristics and school attendance are accounted for. Thus the relatively high VET participation of Indigenous students turns out to be not such a good news story as first thought.

6. Concluding comments

Our key findings are that:

- There are very substantial differences between the academic performance at age 15 of Indigenous and non-Indigenous students. Part of this difference can be attributed to differences in socio-economic status and other background variables, and to differences in schools which Indigenous students attend. However, a sizable gap remains between the academic performance at age 15 of Indigenous and non-Indigenous students which is not explained by these factors.

- There was, at best, a very modest improvement in the academic performance of Indigenous students at age 15 between the 2006 and the 2009 cohorts, once we control for background characteristics of the students. The more sophisticated model provided an estimate of around three points in the PISA literacy scale (the raw difference between non-Indigenous and Indigenous scores across the two cohorts was around 73 points).

- There is no significant difference between the subsequent educational outcomes of Indigenous and non-Indigenous students *once we control for academic achievement at age 15*. This finding is robust across all our educational outcome variables: school drop-out, year 12 completion, intention to go to university, participation at university and participation at VET (certificate III or higher). The finding that Indigeneity does not play a role in exacerbating educational disadvantage in the final years of secondary schooling is a very encouraging finding.

These findings have important policy implications. First, they confirm that the orthodox view that educational disadvantage should be addressed early in the education process. That is, the greatest scope for improvement in educational outcomes for Indigenous students post-school comes from improved educational performance during the early and middle levels of school. And those improvements would be very substantial if the academic achievement at age 15 of Indigenous students were raised to that of non-Indigenous students.

The other policy implication is that current programs over the latter years of secondary school have been successful at ensuring that Indigenous students do not suffer further disadvantage relative to their non-Indigenous counterparts, but have been largely ineffective in remediating earlier disadvantage. Thus, on the basis of this analysis at least, it is suggested that the preponderance of effort in addressing Indigenous educational disadvantage should be before the final years of schooling.

As an aside, the analysis suggests that programs which can address the lower academic achievement of low SES students, and the poorer performance of some schools will benefit Indigenous students particularly, for the simple reason that the Indigenous student population is over represented among the lower SES and the poorer performing schools. For example, if Indigenous students were distributed across schools in the same way as non-Indigenous students then we would expect to see an improvement in year 12 completion and in the proportion participation in university immediately after year 12 of around two percentage points.

There is still a long way to go before the gap between Indigenous and non-Indigenous educational outcomes is closed, and the very modest reduction in the gap at age 15 between the two cohorts is disappointing. However, the benefit in reducing the size of the gap at age 15 on subsequent education outcomes remains very substantial. If performance of Indigenous students at age 15 could be increased to that of their non-Indigenous counterparts (that is increasing the academic achievement at age 15 of low SES Indigenous students to that of low SES non-Indigenous students, for example) according to our analysis

there will be a significant flow through to improved educational outcomes: a reduction in the drop-out rate of 15 percentage points, an increase in the proportion requesting an ATAR of 29 per cent, and an increase in the proportion participating at University immediately after leaving school of 22 percentage points. Of course, such calculations assume that those who improve their PISA score benefit to the same extent as those students who currently are obtaining the higher PISA scores.

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