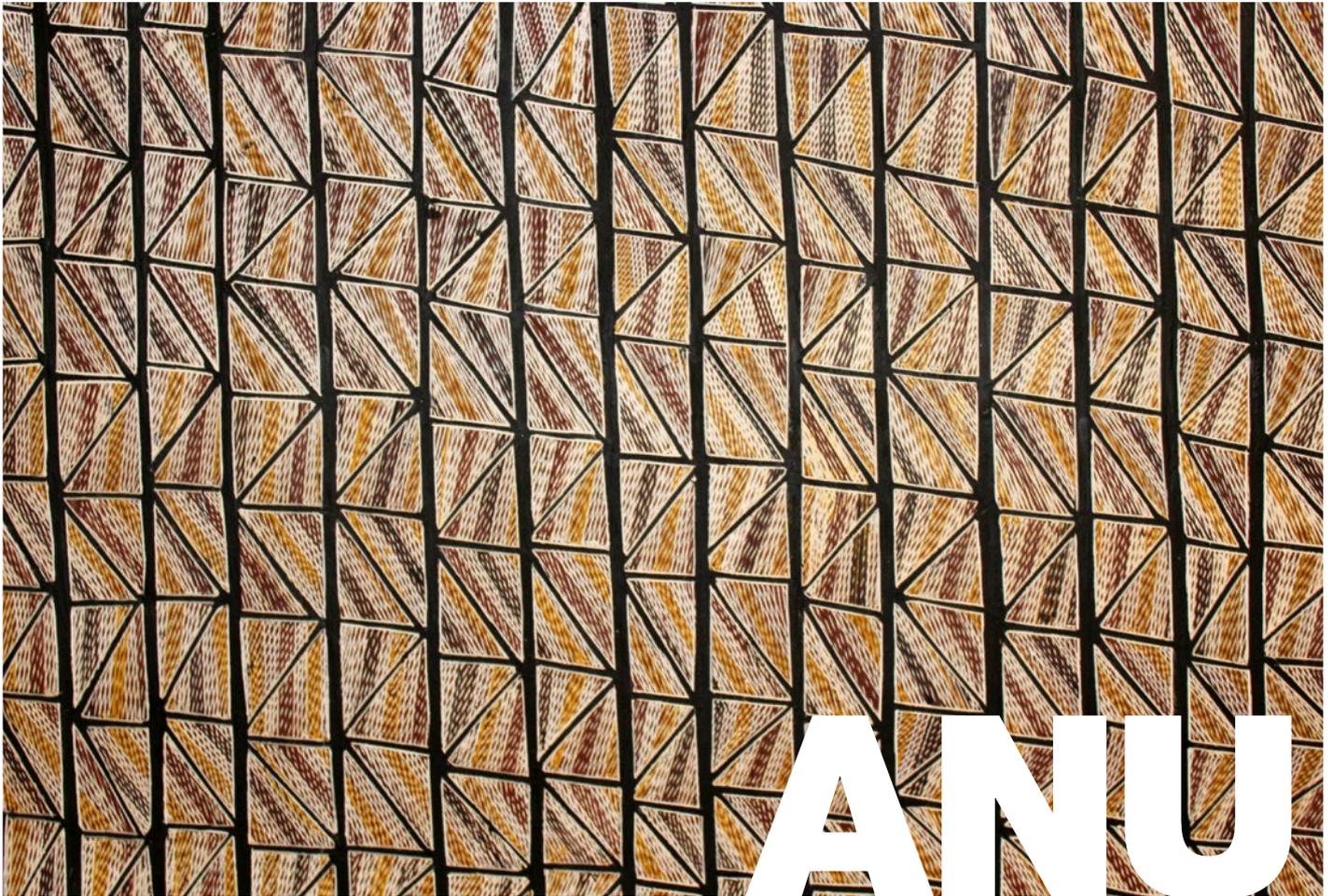




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THE CHARACTERISTICS AND POTENTIAL
EFFECTS OF THE SCHOOLS THAT
INDIGENOUS AUSTRALIANS ATTEND

N BIDDLE AND B EDWARDS

Centre for
Aboriginal Economic
Policy Research
ANU College of
**Arts & Social
Sciences**

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The characteristics and potential effects of the schools that Indigenous Australians attend

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Abstract

This paper uses data from the National Assessment Program, Literacy and Numeracy (NAPLAN) to document the distribution of Indigenous students across Australian schools, as well as some of the potential effects of that distribution on literacy and numeracy outcomes. The results show three main things: the Indigenous population is not evenly distributed across schools, with high rates of school segregation; using a school fixed effects model, it appears that the characteristics of schools matter in explaining change through time in Indigenous outcomes; and the distribution of Indigenous students across different schools explains some, but not all, of the difference between Indigenous and non-Indigenous students in literacy and numeracy. A key policy finding from the analysis is that the school system seems to matter. Growth through time of literacy and numeracy for Indigenous students is lowest in New South Wales, the Australian Capital Territory and the Northern Territory.

Keywords: literacy and numeracy, schools, administrative data

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Acronyms

ANU	The Australian National University
CAEPR	Centre for Aboriginal Economic Policy Research
DI	dissimilarity index
NAPLAN	National Assessment Program, Literacy and Numeracy

Contents

Series Note	ii
Abstract	iii
Acknowledgments	iv
Acronyms	iv
Introduction and overview	1
A brief history of Indigenous education	1
Mission era	1
Protection era	2
Assimilation period	2
Contemporary era	3
The importance of understanding the schools that Indigenous children attend	3
School sorting in Australia	5
Data and methods	5
Results	6
Association between school and literacy and numeracy outcomes	9
Data and methods	9
Results	11
Concluding comments and ongoing research	15
Notes	16
References	16

Tables and figures

Fig. 1. Dissimilarity index for Australian schools, Indigenous and non-Indigenous students, 2015	6
Table 1. Percentage of Indigenous students by Indigenous share of school	8
Table 2. Percentage of non-Indigenous students by Indigenous share of school	8
Table 3. Literacy and numeracy index values by Indigenous status, sex and year level, 2015	9
Fig. 2. Relationship between Indigenous status and change in literacy/numeracy with and without school-level fixed effects, 2015	12
Fig. 3. Relationship between school and individual-level characteristics and change in literacy/numeracy, by Indigenous status, Year 3 to Year 5 change, 2015	13
Fig. 4. Relationship between school and individual-level characteristics and change in literacy/numeracy, by Indigenous status, Year 7 to Year 9 change, 2015	14

Introduction and overview

Inequality and disadvantage are increasingly areas of scholarly, media and policy attention. Education, and the role it can play in overcoming inequality and disadvantage, is a core aspect of these discussions. However, the issue of school segregation (or sorting) in Australia, and its possible impact on differences in outcomes by race and ethnicity, has received comparatively little attention.¹

Ultimately, we argue in this paper that schools matter, in terms of both the resources available to student learning and the peers who students interact with (Epple & Romano 2011). Schools do not define or completely determine success in terms of completion, attainment, literacy and numeracy, or student wellbeing. And many individuals do very well in schools that might otherwise be considered poor performing or of low quality. As well, what is occurring within a child's family or their community influences the context in which they receive a formal education, as well as the supports in place for the inevitable times when a child or youth is finding aspects of school difficult (Chevalier et al. 2013).

School effects are more likely to explain differences in outcomes by a student's characteristics when the schools that are attended differ (school segregation). This paper aims to very briefly document the history and current levels of school segregation in Australia with regard to Aboriginal and Torres Strait Islander (Indigenous) Australians. We then consider whether and how school segregation plays a role in undermining the educational performance of Indigenous children.

The paper begins with an overview of four distinct phases of Indigenous education policy, which contextualise the current segregation levels experienced by Indigenous and non-Indigenous students. These phases are the mission era, which emphasised saving and civilising the Indigenous population; the protection era, which was typified by restrictive and racist measures; the assimilation era, which was marked by attempts to assimilate Indigenous children with European ancestry; and the contemporary era.

The section that follows documents the level of school sorting, using a complete, unit-record dataset of all students in Years 3, 5, 7 and 9 who were eligible to participate in the National Assessment Program, Literacy and Numeracy (NAPLAN). The next set of results uses econometric techniques to test the extent to which the school that an Indigenous child attends explains their position on the standardised achievement tests and,

perhaps more interestingly, the extent to which it explains the change over a two-year period on these tests (student growth). The final set of analyses using NAPLAN focuses on the specific, observable characteristics of the schools that explain that growth, and how these characteristics vary between Indigenous and non-Indigenous students. The final section in the paper provides some concluding comments and recommendations for policy.

A brief history of Indigenous education

For much of Australia's history, schools for Indigenous children have acted as tools for assimilation and the stripping away of Aboriginal and Torres Strait Islander culture; the value of cultural diversity has been whitewashed while non-Indigenous statistics are presented as an aspirational 'norm'. Although policy towards Indigenous education in the contemporary era has changed, this history continues to have an effect on policy today.

Before the colonisation of Australia by Great Britain, Indigenous education was deliberate, systematic, comprehensive and lifelong. It was a living culture, belonging to the family, and everyone was an educator (Burridge & Chodkiewicz 2012). This changed with British settlement, and the colonisation of the country had significant negative impacts on the Indigenous way of life. Post-settlement, education centred on improving the Indigenous population through the use of missionary schools, segregated public schooling, and training institutions that focused on manual work.

Under the Australian federal system, education has primarily been the responsibility of the states and territories, leading to a varied history of Indigenous education policy throughout Australia. Nevertheless, a distinct pattern is still evident. Partington (1998) describes three phases of Indigenous education policy from colonisation until the 1960s: the mission era, the protection era and the assimilation era. Each of these is documented in more detail below.

Mission era

During most of the 1800s in Australia, schools were generally established by churches or charities and, as a result, few government policies explicitly focused on Indigenous education. Missions were established, however, with the goal of civilising and centralising the Indigenous population, often with the aim of making access to, or ownership of, land easier for non-Indigenous Australians (Cole 2011). Even after state

governments began to take responsibility for school education, Indigenous students were excluded from government schools (Parbury 1999). There was a strong belief during this period that the Indigenous population was dying out and, as a result, there was a greater need to Christianise them than to educate them.

Protection era

The mission era gave way to the protection era as governments took responsibility for the Indigenous population through protectorate Acts. This began in Victoria in 1869, and all other colonies followed suit in the following decades. Colonial and then state governments claimed significant control over almost all aspects of Indigenous life, including marriage, child rearing, residence, employment and education.

During this era, there was significant conflict between protection boards and education departments. The protection board in New South Wales wanted to continue to refuse the Indigenous population attendance at government schools, whereas the education department allowed admittance to Indigenous students if they were deemed 'clean, clad and courteous' (Fletcher 1989). This saw Indigenous students slowly gaining admittance into government schools from as early as 1870. The policy received strong opposition from non-Indigenous parents, who felt that their child's education was being compromised by the presence of Indigenous students. After this brief period of improved access, a new Minister for Education in New South Wales reinvigorated a policy of segregation between Indigenous and non-Indigenous students. Segregated schools were established in localities with sufficient numbers of Aboriginal children, a policy that was eventually emulated by other states (Fletcher 1989).

Despite protests, Indigenous children were still allowed to attend public schools in areas where segregated schools could not be established. Continued pressure from parents did, however, eventually result in a change of government policy in 1902 to allow the exclusion of Indigenous children if parents of non-Indigenous children demanded it. This policy became widespread throughout Australia and continued for more than half a century. Over the following decades, 50 Indigenous schools were established in New South Wales, fully segregating the population in terms of education (Fletcher 1989).

One significant aspect of these schools was their different curriculum and administrative procedures. In some cases, they were so small that the government did not even provide a building, and teachers were not required

to hold teaching qualifications. A special syllabus was introduced in 1916 for Indigenous education, prescribing a meagre amount of time for numeracy and literacy, with a heavy focus on manual work for boys and domestic arts for girls (Fletcher 1989).

Although there was a large degree of uniformity in policies during this period, differences could be found in Western Australia and the more remote regions of Australia. Many did not cater for the Indigenous population's education – often, there was no school, and Aboriginal children were barred from public schools (Parbury 1999).

Assimilation period

Concerns regarding the steady rise of the 'half- and part-caste' population saw the development of policies aiming to merge them with the non-Indigenous population (Smith 2010, Biddle et al. 2015). This was the basis of the 'Stolen Generations' policy, under which Indigenous children were taken away from their families and communities by the state to remove them from Indigenous influence and assimilate them into non-Indigenous society (Australian Human Rights Commission 1997). The idea to assimilate Indigenous children with some non-Indigenous ancestry into the population became evident in education policy during the 1937 Commonwealth–State Native Welfare Conference, the first of its kind. The conference reported that it:

believes that the destiny of the natives of aboriginal origin, but not of the full blood, lies in their ultimate absorption by the people of the Commonwealth, and it therefore recommends that all efforts be directed to that end. (Commonwealth of Australia 1937)

It was also stated that the education of children of mixed Aboriginal blood should meet 'white standards, and their subsequent employment under the same conditions as whites with a view to their taking their place in the white community on an equal footing with the whites' (Commonwealth of Australia 1937).

Between 1940 and 1968, there was a decline in the Aboriginal schooling system, with the closure of many of the smaller schools; half- and part-caste children were increasingly admitted into public schools (Fletcher 1989). This move towards assimilation still maintained many of the beliefs of the protection era. Indigenous children were still not considered fit to receive a full and proper education. For example, the New South Wales and Queensland governments allowed tuition of Aboriginals only up to Year 3 standard (Purdie & McCrindle 2004).

Levels of school provision also remained low; in the 1940s, it was estimated that less than 10% of Indigenous children were attending public schools, and nearly two-thirds of children were receiving no education whatsoever (Beresford & Gray 2008). Conditions in remote areas also continued as before, with the education of Indigenous children still provided by missions, or not provided at all.

Contemporary era

The 1960s marked a significant change for the Indigenous population, with a range of Indigenous (and non-Indigenous) leaders advocating for Indigenous rights. One of the significant outcomes was the successful 1967 referendum allowing the Australian Government to develop and implement policy for Indigenous Australians. The referendum also led to the inclusion of the Indigenous population in census counts of the total Australian population. This period saw education policy move away from assimilation towards integration, in which the Indigenous population was able to enter into wider society slightly more on their terms.

There was a shift away from the belief that Aboriginal people were incapable of matching non-Indigenous students as a result of inherent or innate abilities. Rather, poor Indigenous education results were believed to stem from impoverished backgrounds and communities where education was not as valued as in the white community (Parbury 1999).

A move towards greater self-determination in the 1970s and 1980s saw Aboriginal advisory groups being placed within state education departments around Australia. One of these groups was the National Aboriginal Education Committee (NAEC), whose outline of a national approach to education in 1985 represents the dominant themes in Indigenous education both currently and during the past few decades. The NAEC stated that:

by any acceptable educational standard in Australia today the education of Aboriginal people is seriously inadequate. A major reason for this inadequacy is that the educational theories and process used in Australia have been developed by and for non-Aboriginal people. They are largely inappropriate for our people. School and further education authorities must develop an education theory and pedagogy that takes into account Aboriginal epistemology. (Vass 2013)

The significance of the NAEC statement was not lost on politicians at the time, and, in 1989, the National

Aboriginal and Torres Strait Island Education Policy was released, incorporating many of the NAEC suggestions.

Attesting to its impact, the policy continues to be the centrepiece of the national approach to Indigenous education, with the central ideas outlined in 1989 continuing to resonate today. These ideas include the importance of culturally appropriate pedagogy, an inclusive curriculum, attendance and retention, and calls for increased parental engagement and numbers of Indigenous teachers (Vass 2013).

Since the 1970s, Australia has been deregulating its education system, and parents have gained greater choice in their child's schooling. Government policies have centred on giving individual schools greater autonomy in decision making and loosening strict school catchment boundaries. Australian Government funding for private schools has increased from 21.5% of total schools funding in 2006 to 24.2% in 2015 (Hanrahan 2017). Parental choice and competition have been key policy drivers for this increased level of Australian Government funding of the nongovernment sector. For three decades, consecutive Australian governments have promoted parental choice and competition through changes to schools funding policies, as well as through other mechanisms, such as My Schools. This has coincided with (either as a determinant of, or determined by) a rise in the share of the student population in private schools, which has increased from just over 20% at the end of the 1970s to 36.5% in 2016.

With families becoming more active in the search for schools, but unevenly equipped to make education decisions, the opening up of the market for schools has the potential to affect levels of segregation (Connors & McMorrow 2015). Campbell et al. (2009), in an extensive study of school choice and the impact of the changing nature of education in Australia, found that, although segregation has occurred, it centres on socioeconomic class rather than race or ethnicity. However, because of the generally low socioeconomic standing of Indigenous Australians, it has also resulted to a certain extent in the segregation of this particular minority group.

The importance of understanding the schools that Indigenous children attend

The previous discussion has shown that, historically, there has been a considerable level of policy deliberation relating to the schools that Indigenous Australians attend. At various times, this is likely to have had the

effect of either separating or integrating Indigenous and non-Indigenous students.

According to the 2016 Census, 63.5% of Australian school students were attending public schools in that year. The schools that these students attend are funded on a per-student basis at a centralised state or territory level, with various adjustments made for economies of scale, and other factors that are likely to affect fixed and marginal costs (Dowling 2007). However, the 36.5% of students who attend private schools are likely to be disproportionately (although not exclusively) from relatively advantaged backgrounds (Le & Miller 2003).

The proportion of students attending nongovernment schools has increased quite substantially in the past 30–40 years. This has been caused in part by a steady rise in Australian Government funding since the early 1950s. Ryan and Watson (2004) show that this increase has not led to a fall in school fees but rather has led to an increase in the amount of resources devoted to each student. This, in turn, maintains the relatively high socioeconomic status of students attending nongovernment schools.

Alongside the increase in the proportion of students attending nongovernment schools, there is also a significant and growing number of selective schools with admission fully or partially based on academic criteria. Because they are funded directly by the government, the resources devoted to the education of a student in a selective school are similar to that devoted to a student in a comprehensive public school.

Selective schools are similar to nongovernment schools in their potential to lead to a grouping of students based on certain background characteristics. In nongovernment schools (especially those with high student fees), this grouping is likely to be based on family/household income. Selective schools, on the other hand, are likely to group students based on measured academic ability. However, given the relationship between family/household income and early childhood education development, as well as the resources devoted to preparation for the selective school examination by a number of parents, sorting by family income is also likely to occur between comprehensive and selective government schools.

It is important to note early in this paper that the effects of school sorting (whereby student background affects the school that a child attends) can be difficult to identify using standard empirical techniques because the type of school that children attend is often not

exogenously determined. Rather, the parents or guardians of the child choose the area in which they live and, conditional on their area, the specific school that the child attends, under income and other constraints. This means that differences in outcomes between students who attend different types of schools may be driven by the effect of the schools themselves, or by the background characteristics of the students that affect that decision. It is exceptionally difficult to separately identify the causal effects and the selection effects. In certain cases, this can be tested experimentally, where vouchers or other experimental approaches are used to create some exogenous variation in location and schooling. A classic example is the Moving to Opportunity study in the United States (Chetty et al. 2016). However, there are no similar examples in the Australian context, or for Indigenous Australians specifically.

Indigenous students are substantially less likely to attend nongovernment schools than their non-Indigenous counterparts. In general, public schools carry the vast majority of groups of students who have various forms of educational disadvantage and challenge (Cobbold 2015). According to the 2016 Census, 16.7% of Indigenous infant/primary students and 24.3% of Indigenous secondary students were attending a nongovernment school. This is substantially lower than the 32.6% and 43.7%, respectively, of the comparative non-Indigenous population.

Less information is available on the proportion of Indigenous students attending selective schools. This information is not collected by the census or any other statistical collection with a large Indigenous sample. Nor is it made publicly available in standard government publications of administrative data sources. This is an area of potential future work, if such administrative data were made publicly available.

School segregation could have several possible negative effects on the Indigenous population. The first is that a concentration of Indigenous students in particular schools could result in a relatively low level of resources available for their education. Unfortunately, currently very little information is available on the resources devoted to the education of Indigenous Australians. On the one hand, the school funding model in Australia provides a greater level of Australian Government and state or territory government funding to schools with a high Indigenous population. On the other hand, Indigenous students are less likely to attend schools that receive significant resources from school fees or fundraising activities.

Secondly, school segregation can affect the peer influences students are exposed to. Peer effects in the context of schooling generally refer to the externalities that arise from the academic or other outcomes of a particular student's classmates or social group. Proving the impact of peer effects is a challenge, but a 2011 literature review by Epple and Romano (2011) highlights strong evidence that peer effects operate both within and out of the classroom, and these influences can have both positive and negative effects.

Studies of classroom achievement effects have been consistent in finding positive results stemming from strong peer abilities. There is a wide range of variability between studies, however, regarding the impact on performance levels (Epple & Romano 2011). Regardless, even small effects could have significant impacts because they could induce stratification as parents seek to move their children into schools that offer the best chance of success (Benabou 1996). A segregated school system is likely to lead to minority or disadvantaged students not being exposed to these high-achieving peers.

The Australian Indigenous population is overrepresented in characteristics of dysfunctional home environments and poor educational achievement. Based on the research discussed above, this should suggest that greater numbers of Indigenous students would lead to stronger negative peer effects. However, the evidence suggests otherwise. Although there is a lack of research on peer effects and culture relating to Indigenous Australians, international studies suggest that peers from one's own ethnic group have a positive impact on a sense of identity and academic achievement. A strong Indigenous presence within schools can help to boost performance of Indigenous students, as measured by achievement gaps compared with non-Indigenous students (Friesen & Krauth 2010).

Finally, school segregation could affect both Indigenous and non-Indigenous children through decreased opportunities for cross-cultural understanding and interaction. Schools provide opportunities for children and young people to interact with students from different backgrounds, leading to increased understanding of diverse cultures (Robinson et al. 2001). One of the unintended consequences of school choice may be an even lower level of interaction at school than would otherwise be the case.

There is, of course, the possibility that school segregation has other potential benefits for the Indigenous population. First, Indigenous-controlled schools may

have a variety of benefits for Indigenous pupils in terms of the ability to teach in Indigenous languages and to incorporate Indigenous knowledge in the curriculum. Secondly, 'ethnic density' may lead to improved mental health outcomes, as a result of reduced stigma and discrimination, and increased social support (Pickett & Wilkinson 2008).

School sorting in Australia

Data and methods

Data for this analysis were provided by the Australian Curriculum, Assessment and Reporting Authority (ACARA), based on administrative data collections for NAPLAN. Information was available for the four year levels in which NAPLAN is undertaken: Years 3, 5, 7 and 9, with median ages for students of 8.6, 10.6, 12.6 and 14.5 years, respectively. In total, there were 61 648 Indigenous students in the data (5.34% of the sample) and 1 092 153 non-Indigenous students. These students were spread across 9477 schools. The average school had 121.7 in-scope students (with a maximum of 1048) and 6.5 Indigenous students (with a maximum of 249).

The simplest measure of sorting used in this paper is the commonly used dissimilarity index (DI), which measures how evenly the Indigenous population is spread across schools, or the degree of departure from a completely even distribution in which every school has the same proportion of Indigenous and non-Indigenous Australians as the national average (Massey & Denton 2008). The DI ranges from 0 to 1 and represents the proportion of Indigenous (or non-Indigenous) Australians who would hypothetically need to change schools to result in a perfectly even distribution.

For example, a value of 0 would imply that every school in the country has the same proportion of Indigenous students as the national average. A value of 1 would imply that schools have either 100% Indigenous students or 100% non-Indigenous students, with no interaction between the two populations.

Specifically, the DI is calculated as:

$$DI = \frac{1}{2} \sum_{i=1}^n \left| \frac{P_{1i}}{P_1} - \frac{P_{2i}}{P_2} \right|$$

where:

- n is the total number of schools in Australia
- P_{1i} is the number of Indigenous students in the i th school

- P_1 is the total number of Indigenous students in Australia
- P_{2i} is the number of non-Indigenous students in the i th school
- P_2 is the total number of non-Indigenous students in Australia.

In this paper, we calculate a DI for Australia as a whole (by year level) and for three broad geographic regions: metropolitan (roughly equivalent to major cities on the standard Accessibility/Remoteness Index of Australia classification), provincial (or regional) and remote. Because a single index can fail to give a good indication of the experiences of Indigenous students, school sorting is also measured using of threshold values, capturing to a large extent the concept of exposure from Massey and Denton 2008 – that is, the percentage of Indigenous or non-Indigenous students who attend schools where Indigenous students make up the following percentages of total enrolments:

- 0%
- more than 0% but less than 2.5%
- 2.5% to less than 5%
- 5% to less than 10%

- 10% to less than 25%
- 25% to less than 50%
- 50% or more.

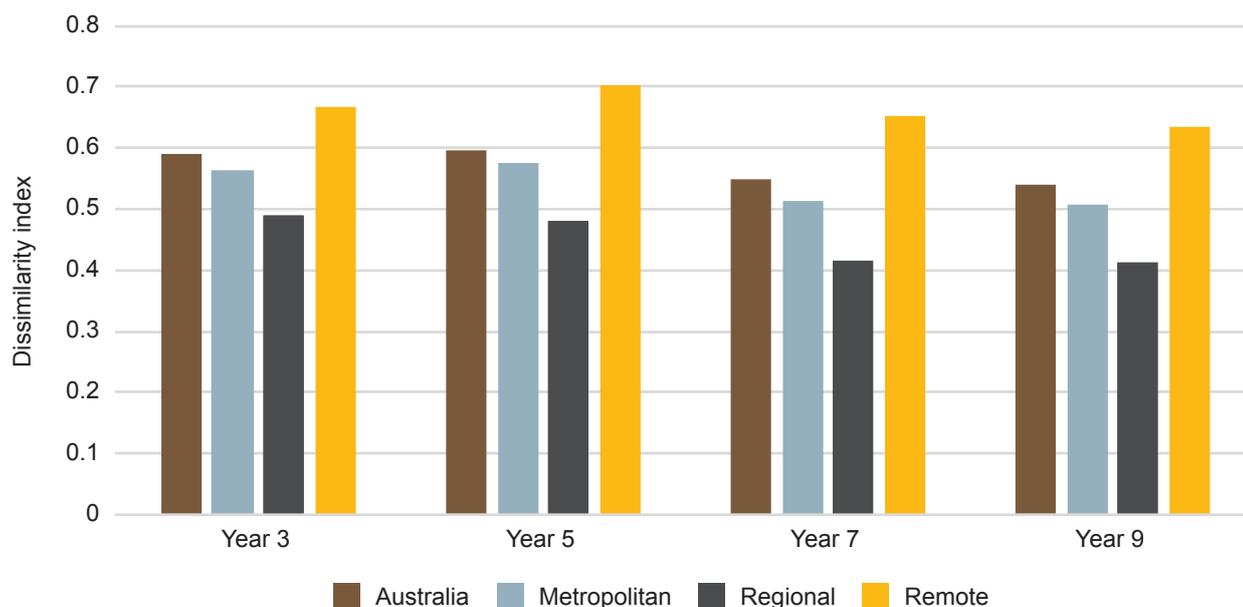
These percentages are calculated separately by year level, by broad geographical regions and by school sector (government and nongovernment – including independent and Catholic schools).

Results

Fig. 1 summarises the level of school segregation for Indigenous and non-Indigenous students in Australia. Results are presented by year level, and for Australia as a whole and by broad geographic region.

The results presented in Fig. 1 show quite high rates of school-level segregation, which are comparable to those for other ethnic groups in other countries. Depending on the year level, between 54% and 60% of Indigenous (or non-Indigenous) Australians would need to change schools to have a completely even distribution between the two populations. School segregation is slightly lower for high-school students (Years 7 and 9) than for primary-school students (Years 3 and 5). According to Rickles and Ong (2001) ‘DI scores above 60 are considered to

FIG. 1. Dissimilarity index for Australian schools, Indigenous and non-Indigenous students, 2015



Source: Customised calculations using NAPLAN data provided by the Australian Curriculum, Assessment and Reporting Authority

represent high segregation, while scores between 40 and 60 indicate moderate segregation and scores below 40 indicate low segregation’.

In comparison, Burgess et al. (2005) found that, in the United Kingdom (in 2001), the level of school segregation was 0.698 for South Asian students and 0.687 for black students (both relative to the white population). In the United States in 1998–99, average school sorting of African American primary-school students was 0.668, compared with 0.477 for Asian/Pacific Islander students and 0.590 for Hispanic students (Rickles & Ong 2001). Finally, the level of school segregation is roughly comparable with the level of residential segregation in the 2011 Census of Population and Housing, estimated by Biddle (2013) to be 0.53.

Another relevant comparison is with the level of school segregation for other groups within Australia. Unfortunately, the data being analysed do not provide any additional information on ethnicity beyond Indigenous status. It is possible, however, to calculate the level of school segregation for those from a language background other than English compared with the rest of the population. Results for this group range from 0.570 for Year 7 students to 0.585 for Year 3 students. This further confirms that sorting of Indigenous students across Australian schools appears to be in the moderate to high range.

One of the contributors to school sorting is the geographic distribution of the Indigenous population. Compared with the non-Indigenous population, Indigenous youth are more likely to live in regional and remote areas in general, and more likely specifically to live in regional and remote areas in the northern part of the country (Biddle 2012). However, the results in Fig. 1 show that, even within these broad geographic classifications, there is a very high rate of school segregation. Specifically, between 63% and 70% of Indigenous or non-Indigenous students in remote areas would need to change schools for there to be an even distribution between Indigenous and non-Indigenous students.

Where the two populations being considered make up roughly similar proportions of the population (e.g. black/non-Hispanic white students in many large United States cities), high levels of school segregation would tend to lead to schools with very few students from one group alongside schools with very few students from the other group. This is not the case, however, for Indigenous students in Australia, who make up only 5.34% of all students. With this distribution and level of school segregation, the more common situation is one in which

most Indigenous students attend schools where they make up a sizeable minority but less than half of the student population, but most non-Indigenous students attend schools with few, if any, Indigenous students.

This distribution is confirmed in Tables 1 and 2, which give the percentages of Indigenous and non-Indigenous students who attend schools with particular shares of the Indigenous population.

Beginning with the results for Australia as a whole, Table 1 shows that the most common experience for Indigenous students is to be attending a school where (in their year level) they make up a sizeable minority of the population. Roughly 3 out of 10 Indigenous students attend a school where they make up 10–25% of the student population, and a further 2 out of 10 students (approximately) attend schools where they make up 5–10%. For non-Indigenous students, on the other hand, the most common type of school is where there are no Indigenous students (around 4 out of 10 students in Years 3 and 5) or between 0 and 2.5% (around 3.5 out of 10 for students in Years 7 and 9). Combining these two types of categories, there are very low rates of exposure for non-Indigenous students across Australia.

These low rates of exposure are even more pronounced for non-Indigenous Australians living in major cities. Around two-thirds of non-Indigenous students in metropolitan areas attend a school where less than 2.5% of their year level is Indigenous.

At the other end of the distribution, a very large proportion of Indigenous students in remote areas attend schools where most their year level is Indigenous. This is true for more than three-quarters of Indigenous primary-school students in remote areas, and 73.3% and 69.8% of Year 7 and 9 students, respectively.

The main school choice in Australia is whether to attend a government or a nongovernment school. When the above distribution is calculated separately for nongovernment schools, the low rates of exposure of non-Indigenous students to Indigenous students are further exacerbated. Specifically, 59.6% and 61.5%, respectively, of Year 3 and Year 5 non-Indigenous students attending a nongovernment school have no Indigenous students in their year level.

TABLE 1. Percentage of Indigenous students by Indigenous share of school

Year level	Location	Indigenous share of school (%)						
		0	0–2.5	2.5–5	5–10	10–25	25–50	50 or more
3	Australia	0.0	5.2	10.3	17.9	29.8	15.4	21.5
5		0.0	5.3	9.4	17.9	30.6	15.4	21.4
7		0.0	8.0	10.7	19.6	30.9	15.2	15.7
9		0.0	8.1	11.7	22.3	28.9	15.5	13.5
3	Metropolitan	0.0	10.5	18.2	25.8	32.4	8.8	4.4
5		0.0	10.7	16.6	25.4	32.8	10.1	4.4
7		0.0	16.0	18.4	24.7	30.1	9.4	1.5
9		0.0	15.5	19.1	30.2	25.1	7.7	2.4
3	Provincial	0.0	1.9	6.4	17.1	38.0	23.1	13.5
5		0.0	1.9	6.0	18.1	40.9	21.9	11.1
7		0.0	2.6	6.7	22.3	42.5	20.1	5.9
9		0.0	3.1	8.1	21.8	41.4	21.5	4.1
3	Remote	0.0	0.0	0.3	1.8	7.5	14.4	75.9
5		0.0	0.1	0.5	1.6	6.1	14.2	77.4
7		0.0	0.0	0.4	0.8	6.8	18.5	73.4
9		0.0	0.0	0.1	1.4	6.6	22.0	69.8

Source: Customised calculations using NAPLAN data provided by the Australian Curriculum, Assessment and Reporting Authority

TABLE 2. Percentage of non-Indigenous students by Indigenous share of school

Year level	Location	Indigenous share of school (%)						
		0	0–2.5	2.5–5	5–10	10–25	25–50	50 or more
3	Australia	39.8	19.1	15.6	13.6	9.8	1.8	0.4
5		41.0	18.7	14.5	13.7	10.0	1.8	0.3
7		21.9	34.9	16.6	14.7	10.0	1.7	0.2
9		20.5	35.9	17.3	15.3	9.1	1.7	0.1
3	Metropolitan	44.0	22.2	15.7	11.2	6.1	0.6	0.1
5		45.8	21.8	14.4	11.0	6.2	0.7	0.1
7		25.5	41.1	16.3	10.8	5.8	0.6	0.0
9		24.1	41.7	16.5	12.2	4.8	0.5	0.0
3	Provincial	27.0	10.1	15.9	21.2	20.4	4.7	0.7
5		26.6	9.7	15.1	22.3	21.5	4.2	0.6
7		10.4	16.6	17.8	28.1	23.0	3.8	0.3
9		9.1	18.9	20.6	25.1	22.1	4.1	0.2
3	Remote	21.8	0.1	7.5	14.9	27.5	18.1	10.0
5		24.6	2.5	9.7	14.4	21.6	19.5	7.8
7		17.0	0.1	9.5	8.6	29.7	26.5	8.6
9		17.9	1.5	3.2	14.1	26.7	29.0	7.7

Source: Customised calculations using NAPLAN data provided by the Australian Curriculum, Assessment and Reporting Authority

Association between school and literacy and numeracy outcomes

The previous section showed a high rate of school segregation for Indigenous and non-Indigenous students. This means that Indigenous students are likely to attend schools where a disproportionate share of their year level is Indigenous, and non-Indigenous students (particularly in urban areas and in nongovernment schools) are likely to attend schools where few, if any, students are Indigenous.

This school-level segregation is important for exposure to students with a different background from themselves. However, school segregation takes on even greater importance if schools have a large predictive association with important student-level outcomes. This section documents the relationship between the school that the child attends and their literacy and numeracy outcomes.

Data and methods

Data

The analysis in this section again uses unit-record data from NAPLAN. Unlike in the previous section, however, in this section we use data from the literacy and numeracy tests completed by the students. Students in Years 3 and 5 participate in four tests, and those in Years 7 and 9 participate in an additional test. However, not every student participates in the test.² Participation rates for the tests are as follows:

- 91.9% – numeracy (noncalculator)
- 92.3% – reading
- 92.6% – language conventions
- 92.4% – writing
- 90.7% – numeracy (calculator allowed), Years 7 and 9 only.

Each student who participates in the relevant tests receives a score for five domains: reading, writing, spelling, grammar and numeracy, with higher values indicating higher levels of proficiency. In the standard school reporting, students are rated based on classifying these scores into six bands. In our analysis, however, we use the raw score as the basis of analysis.

To keep the analysis tractable, we create a further index value, combining the scores for the individual students across the five domains. To do so, we use principal components analysis (Bryman 2012), a technique that takes into account the correlation between different

variables to create a summary variable that captures the maximum amount of variation in the data. Principal components analysis is undertaken separately for each year level, with the resulting variable scaled to have a mean of 0 and a standard deviation of 1. Our analysis therefore focuses on each student's relative position on the within-year distribution. Any student who has a missing value for at least one of the underlying domains will also have a missing value for the overall index. Table 3 gives the average index value for Indigenous and non-Indigenous male and female students by year level.³

TABLE 3. Literacy and numeracy index values by Indigenous status, sex and year level, 2015

Year level	Indigenous		Non-Indigenous	
	Male	Female	Male	Female
3	-1.079	-0.839	-0.032	0.132
5	-1.102	-0.861	-0.021	0.121
7	-1.134	-0.830	-0.049	0.144
9	-1.067	-0.795	-0.076	0.155

Source: Customised calculations using NAPLAN data provided by the Australian Curriculum, Assessment and Reporting Authority

A particular focus of our analysis is on the change through time in relative literacy and numeracy outcomes. Students have a range of early childhood, family, community and schooling experiences by the time they undertake their first NAPLAN test. The average index values for students in a particular school are likely to be influenced by much more than the school itself, and differences across schools are more likely to reflect the types of students who have access to, or choose to attend, a particular school. It would be quite problematic, therefore, to ascribe differences across schools to the effectiveness of the schools themselves. It might be possible to control for some of these differences through a regression approach, but there are only limited data on file, and many other characteristics are not only unobserved but unobservable.

Taking the score in a base year as capturing all that previous experience, however, an individual school is likely to have a much greater impact on change in an individual student's relative position on the distribution between tests. For students who stay within the same school between Years 3 and 5, for example, the effectiveness of that school's instruction in the second part of Year 3, all of Year 4 and the first part of Year 5 will be captured in change through time in literacy and numeracy.

The association between a school and the change through time in the student's outcomes is still not definitively causal. Students may select schools based on what they (or, more accurately, their family) know about the capacity for growth within that school. Furthermore, there are unobservable characteristics that may change between the two tests that affect literacy and numeracy. Finally, there may be random or systematic errors in the measurement of literacy and numeracy that induce changes in test scores that are not indicative of underlying literacy and numeracy.

Methods: identifying school-level effects

Despite these caveats, change through time in the relative distribution of students is a very robust and informative measure of the potential effects of schools on literacy and numeracy. Because we are only able to observe the school that the student attended at the end of a two-year period and we do not have information on the school that the student attended during their previous test, we undertake separate analyses for those students who did not change schools between Year 3 and Year 5 (using Year 5 school characteristics), and those who did not change schools between Year 7 and Year 9 (using Year 9 characteristics). To analyse this change, we begin by estimating two sets of models:

Model 1:

$$\Delta y_{i,j}^{l,l-2} = \alpha_{0,l} + \alpha_{1,l} \text{Ind}_{i,j} + \alpha_{2,l} \text{Age}_{i,j} + \alpha_{3,l} \text{Sex}_{i,j} + \alpha_{4,l} y_{i,j}^{l-2} + \mu_{i,j}$$

Model 2:

$$\Delta y_{i,j}^{l,l-2} = \beta_{0,l} + \beta_{1,l} \text{Ind}_{i,j} + \beta_{2,l} \text{Age}_{i,j} + \beta_{3,l} \text{Sex}_{i,j} + \beta_{4,l} y_{i,j}^{l-2} + \epsilon_j + \delta_{i,j}$$

Model 1 is an individual-level model of change through time in relative literacy and numeracy outcomes, with an individual-level error term. Model 2, on the other hand, is a school-level fixed effects model of change through time, with both an individual-level and a school-level error term. More specifically:

- $\Delta y_{i,j}^{l,l-2}$ is the change through time, between year levels $l-2$ and l in the literacy and numeracy index for a student i in school j
- $\alpha_{0,l}$ and $\beta_{0,l}$ are constant terms for year level l that measure the change through time when all other observed characteristics are set to 0
- $\alpha_{1,l}$ and $\beta_{1,l}$ are the predicted differences for year level l between an Indigenous and non-Indigenous student in change through time, while holding constant other observable differences

- $\alpha_{2,l}, \beta_{2,l}, \alpha_{3,l}$ and $\beta_{3,l}$ are the predicted associations between student age and student sex (respectively) for year level l
- $\alpha_{4,l}$ and $\beta_{4,l}$ are the predicted effects of previous test scores ($y_{i,j}^{l-2}$) on change through time between the two year levels. This captures the process of regression or reversion to the mean. Specifically, if there is a random component to test scores in the previous year level, students with relatively high or low test scores in one year are biased towards decreasing or increasing scores in a subsequent year, and hence the coefficients will be negative⁴
- $\mu_{i,j}, \epsilon_j$, and $\delta_{i,j}$ are a set of error terms that capture all other characteristics that affect change through time in measured literacy and numeracy. These error terms all have a mean of 0, indicating that there are some individuals and schools that have higher test scores than their other observable characteristics would predict, as well as other individuals and schools that have lower test scores than would be predicted. Across the sample, however, they cancel each other out.

The key differences between model 1 and model 2 are in error terms. For model 1, $\mu_{i,j}$ captures individual-level variation only. The coefficient on Indigenous status ($\alpha_{1,l}$) captures the relationship between Indigenous status and change in test scores while holding constant the student's age, sex and test scores the previous time the student undertook NAPLAN.

In model 2, in contrast, there are two error terms. The first (ϵ_j) is the school-level fixed effect – that is, the difference in the average change in test scores for students in school j after controlling for observable characteristics of their students (Indigenous status, age, sex and previous test scores). A positive value indicates that students in that school, on average, improve at a faster rate than would be expected, whereas a negative value indicates that students improve at a slower rate. The final error term ($\delta_{i,j}$) therefore captures any additional unobserved characteristics of the student, above and beyond the characteristics of the school that they attend.

Ultimately, we are interested in two characteristics of the models. The first is $\alpha_{1,l}$, the observed effect of Indigenous status on change through time in outcomes. Keeping in mind that the model controls for the student's age, sex and previous test scores (which captures the student's experience up to then), this variable gives an indication of whether, on average, Indigenous students are catching up to non-Indigenous students between NAPLAN exams ($\alpha_{1,l} > 0$), falling behind non-Indigenous students ($\alpha_{1,l} < 0$), or staying at the same point on the

distribution ($\alpha_{1,l} = 0$). The second characteristic we are interested in is the difference between $\alpha_{1,l}$ and $\beta_{1,l}$. If there are no differences in these variables, the schools that Indigenous Australians attend can be taken to be relatively unimportant with regard to explaining differential growth rates. If the coefficient is smaller in model 2 than in model 1, however, this can be taken as an indication of the importance of school-level factors.

Methods: explaining-school level effects

The analyses for models 1 and 2 essentially show whether schools are important in explaining differences in literacy and numeracy growth between Indigenous and non-Indigenous students. They do not, however, give any indication of the source of the effect of schools on Indigenous (or non-Indigenous) growth. We model this explicitly in models 3 and 4, as follows:

Model 3:

$$(\Delta y_{i,j}^{l,t-2} | nd_{i,j} = 1) = \gamma_{0,l,I} + \gamma_{2,l,I} Age_{i,j} + \gamma_{3,l,I} Sex_{i,j} + \gamma_{4,l,I} y_{i,j}^{l,t-2} + \gamma_{5,l,I} Scl_j + \eta_{i,j}$$

Model 4:

$$(\Delta y_{i,j}^{l,t-2} | nd_{i,j} = 0) = \gamma_{0,l,N} + \gamma_{2,l,N} Age_{i,j} + \gamma_{3,l,N} Sex_{i,j} + \gamma_{4,l,N} y_{i,j}^{l,t-2} + \gamma_{5,l,N} Scl_j + \eta_{i,j}$$

The first four coefficients in models 3 and 4, as well as the error term ($\eta_{i,j}$), can be interpreted in the same way as the corresponding coefficients in model 1. The only difference is that the models are estimated separately for Indigenous students (model 3) and non-Indigenous students (model 4). The final terms ($\gamma_{5,l,I}$ and $\gamma_{5,l,N}$) are a set of coefficients capturing characteristics that are constant for the particular school, j . The characteristics that are controlled for are:

- geography – schools in provincial and remote areas are compared separately from schools in metropolitan areas
- state or territory – schools in the other seven states and territories are compared separately from schools in New South Wales
- sector – schools in the nongovernment sector (independent and Catholic combined) are compared with government schools
- proportion of year level in that school that identifies as Indigenous
- proportion of year level from a language background other than English
- proportion of year level with at least one parent who has completed Year 12

- proportion of year level with at least one parent employed as a manager (specifically, in ‘Senior management’ or ‘Other business manager,’ the two occupation categories with children with above-average test scores)
- proportion of year level with both parents not in paid work.

Results

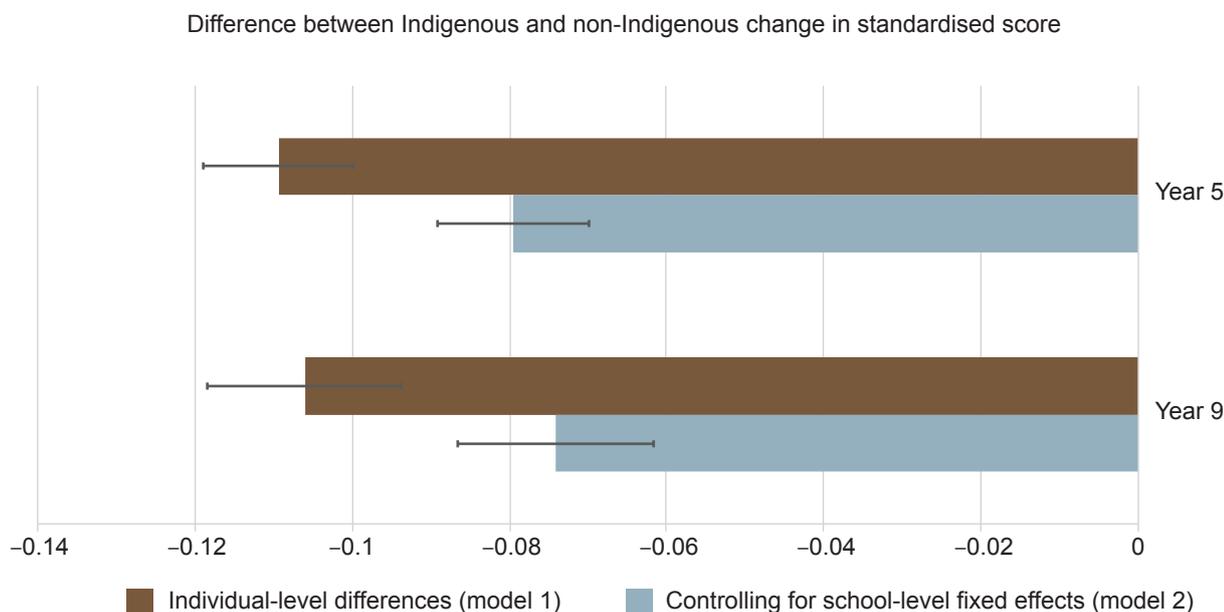
We begin our presentation of results of the association between school and literacy/numeracy outcomes in Fig. 2. Based on models 1 and 2, outlined above, Fig. 2 gives coefficient estimates for the relationship between Indigenous status and index values. The error bars around the estimates represent the 95% confidence interval on the coefficient estimates. If the error bars do not overlap, we can conclude that controlling for school-level fixed effects influences the relationship between Indigenous status and literacy/numeracy.

The darker bar (from model 1) shows that, after controlling for age, sex and previous year test scores, Indigenous students fall further behind on the test score distribution between Year 3 and Year 5, and between Year 7 and Year 9. Keeping in mind that the index value is scaled to have a standard deviation of 1, this decline is both statistically and qualitatively significant.

The lighter bar (from model 2) shows that there are still differences between Indigenous and non-Indigenous students once school-level characteristics are controlled for.⁵ In other words, an Indigenous student who attends the same school as a non-Indigenous student with the same age, the same sex and the same test score the last time NAPLAN was undertaken is still predicted to fall further behind between Year 3 and Year 5, and between Year 7 and Year 9. Importantly, the Indigenous coefficient declines by 27.2% or 30.1%, respectively, showing that school characteristics definitely matter for literacy and numeracy growth. However, even for a given school, substantial individual differences remain.

Figs. 3 and 4 focus on aspects of schools (and individuals, to a lesser extent) that are associated with that change through time. Fig. 3 gives results for the factors associated with Year 3 to Year 5 change, and Fig. 4 gives results for the factors associated with Year 7 to Year 9 change.

FIG. 2. Relationship between Indigenous status and change in literacy/numeracy with and without school-level fixed effects, 2015



Source: Customised calculations using NAPLAN data provided by the Australian Curriculum, Assessment and Reporting Authority

The coefficients for the binary variables should be interpreted as the difference in the predicted change for an individual or school with that characteristic compared with the base-case category (described above). The coefficients for the continuous variables are from a one standard deviation change in previous test scores or from a one unit change in the proportion of students or parents of students with that characteristic. The error bars represent the 95% confidence intervals. Bars that do not cross 0 indicate a statistically significant association between that characteristic and the change in test scores.

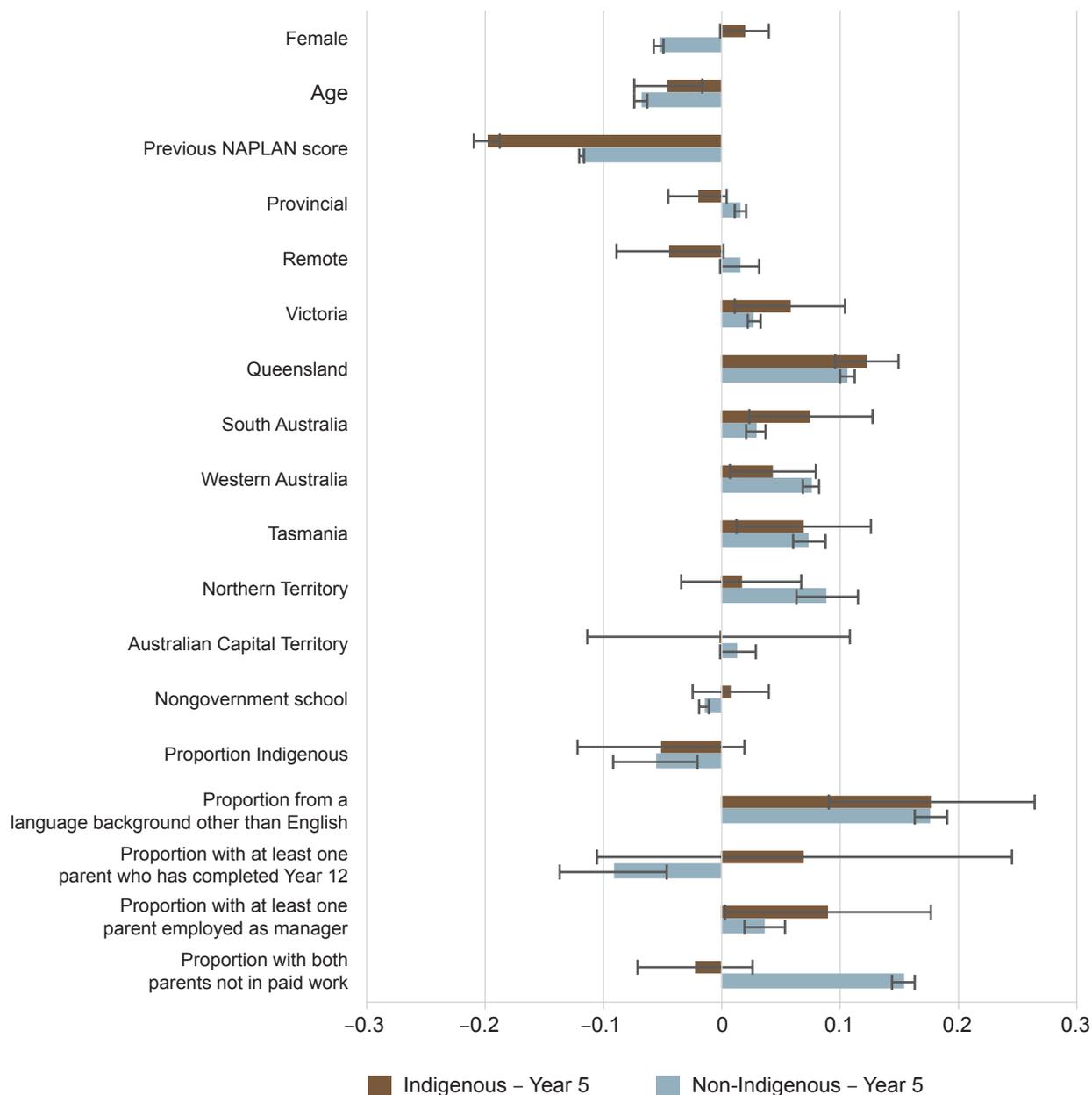
Figs. 3 and 4 contain several interesting and policy-relevant results:

- Sex – Across both sets of year levels, Indigenous females experience a more rapid growth in the combined literacy and numeracy index than males. Given that Indigenous females have better outcomes in the base year than Indigenous males (Years 3 and 7, respectively), this represents a worsening by gender through time (i.e. males falling further behind females). For the non-Indigenous population, on the other hand, there is a catch-up between males and females between Years 3 and 5, but a worsening between Years 7 and 9.
- Age – In general, the older a student is, the more likely their relative literacy/numeracy position is to decrease between Years 3 and 5 and between Years 7 and 9 (for non-Indigenous students only). This shows that,

whatever advantage school starting age confers at commencement (and there is mixed evidence – Dhuey et al. 2017), this would appear to relate to levels, rather than change in relative distribution.

- Location – There is no difference in growth for Indigenous students attending a school in a provincial area compared with those in a metropolitan area, nor between those in a remote area and a metropolitan area (at the 5% level of significance). This is a very important finding, because there is considerable focus at the national level on remote education. However, these results show that, once baseline characteristics are taken into account, as well as other characteristics associated with the school, the growth in literacy/numeracy scores for Indigenous students in remote and provincial schools is similar to those in other schools.
- State or territory – In a number of jurisdictions, students appear to be improving at a faster rate than in New South Wales (the base case). Between Years 3 and 5 (and controlling for other characteristics), students’ academic achievements in Queensland, South Australia, Tasmania and Victoria (in that order) appear to be growing at a faster rate than in New South Wales. Between Years 7 and 9, students in South Australia, Western Australia and Tasmania have higher growth rates in academic achievement than in New South Wales, and students in the Northern Territory have significantly slower growth rates than

FIG. 3. Relationship between school and individual-level characteristics and change in literacy/numeracy, by Indigenous status, Year 3 to Year 5 change, 2015



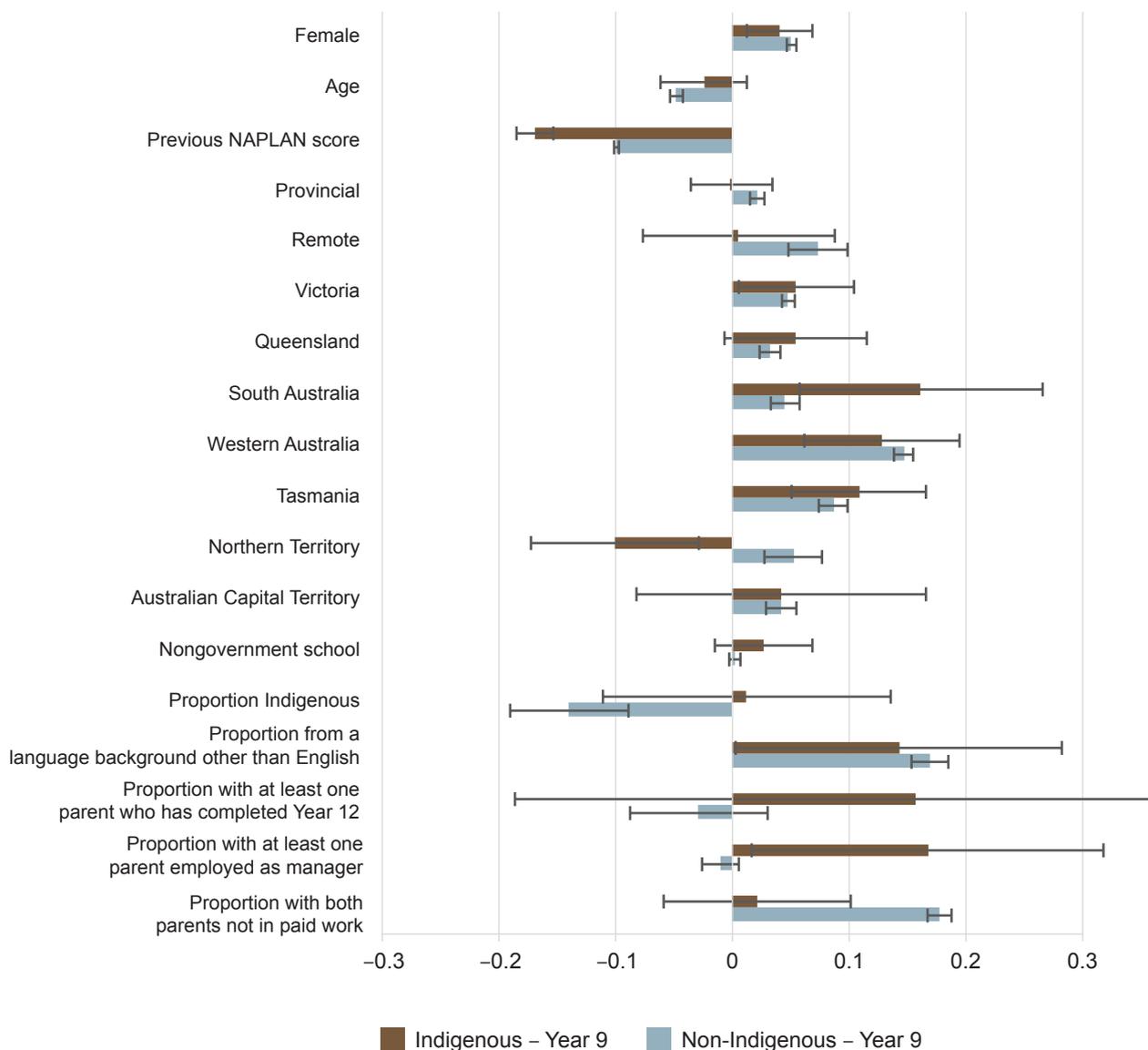
Note: The omitted category for the model is a female living in a major city in New South Wales who attends a government school.
Source: Customised calculations using NAPLAN data provided by the Australian Curriculum, Assessment and Reporting Authority

in the other states. Given that we are controlling for remoteness and a range of other characteristics (including baseline test scores), this is prima facie evidence that the school system matters, and, in particular, that the Australian Capital Territory, the Northern Territory and New South Wales are doing relatively poorly for the Indigenous population.

- School sector – There is essentially no difference by school sector in growth rates between Years 3

and 5 and between Years 7 and 9 for the Indigenous population, and a small, negative association for the Year 3 to Year 5 growth for the non-Indigenous population. When public and private funding is combined, students in nongovernment schools have a much greater level of resources devoted to them, and, when other characteristics are not controlled for (particularly baseline test scores), it appears that students in nongovernment schools do better than those in government schools (Gonski et al.

FIG. 4. Relationship between school and individual-level characteristics and change in literacy/numeracy, by Indigenous status, Year 7 to Year 9 change, 2015



Note: The omitted category for the model is a female living in a major city in New South Wales who attends a government school.
Source: Customised calculations using NAPLAN data provided by the Australian Curriculum, Assessment and Reporting Authority

2012). However, the more detailed analysis with longitudinal NAPLAN data strongly implies that these differences are due to baseline characteristics of students or the characteristics of other students in the school. Encouraging or financially supporting Indigenous (or non-Indigenous) students to attend nongovernment schools would not appear to be supported by the longitudinal NAPLAN data.

- Proportion of student population Indigenous – There is no association for the Indigenous population between the proportion of the student’s year level who are Indigenous and that student’s own growth rate in

literacy and numeracy. There is, however, a negative association with the growth for non-Indigenous students, particularly between Years 7 and 9. This is a difficult variable to interpret, and we should not automatically assume that having Indigenous peers within one’s school directly hinders the literacy and numeracy outcomes of non-Indigenous students. Nonetheless, the results suggest that a special type of school selectivity is at play: non-Indigenous students who attend schools with a greater proportion of Indigenous students do not learn at the same rate as non-Indigenous peers with few Indigenous students.

- Other characteristics of the student population – The characteristic of the student population that is most strongly associated with Indigenous growth is the occupation of parents. Indigenous students who attend schools where a high proportion of their peers have a parent employed as a manager improve fastest over both sets of NAPLAN exams.
- Previous NAPLAN score – This has a negative association with change through time in relative literacy and numeracy, a finding that was expected based on normal patterns of reversion to the mean. That is, if students have a relatively high or low value in Years 3 or 7, their relative position is likely to go down or up, respectively, over the subsequent two years. What is interesting though, is that this appears to be a more influential factor for Indigenous students, suggesting that there may be greater uncertainty or random variation in the literacy/numeracy of Indigenous students than for non-Indigenous students.

Concluding comments and ongoing research

The results presented in this paper show three main things: the Indigenous population is not evenly distributed across schools; characteristics of schools matter in explaining change through time in Indigenous outcomes; and the distribution of Indigenous students across different schools explains some, but not all, of the difference between Indigenous and non-Indigenous students in literacy and numeracy.

Reflecting on this last point, results in Table 3 show that, by Year 3, Indigenous males and females are roughly one standard deviation behind their non-Indigenous peers. Furthermore, results presented in Fig. 2 show that a little over two-thirds of the (conditional) difference in growth rates between Indigenous and non-Indigenous students is explained by factors other than the school that they attend. Schools matter, but clearly so does early childhood education, family and community functioning, and broader policy settings.

The results point to some aspects of schools that could be used to support growth in Indigenous literacy and numeracy. There is evidence that some jurisdictions appear to be doing better than others, with this information potentially supporting those jurisdictions that are not doing as well (in particular, New South Wales, the Australian Capital Territory and the Northern

Territory). This assumes, of course, that the variables included in the analysis capture the main determinants of growth above and beyond the jurisdictional policy differences. While this is a difficult assumption to test, the fact that we are using growth in child outcomes rather than cross-sectional differences and that we exclude those who change school systems means that we are at least controlling for baseline (Year 3 or Year 7) outcomes. Nonetheless, further research is required before concluding definitively that school policy is the cause of these differences.

Making sure that Indigenous students are exposed to students and families from a diverse set of backgrounds is one potential area to trial. Other characteristics appear to matter less than our current policy framework might suggest, including remoteness and school sector. Providing parents with more choice in where children attend schools is unlikely to address the gap between Indigenous and non-Indigenous children's literacy, given that the existing research on school choice suggests that a very small percentage of parents actually move their children from one school to another within a given geographic area (Mussett 2012). Putting this another way, the geographic distribution of school students appears to be a large driver of the school distribution, and therefore policies that support access to housing markets in areas where people may not otherwise have access to housing should be considered (and evaluated robustly).

Much additional work is required to understand the characteristics of the schools that Indigenous students attend that support growth and success. Using subjective data (e.g. through the Programme for International Student Assessment [PISA] or through qualitative data collection) is likely to draw out other characteristics of schools that differ between Indigenous and non-Indigenous students.

Perhaps more importantly, using a slightly less de-identified dataset with a broader set of school characteristics and more detailed geography would allow a richer set of factors to be analysed. In particular, the dataset available for this analysis does not include school funding or any other characteristics of schools above and beyond aggregations of individual values. Given the considerable political and research interest in school funding models, analysis of such factors is important to extend our understanding of school characteristics and Indigenous children, and the current quite onerous restrictions on access to government data should be seriously questioned.

Ultimately, however, the results presented in this paper show that schools and school systems matter for Indigenous growth and success in literacy and numeracy, but they do not explain all the difference. An Indigenous student who attends the same school as a non-Indigenous student and has the same baseline index value is still predicted to fall further behind the non-Indigenous student in literacy and numeracy over a two-year period. It is hoped that these findings can support a more nuanced policy debate around the schools that Indigenous students attend.

Notes

1. There is considerable overlap between the terms 'race' and 'ethnicity' (Bonilla-Silva 2017). In the United States context, where much of the research on school segregation has taken place, the concept that tends to be used is race; the census, American Community and other survey data, and administrative data ask explicitly about a person's race, and include further questions on whether the individual identifies as being Hispanic. In Australia, on the other hand, most data collection focuses on self-identification and, in the context of this paper, whether an individual identifies as being Aboriginal and/or Torres Strait Islander. Where race is used as a concept in the literature, we follow the terminology used in the original report. For our analysis, however, we make it clear that we are referring to an individual's self-identification, or the way in which they were identified by their parent or guardian.
2. Students are recorded as not participating for the following reasons: absent, exempt, sanctioned abandonment, and withdrawn.
3. We also replicate the analysis using the individual, unscaled scores on the five domains. We note where the results for the different domains vary; however, there are no differences in substantive conclusions from the analysis when using the individual domains.
4. To consider why this might be the case, it is instructive to think of both the highest-ranking and lowest-ranking students in Years 3 or 7. It is impossible for the highest-ranking student to increase their relative position between Years 3 and 5 or for the lowest-ranking students to decrease their relative position. They could stay at the same point on the distribution, but they cannot go beyond these extremes. More broadly, those at the top or the bottom have more scope to go down or up the distribution, respectively.
5. When looking at individual-domain test scores, these main findings still hold. However, the magnitudes vary somewhat. The largest (conditional) gap in growth between Indigenous and non-Indigenous students is in the writing domain, and the smallest gap is in the spelling domain. Controlling for school-level fixed effects reduces the gap by between 23.2% (for Year 3 to Year 5 reading) and 36.4% (for Year 7 to Year 9 reading).

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