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Explaining the achievement gap between Indigenous and non-Indigenous students: an analysis of PISA 2009 results for Australia and New Zealand

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This study investigates the relative roles of home and school variables in accounting for achievement gaps between Indigenous and non-Indigenous students in Australia and New Zealand. Using data from the Programme for International Student Assessment [PISA] 2009, our findings show that achievement gaps between Indigenous and non-Indigenous students are associated with both home and school resources, not only in terms of unequal allocations but also in relation to differences in the rates at which home and school affordances are converted into positive educational outcomes. In both countries, home resources accounted for more of the achievement gap than differences in schooling resources. However, the achievement gap between Indigenous and non-Indigenous students is substantially larger in Australia than in New Zealand, apparently related to greater inequity in the allocation of school resources. We suggest that education policymakers in Australia ensure a more equitable allocation of school resources between Indigenous students and their non-Indigenous peers.

\textbf{Keywords:} academic performance; PISA; Indigenous students

\section*{Introduction}

In many countries, students from some ethnic minority groups have consistently lower educational outcomes than their peers from ethnic majority groups. For example, in Europe, Turkish students (Simon, 2003; Song, 2011; Van Ewijk, 2011; Worbs, 2003) and Roma students (Gimenez Adelantado, 2003; Open Society Institute, 2007) and in the US, Latino and African American students (Darling-Hammond, 2010; Fleischman, Hopstock, Pelezar, & Shelley, 2010; Losen & Orfield, 2002; National Center for Education Statistics, 2002) have consistently lower educational outcomes than their peers from dominant ethnic groups. While it is normal and natural that educational outcomes vary between individuals, stable and substantial differences in educational outcomes between groups of individuals are a cause for concern. Such differences suggest that social and educational forces, policies, and structures are systematically privileging some groups over others. Examining how schools and education systems can be reformed for the purpose of reducing achievement gaps between groups of students has therefore received considerable attention in the education research literature. International case studies can illuminate how context, cultural

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dynamics, and educational systems may be related to achievement gaps between ethnic minority students and their majority peers. This understanding can then lead to concrete recommendations about ways to reduce achievement gaps.

Additionally, our motivation for this study is the severe poverty that many Indigenous people in both New Zealand and Australia continue to experience. On all major social indicators, Indigenous people in both countries continue to be at substantial disadvantage compared to their non-Indigenous peers. In Australia, for example, the life expectancy rate is up to 20 years less for Indigenous people than for non-Indigenous people (Oxfam, 2013). Indigenous people are also 3 times more likely to be unemployed than non-Indigenous people and 3 times more likely to die of accident, violence, or self-harm (Australian Bureau of Statistics, 2009). Large inequalities in health and wellbeing between Indigenous and non-Indigenous people also exist in New Zealand (Ministry of Social Development, 2010). Education is strongly related to social development, poverty alleviation, and health and wellbeing (McMahon, 2002; Reimers, 2003). It is also a major tool for the empowerment of disenfranchised people (Freire, 2002). Finding ways to improve the educational experiences and outcomes of Indigenous students in both countries is therefore a policy priority, and comparing the experiences of two similar countries, as in this paper, can provide insight about ways to reduce educational inequity. To our knowledge, limited research has attempted to compare the educational opportunities and outcomes of Indigenous populations in New Zealand and Australia, with some recent exceptions (e.g., Woods-McConney, Oliver, McConney, Maor, & Schibeci, 2013).

This study examines long-standing gaps in educational achievement between Indigenous and non-Indigenous students in Australia and New Zealand. It builds on a previous study by Song (2011), which examined substantial disparities in educational outcomes between Turkish and native students in Austria, Germany, and Switzerland. Turkish students show the lowest academic performance of any ethnic minority group in these countries. In Australia and New Zealand, the ethnic minority group that has the lowest academic performance is Indigenous and Māori students, respectively. Like Song’s study, this paper examines school and student factors that could contribute to our understanding of academic performance gaps between ethnic minority groups and their peers from the larger society. By comparing the achievement of Indigenous students in two similar countries, our purpose is to better understand how educational systems could be made more equitable for the purpose of reducing academic performance gaps between groups of students.

The present study comparatively examines relationships among student home backgrounds, school characteristics, and academic achievement to determine the extent to which these variables are associated with gaps in educational outcomes between Indigenous and non-Indigenous students in Australia and New Zealand. Specifically, using the Oaxaca-Blinder decomposition, a variant of statistical methodology most often applied in labour economics (Blinder, 1973; Oaxaca, 1973), the study assesses the extent to which differences in resources, both at home and school, contribute to explaining the achievement gap observed between these groups. Furthermore, the present study examines differences in rates of return for the allocation of these resources. In other words, in explaining the achievement gap between Indigenous students and non-Indigenous students, the present investigation asks the following research questions:

1. How different are Indigenous and non-Indigenous students in Australia and New Zealand in terms of student resources (e.g., parental education, number of books
at home) and school resources (e.g., supply of instructional materials, quality of the teaching staff)?

(2) To what extent are differences in student and school resources associated with differences (gaps) in educational outcomes between Indigenous and non-Indigenous students in Australia and New Zealand?

(3) Further, and directly related to our use of the Oaxaca-Blinder decomposition, are differences in rates of return evident for student and school resources between Indigenous and non-Indigenous students in Australia and New Zealand?

The undergirding rationale and intended practical significance of our choice of the Oaxaca-Blinder decomposition method for analysing the data for this study is that educational researchers and policymakers must be aware of not only unequal allocations of resources among groups but also differences in the extent and/or efficiency with which resources may be utilized. Importantly, this allows researchers and policymakers insight into what resources are likely to work in redressing a social issue as well as providing a measure of how well or poorly any particular resource may be utilized. Put another way, the simple provision of a resource, while important, does not in itself necessarily mean that the resource is being utilized efficiently, or to its full potential. Theoretically, the underutilization of a particular resource could be due to a variety of factors, including a lack of awareness that it is available, a lack of understanding of how it could potentially be used, or an inability to take advantage of the resource because of poor access. For example, even if after-school tutorial services are provided, we need to ask if students and parents are aware of the programme, and if appropriate transportation is available for students if parents are not able to provide it, as may be the case for many working-class families. Of course, we also readily acknowledge that the Oaxaca-Blinder decomposition method cannot tell us why or how the resources are unequally allocated or unevenly utilized. Rather, the Oaxaca-Blinder decomposition can show us that there is evidence of the existence of such differences, and the strength of their associations with the policy issue being targeted (in this case, group differences in educational achievement). Such divides must be first seen before they can be investigated and perhaps remediated.

The article is structured in five parts. First, we provide an overview of the recent academic performance of Indigenous students in Australia and New Zealand, as measured in large-scale assessments, and briefly describe the educational contexts of the two countries. Second, we describe the dataset used in the current study (Programme for International Student Assessment [PISA], 2009) and overview the analytic method used. Third, we describe the main findings of this secondary analysis. Last, we discuss the major findings of the analysis and offer several conclusions for consideration.

Performance of Indigenous students in Australia and New Zealand

Australia and New Zealand were purposefully chosen for this study. Despite obvious, dramatic differences in their physical geographies, Australia and New Zealand are nevertheless co-located in the same region of the world (on either side of the Tasman Sea) and share strong commonalities in sociocultural histories and traditions (e.g., both are long-standing parliamentary democracies, with shared histories of British colonial rule and are current members of the Commonwealth), in the proportions of their populations (about 20%) who are recent migrants, in systems of state-supported comprehensive secondary schooling, and in perennially high performance on comparative international assessments like PISA.
Typically, students in New Zealand and Australia have been among the top performers on international assessments. For example, and directly relevant to this secondary analysis, if the PISA results of the 15 top-performing countries are compared across time, there are only 5 countries that have performed above the Organisation for Economic Co-operation and Development (OECD) average in all tests since the assessment began in 2000. These are Finland, South Korea, Canada, New Zealand, and Australia. In the most recent publicly-released PISA study (2009), the top overall performing countries/regions are as follows: Shanghai (ranked 1st in all categories in its first participation in 2009), Finland, South Korea, Hong Kong, Singapore, Canada, New Zealand, Australia, The Netherlands, and Estonia (Knighton, Brochu, & Gluszynski, 2010; OECD, 2010).

Although Australia and New Zealand as a whole have performed consistently well, there continues to be substantial gaps in educational attainment and in other life outcomes (e.g., health, life expectancy, employment) between Indigenous and non-Indigenous peoples, with advantages often going to the latter (Australian Bureau of Statistics, 2012; Sullivan, Perry, & McConney, 2013; Woods-McConney et al., 2013). Thus, some may argue that in Australia and New Zealand, the overall high achievement has masked, to some extent, issues around equity in educational achievement for some groups. In both countries, for example, there are longstanding and substantial disparities in achievement between ethnic groups. For New Zealand, PISA scores of Māori and Paciﬁka students are much lower than the average for Pākehā/European students; and although the gap has narrowed slightly for Māori, the gap is not closing nearly fast enough for Indigenous students to catch up to their Pākehā/European peers (Telford, 2010). Specifically, students identifying as Pākehā/European (71% of all students) achieved an average reading score of 541 score points in reading literacy on PISA 2009. In contrast, students identifying as Māori (19%) and Paciﬁka (10%) scored 478 score points and 448 score points, respectively, considerably below the OECD mean (Telford, 2010).

For Australian Indigenous students, the picture may be even bleaker. As noted by Thompson and colleagues at the Australian Council for Educational Research (ACER) in their analysis of PISA 2009 results, on average, Indigenous students lagged behind their non-Indigenous peers by 82 points in reading literacy. This gap equates to more than one PISA proficiency level or more than 2 years of schooling. Australian Indigenous students also performed significantly lower (57 score points) than the OECD average (Thompson, De Bortoli, Nicholas, Hillman, & Buckley, 2010). On the positive side, Indigenous Australians’ participation in early childhood and primary schooling has improved: Retention rates in the final year of high school (Year 12) have notably increased, and participation rates of 15- to 24-year-old Indigenous students in vocational training approximately equate those of the total population (McRae et al., 2000). On average, however, substantial difficulties remain for Indigenous Australians, who in comparison to their non-Indigenous peers are less likely to attend preschool, have less access to secondary school in the communities where they live, have 2 to 3 times the rate of absenteeism of other students, leave school much younger than non-Indigenous students, and are less than half as likely to complete high school (McRae et al., 2000).

In summary, Australia and New Zealand have been perennially high-performing countries in international assessments of educational achievement, including PISA. In both countries, however, significant challenges remain around equity of access and outcomes for Indigenous students.

**Education context of Australia and New Zealand**

Education systems of Australia and New Zealand share many similarities. Both systems offer comprehensive secondary education rather than the differentiated system of secondary
education common in Europe. New Zealand and Australia have similar years of compulsory education, share educational philosophies based on progressivism and constructivism. In New Zealand, because of its smaller size, education is the responsibility of the national government, whereas in Australia, education remains the purview of state governments. This means that in Australia, some education policies vary slightly by state. Nevertheless, the Australian federal government plays a large role in education. For example, Australia has a national curriculum (as does New Zealand), national standardized testing, and national reporting of school performance indicators. The federal government also provides funding to private schools and, to a lesser extent, public schools as well.

School choice is supported in both education systems. Within the public (government) sector, students may apply for admission to the public school of their choice, subject to the availability of places. Schools that receive more enrolment requests than places must give priority to students who reside within the school’s enrolment area (Australia) or home zone (New Zealand). These “over-enrolled” schools are typically in wealthy communities in large cities. Secondary schools may also select out-of-area students based on their academic performance or demonstrated talent in the arts or sport.

School choice is also promoted in both countries by the public funding of non-government (private) schools, including faith-based schools. The funding mechanisms of non-government schools vary between the two systems. In New Zealand, non-government schools may become “state-integrated” schools; in which case, they receive full public funding for their operating costs but cannot charge tuition fees. These are typically Catholic schools. Non-government schools may also remain “independent”, in which case they receive much less public funding but are able to (and do) charge tuition. Independent schools receive a per-pupil public subsidy based on the year level of the student, ranging from approximately $1,000 New Zealand dollars (USD $820) for primary school students to $2,200 (USD $1,803) for upper secondary students (New Zealand Ministry of Education, 2012a). In Australia, “state-integrated” schools do not exist. All private schools receive federal public subsidies, and all private schools charge tuition. Tuition can range from $7,000 Australian dollars (USD $6,345) at a Catholic school to $25,000 (USD $22,662) or more at a Protestant or non-denominational private school. To set these figures in context, the annual median household income in New Zealand is $67,808 (USD $55,572) and $74,984 (USD $67,972) (Australian Bureau of Statistics, 2013; Statistics New Zealand, 2013).

Accompanying these differences in the public funding of non-government schools are differences in enrolment patterns across school sectors. In New Zealand, approximately 4% of students attend a private school, 11% attend a state-integrated school, and 85% attend a public school (New Zealand Ministry of Education, 2012b). In Australia, approximately 67% of students attend a public school, and this number drops to 62% for students in high school (Australian Bureau of Statistics, 2006). These enrolment figures show that the proportion of high school students attending schools that charge tuition varies dramatically between the two countries: less than 4% in New Zealand versus 38% in Australia.

Method

Data

PISA is an internationally standardized assessment administered every 3 years to 15-year-olds in schools. The survey was implemented in 43 countries in the first assessment round in 2000, 41 countries in 2003, and 57 countries in 2006. For the 2009 assessment, 65 countries and economies are represented. Tests are typically administered to between 4,500 and 10,000 students in
each country. Schools in each country are randomly selected by the international contractor for participation in PISA. At these schools, the test is given to students who are between age 15 years 3 months and age 16 years 2 months at the time of the test, rather than to students in a specific year of school. An average age of 15 was chosen because at this age young people in most OECD countries are nearing the end of compulsory education.

As a large-scale international assessment, PISA assesses students in three subjects – reading, mathematics, and science. Within each subject, the main focus is not to assess how well students have mastered a specific curriculum, but to assess their ability to apply the knowledge and skills learned at school to solve real-life problems (OECD, 2001). The scores are standardized to an international mean of 500 with a standard deviation of 100. The datasets used in this investigation of PISA 2009 comprise the following: 1,143 Indigenous and 13,108 non-Indigenous students for Australia; and 833 Indigenous (Māori) and 3,768 non-Indigenous students for New Zealand. These groupings were derived from students’ responses to PISA’s student questionnaire, which asked students to indicate their ethnic background. For Australia, students who indicated Aboriginal or Torres Strait Islander ethnicity, and for New Zealand those students who indicated Māori, were designated “Indigenous” for this analysis. All other students in the two samples, regardless of ethnic background or immigrant status, were considered “non-Indigenous”. It should also be noted that Australia intentionally oversamples its Indigenous students, who constitute about 2% of the population, so that this subsample is large enough in PISA to accommodate analyses that meet national reporting priorities. Differences in the proportions of male and female Indigenous students in the two countries, however, are likely reflective of actual differences in the population.

Data analysis

Observed differences in educational outcomes between Indigenous and non-Indigenous students in Australia and New Zealand may be related to several factors. First, non-Indigenous students may have, as a group, higher proportions of highly educated parents and/or more resources at school. Second, the relationships of different school and student-level factors with educational achievement may differ for Indigenous students as compared to their non-Indigenous counterparts. In other words, the same characteristics (variables) may have different “rates of return” for Indigenous and non-Indigenous students, as measured by scores on standardized assessments, and reflected by substantial gaps in educational outcomes between the two groups.

Analysis of such observed differences in group characteristics and associated academic outcomes can be performed using a technique called the Oaxaca-Blinder decomposition employed most often in labour economics (Blinder, 1973; Oaxaca, 1973). The technique is simple to apply as it requires only coefficient estimates from linear regressions for the outcome variable and sample means of the explanatory (independent) variables. In essence, the Oaxaca-Blinder decomposition compares ordinary least squares (OLS) regression models for multiple groups to estimate differences in the association of each explanatory variables (e.g., parental education level, gender, etc.) on the outcome variable in question (e.g., test scores).

The classic Oaxaca-Blinder decomposition equation can be expressed as:

\[ \bar{s}_n - \bar{s}_T = \beta_n (\bar{x}_T - \bar{x}_r) + (\beta_n - \beta_r) \bar{x}_T \]

For the purposes of this study, \( \bar{s}_n - \bar{s}_T \) represents the gap in PISA test scores between Indigenous and non-Indigenous student groups. The first term on the right side of the equation,
reflects mean differences in student and school resources between the two
groups, also referred to as “endowments”. The second term on the right hand side,
(β̂ₙ − β̂₇) xlabel{\text{x}}ˈₗ, is referred to as “coefficients”, which represents differences attributed to
“rates of return” (i.e., the relationship between the dependent and independent variables)
for each explanatory variable or characteristic. In labour economics, endowments are
also known as the “explained” portions of observed differences, whereas coefficients are
often referred to as “unexplained” portions of observed differences (or gaps in test
scores, as in the current case).

A useful example to clarify the difference between endowments and coefficients can be
seen in studies examining the relationship between access to clean water and health of poor
and less poor children in some developing countries. Two studies in particular found that
children in some of the poor regions in India and Vietnam may be less healthy not only
because they have less access to clean, piped water (endowments or the “explained
portion”) but also because their parents tend to be less knowledgeable about how to maxi-
mize health benefits from it (coefficients or the “unexplained” portion) (Jalan & Ravallion,
2003; Wagstaff & Nguyen, 2004).

To avoid imprecise estimated coefficients due to large differences in sample sizes
between Indigenous and non-Indigenous students, Neumark’s (1988) pooled sample
approach was applied. The non-Indigenous group was then used as the reference group.
This variant of the standard Oaxaca-Blinder model has the added advantage of using the
same coefficient estimates for weighting the explained portion of the decomposition,
which allows for a more direct comparison between groups (Appleton, Hoddinott, &
Krishnan, 1999; Rangvid, 2007).

**Variables**

In the current study, PISA 2009 reading scores served as the outcome variable. We
chose reading as an indicator of student achievement because it is a foundational skill
that is important for learning in all curriculum areas. Reading literacy is also commonly
used to compare levels of educational attainment and human capital across countries. We
list below explanatory (independent) variables used in our analysis. These variables were
selected because theory and empirical research have shown that they are related to
student educational outcomes (OECD, 2010). All of these explanatory variables have
been used in many secondary analyses (and the OECD’s primary analysis) of the
PISA dataset using a variety of multivariate statistical methods, including regression-
based Oaxaca-Blinder (see Lounkaew, 2013, for a recent example). Regression analyses
often use a mixture of ordinal and interval data, and this is considered “acceptable,
appropriate, and quite useful” (Meyers, Gamst, & Guarino, 2006, p. 23) by most
researchers.

**Student-level variables**

**Parental education level.** This variable was measured using the International Standard
Classification of Education (ISCED). In this analysis, we used the higher of the parent edu-
cation levels (HISCED). The categories were as follows: 0 = “Did not go to school”, 1 =
“primary education”, 2 = “lower secondary education”, 3B/3C = “upper secondary
school with entry into the labour market”, 3A and 4 = “upper secondary school providing
entry into tertiary education”, and 5A/5B/6 = “tertiary education and/or beyond”. 
**Parental occupational status.** This variable was measured using the International Socioeconomic Index of Occupational Status (ISEI), based on a hierarchical coding scheme comprising 390 different occupational categories provided by the International Labour Office. In this study, we used the higher of either the father’s or mother’s occupation (HISEI) to capture the attributes of the occupations that convert parent’s education into income. The value on the index ranged from 0 (lowest) to 90 (highest).

**Gender.** As a categorical variable, female was indexed as “1” and male as “2”.

**Language.** This categorical variable was labelled, 0 = “spoke the same test language at home” or 1 = “spoke a different language than the test language at home”.

**Computers at home.** The number of computers at home was set on a 4-point scale, from 1 = “0 computers at home”, 2 = “one”, 3 = “two”, and 4 = “three or more”.

**Books at home.** The number of books at home was set on a 6-point scale, from 1 = “0 to 10 books”, 2 = “11 to 25 books”, 3 = “26 to 100 books”, 4 = “101 to 200 books”, 5 = “201 to 500 books”, to 6 = “more than 500 books”.

**School-level variables**

**School community.** Past research suggests that academic achievement varies depending on whether students live in rural or urban settings (OECD, 2000). To assess the association of the size of the communities in which participants receive their schooling, a categorical variable was created with 1 = “village” (less than 3,000 residents), 2 = “small town” (3,000 to 15,000 residents), 3 = “town” (15,000 to 100,000 residents), 4 = “city” (100,000 to 1,000,000 residents), and 5 = “large city” (greater than 1,000,000 residents).

**School size.** This variable measured the number of students enrolled at each participating school.

**Instructional materials.** Each school principal was asked to assess how well or poorly their schools were resourced as far as instructional materials were concerned. The 4-point scale ranged from 1 = “not at all” (i.e., “The school did not lack instructional materials”) to 4 = “a lot” (i.e., “The school very often experiences lack of instructional materials”).

**Computers.** As a measure of how well schools were resourced in terms of their educational resources/materials, the analysis included the extent to which schools were equipped with computers. The 4-point scale options ranged from 1 = “not at all” (i.e., “The school did not lack computers”) to 4 = “a lot” (i.e., “The school very often experiences lack of computers”).

**Qualified teacher supply.** As a composite variable, this measure was the average of teacher shortages for each school in reading, math, and science. As with instructional materials and computers, the 4-point scale ranged from 1 = “not at all” (i.e., “The school did not lack teachers”) to 4 = “a lot” (i.e., “The school very often experiences lack of teachers”).

**Proportion of teachers with advanced degrees.** This variable assessed the prevalence of “highly qualified” teachers in the schools by examining the percentage of teachers in each school with the highest level of education (i.e., graduate degrees). This was calculated by dividing the number of teachers with graduate degrees by the total number teachers at each school.

**Proportion of certified teachers.** This variable was calculated by dividing the number of certified teachers by the number of all the teachers at each of the schools.
Student–teacher ratio. This variable was calculated by dividing the number of students by the number of teachers for each school.

Results

Descriptive analysis

Tables 1 and 2 present descriptive statistics that compare student- and school-level variables for Indigenous and non-Indigenous students in Australia and New Zealand. In both countries, on average, parents of Indigenous students had fewer years of formal education and lower levels of occupational status. Indigenous students also reported fewer numbers of books and computers at home. The two countries also differed in the use of the test language at home, between Indigenous and non-Indigenous students. In Australia, non-Indigenous students were more likely to speak English at home than their Indigenous counterparts, although the opposite was the case for New Zealand. In terms of gender distribution, Australia had a slightly higher percentage of girls among Indigenous students than among non-Indigenous students, whereas the opposite was true for the New Zealand sample. As noted previously, these small differences in the proportions of male and female Indigenous students in the two countries are most likely reflective of actual differences in the population.

Both countries showed varying levels of support and resources between Indigenous and non-Indigenous students on several school variables. In Australia, for example, Indigenous students, on average, were more likely than their non-Indigenous peers to be enrolled in schools in less populous communities, attend smaller schools, and attend schools reporting greater shortages of instructional materials, computers, and qualified teachers. Australian

| Table 1. Student and school variables for Indigenous and non-Indigenous students in Australia, PISA 2009. |
|--------------------------------------------------|--------------------------------------------------|
| **Indigenous** | **Non-Indigenous** |
| **(n = 1,143)** | **(n = 13,108)** |
| **Mean** | **SD** | **Mean** | **SD** |
| **Student Academic Performance** | | | |
| Reading | 435.13 | 101.98 | 514.46 | 95.58 |
| **Student Variables** | | | |
| HISCED | 4.44 | 1.14 | 4.83 | 1.17 |
| HISEI | 46.32 | 15.22 | 53.83 | 16.03 |
| Gender (% male) | 47.94 | NA | 49.37 | NA |
| Language (% test language) | 85.48 | NA | 89.08 | NA |
| Number of computers at home | 2.74 | 0.89 | 3.24 | 0.81 |
| Number of books at home | 3.03 | 1.39 | 3.73 | 1.37 |
| **School Variables** | | | |
| School community | 3.26 | 1.09 | 3.77 | 1.16 |
| School size | 911.52 | 393.34 | 965.97 | 418.79 |
| Shortage of instructional materials | 1.75 | 0.84 | 1.57 | 0.77 |
| Shortage of computers | 2.23 | 0.84 | 1.94 | 0.91 |
| Shortage of qualified teachers | 2.20 | 0.88 | 1.90 | 0.86 |
| Proportion of qualified teachers | 0.95 | 0.16 | 0.96 | 0.14 |
| Proportion of certified teachers | 0.99 | 0.09 | 0.98 | 0.09 |
| Student-teacher ratio | 13.62 | 1.96 | 13.51 | 2.08 |

Note: Calculations were performed using weighted PISA 2009 data.
Indigenous students, however, were also more likely to matriculate in schools with slightly smaller student–teacher ratios. In terms of existing proportions of qualified and certified teachers, observed differences between Indigenous and non-Indigenous students in Australia were negligible. Similarly, in New Zealand, Indigenous students were more likely than non-Indigenous students to be in schools located in less densely populated communities, attend smaller schools, and matriculate in schools reporting greater shortages of qualified teachers. As with Australian Indigenous students, Indigenous students in New Zealand were more likely to matriculate in schools with slightly smaller student–teacher ratios. In terms of shortages of instructional materials and computers, and proportions of qualified and certified teachers, the schools attended by Indigenous and non-Indigenous students in New Zealand did not differ greatly.

### Regression analysis

Having assessed differences on student and school variables between Indigenous and non-Indigenous groups in Australia and New Zealand at a descriptive level, the next phase of the investigation analysed the relative roles of each of these variables using OLS regression. On average, as shown in Tables 3 and 4, the results of this analysis suggest that among student-level variables, almost all were found to have meaningful relationships to reading achievement.

For Indigenous students in Australia, gender, language spoken at home, and the number of books at home were variables showing the strongest relationships to reading performance. On average, being male was associated with 39 fewer points, and speaking a language
other than English at home was associated with almost 83 fewer points in reading performance. Number of books at home was positively associated with reading performance for Australian Indigenous students, that is, students with more books at home tended to have higher reading scores than their counterparts with fewer books. Similarly, for non-Indigenous Australian students, males trailed their female counterparts by almost 32 points, controlling for other variables. The number of books at home was also a significant, positive predictor of reading performance for non-Indigenous Australian students, with a 15-point increase in reading performance associated with each unit increase in number of books at home.

Table 3 shows that for Indigenous and non-Indigenous students in Australia, gender, language spoken at home, and the number of books at home were the strongest predictors of reading performance. Controlling for other variables, being male was associated with a
39-point gap in reading performance for Indigenous students, and a 32-point gap for non-Indigenous students. In terms of speaking the test language (English) at home, Indigenous students who spoke a language other than English at home lagged behind those who spoke English at home by almost 83 points. This very large difference was not evident among non-Indigenous Australian students. For number of books at home, each additional unit increase was associated with a 14-point increase in reading for Indigenous students and a similar 15.5-point increase for their non-Indigenous counterparts. Also significant were parental education (HISEI) for Indigenous students and both parental education and occupational status (HISCED) for non-Indigenous students. These statistically significant relationships suggest that Australian students with parents who had higher levels of education and/or occupational status also had higher reading performance scores.

Table 4 presents similar findings for New Zealand. Among the student-level variables, parental education, gender, and number of books at home showed the strongest relationships with reading performance for both Indigenous and non-Indigenous students. Controlling for other variables, being female was associated with a 42-point advantage in reading for Indigenous students, and a 39-point advantage for non-Indigenous students, respectively. Furthermore, as for Australian students, the number of books at home was strongly related to reading performance on PISA for students in New Zealand. As to parental education levels, both groups showed that those students whose parents had more years of education had demonstrated higher reading performance. Each additional unit increase in the number of books at home was associated with an 18-point increase in reading performance for non-Indigenous students, and a 15-point increase for Indigenous New Zealanders. Also significant was the home language variable, where those who spoke English at home had 60- and 37-point advantages over their counterparts, with Indigenous students showing the larger gap.

For the school-level variables examined in this study, the number of variables associated with student performance varied widely between student groups. For Indigenous Australians, only school size had a statistically meaningful relationship with reading performance; Indigenous students attending schools with larger enrolments had more positive outcomes. On the other hand, for non-Indigenous Australian students, all but two school-level variables (i.e., reported shortage of computers and proportion of certified teachers) were found to be significantly associated with reading performance. Specifically, non-Indigenous Australian students who attended schools in more populous communities were enrolled in larger schools, and reported more abundant resources in terms of instructional materials and qualified teachers had higher reading scores. These relationships were also more or less reflected for Australian Indigenous students but fell short of statistical significance, possibly due to the comparatively small size of the Indigenous sample.

For New Zealand, few of the school variables were found to be meaningfully related to reading achievement for both Indigenous and non-Indigenous student groups. As shown in Table 4, among Indigenous students, only shortages of qualified teachers and the student–teacher ratio produced statistically significant relationships with reading performance. These regression results suggest that Māori students who attended schools with more qualified teachers and higher student–teacher ratios tended to outperform their peers attending schools with greater shortages of qualified teachers and smaller student–teacher ratios. For non-Indigenous New Zealand students, those attending larger schools and schools with fewer shortages of instructional materials had better reading performances.

Considered together, student-level and school-level variables explained between 22% and 29% of the variability in reading performance for Indigenous and non-Indigenous students in Australia and New Zealand. In the following section, we examine how these
variables differed in their allocation and “utilization” among these four student groups, organized by country and indigenous status.

**Decomposition analysis**

Using the Oaxaca-Blinder decomposition, this section examines differences in the proportional roles played by each of the student and school variables (i.e., allocation of resources) as well as their coefficients (i.e., rates of return) for Indigenous and non-Indigenous students in Australia and New Zealand.

As can be seen in Table 5, student-level variables explained 34.7% of the achievement gap in reading between Indigenous and non-Indigenous students in Australia. Put another
way, if Australian Indigenous students were to have the equivalent advantages of student-related variables (e.g., number of books at home) as compared to their non-Indigenous counterparts, their reading achievement as measured by PISA 2009 would benefit by about 27.5 points. Similarly, school-related variables, considered separately from student-related variables, explain about 18.5% of the gap between the two groups. In other words, if Australian Indigenous students had the affordances of school-related variables (e.g., proportions of qualified teachers) equivalent to their non-Indigenous counterparts, their reading achievement as measured by PISA 2009 would benefit by 14.7 points. Considered together, student- and school-level variables explained almost 44% (34.8 points) of the reading achievement gap between Indigenous and non-Indigenous students in Australia.

Specifically, as detailed in Table 6, when assessing differences in reading performance between Indigenous and non-Indigenous students in Australia in terms of their endowment (i.e., allocation of resources), parental occupation and education level, gender, numbers of computers and books at home, size of the community in which the school is located, and shortages of qualified teachers were found to be statistically significant. These results suggest that if Indigenous students in Australia were afforded the equivalent value of these variables as enjoyed by their non-Indigenous peers, the benefit accrued would reduce the gap in reading achievement between Indigenous and non-Indigenous students by almost 44%. For the “rate of return” (unexplained) part of the decomposition analysis, parental education and occupational status, language spoken at home, and the size of the community in which schools are located resulted in statistically significant associations with the observed gap between Indigenous and non-Indigenous Australian students, favouring the latter group. For these and other student-level variables, the “rates of return” analysis showed a 29-point disadvantage for Indigenous students, accounting for about 37% of the gap in reading achievement between Australian Indigenous and non-Indigenous students.

These findings suggest that in Australia, unequal allocation of resources and the ways in which resources or affordances translate to educational outcomes together account for about 80% of the achievement gap in reading between Indigenous and non-Indigenous students. Additionally, it appears that the role of variables that are theoretically amenable to being translated into more positive educational outcomes for students (i.e., rates of return associated with parental education or occupational status) play a somewhat less substantial role (29 points) than the actual unequal allocation of resources (35 points) in explaining the gap in reading achievement between Indigenous and non-Indigenous students.

For New Zealand, the unequal allocation of resources in the student-level variables explained 35% of the achievement gap in reading between Indigenous and non-Indigenous students. Put another way, if the Indigenous students in New Zealand were to have the equivalent advantages of student-level resources (e.g., number of books at home) as

<table>
<thead>
<tr>
<th></th>
<th>Home Explained</th>
<th>Home Unexplained</th>
<th>School Explained</th>
<th>School Unexplained</th>
<th>Home &amp; School Explained</th>
<th>Home &amp; School Unexplained</th>
</tr>
</thead>
<tbody>
<tr>
<td>Australia</td>
<td>27.49***</td>
<td>34.49***</td>
<td>14.67***</td>
<td>49.19***</td>
<td>34.79***</td>
<td>29.08***</td>
</tr>
<tr>
<td>New Zealand</td>
<td>19.32***</td>
<td>32.90***</td>
<td>4.11*</td>
<td>48.89***</td>
<td>20.29***</td>
<td>32.71***</td>
</tr>
</tbody>
</table>

Note: Calculations were performed using weighted PISA 2009 data.
*p ≤ .05. **p ≤ .01. ***p ≤ .001.
compared to their non-Indigenous counterparts, their reading achievement as measured by PISA 2009 would benefit by about 19 points. On the other hand, school-related variables, considered separately from student-level variables, explain only about 7.5% (4 points) of the gap between the two groups. Considered together, home- and school-related variables explained just over 37% (20 points) of the reading achievement gap between Indigenous and non-Indigenous students in New Zealand.

As detailed in Table 6, for students in New Zealand, endowment differences related to parental occupation and education levels, language spoken at home, and the numbers of computers and books at home were found to be statistically significant. For the “rate of return” aspect of the decomposition analysis, only language spoken at home and shortages of qualified teachers provided statistically significant contributions in accounting for the gap between New Zealand’s Indigenous and non-Indigenous students.

As a whole, the decomposition analysis suggests that for New Zealand, differences in student resources explain substantially more (about 35%) of the gap in reading performance between Indigenous and non-Indigenous students than differences in school resources.

Table 6. Decomposition of student and school variables related to the gap in reading achievement between Indigenous and non-Indigenous students in Australia and New Zealand, PISA 2009.

<table>
<thead>
<tr>
<th>Explained</th>
<th>Coefficients</th>
<th>Z</th>
<th>Coefficients</th>
<th>Z</th>
</tr>
</thead>
<tbody>
<tr>
<td>HISCED</td>
<td>4.31***</td>
<td>6.08</td>
<td>2.09***</td>
<td>3.10</td>
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<tr>
<td>HISEI</td>
<td>6.86***</td>
<td>7.82</td>
<td>7.06***</td>
<td>5.84</td>
</tr>
<tr>
<td>Gender</td>
<td>−1.58*</td>
<td>−2.09</td>
<td>1.08</td>
<td>0.92</td>
</tr>
<tr>
<td>Language at home</td>
<td>−0.30</td>
<td>−0.87</td>
<td>−2.09***</td>
<td>−2.70</td>
</tr>
<tr>
<td>Number of computers at home</td>
<td>4.87***</td>
<td>5.44</td>
<td>1.41**</td>
<td>2.72</td>
</tr>
<tr>
<td>Number of books at home</td>
<td>11.05***</td>
<td>9.13</td>
<td>7.75***</td>
<td>6.57</td>
</tr>
<tr>
<td>School community</td>
<td>5.74***</td>
<td>3.25</td>
<td>−0.98</td>
<td>−0.92</td>
</tr>
<tr>
<td>School size</td>
<td>1.41</td>
<td>1.24</td>
<td>2.19</td>
<td>1.67</td>
</tr>
<tr>
<td>Shortage of instructional materials</td>
<td>1.00</td>
<td>1.15</td>
<td>0.57</td>
<td>1.12</td>
</tr>
<tr>
<td>Shortage of computers</td>
<td>−0.71</td>
<td>−0.75</td>
<td>−0.02</td>
<td>−0.17</td>
</tr>
<tr>
<td>Shortage of qualified teachers</td>
<td>2.23*</td>
<td>2.17</td>
<td>0.55</td>
<td>1.10</td>
</tr>
<tr>
<td>Proportion of qualified teachers</td>
<td>0.22</td>
<td>0.74</td>
<td>−0.10</td>
<td>−0.34</td>
</tr>
<tr>
<td>Proportion of certified teachers</td>
<td>0.13</td>
<td>1.33</td>
<td>−0.03</td>
<td>−0.12</td>
</tr>
<tr>
<td>Student–teacher ratio</td>
<td>−0.46</td>
<td>−1.01</td>
<td>0.80</td>
<td>0.96</td>
</tr>
<tr>
<td>Total</td>
<td>34.79***</td>
<td>11.53</td>
<td>20.29***</td>
<td>6.93</td>
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</tbody>
</table>

<table>
<thead>
<tr>
<th>Explained</th>
<th>Coefficients</th>
<th>Z</th>
<th>Coefficients</th>
<th>Z</th>
</tr>
</thead>
<tbody>
<tr>
<td>HISCED</td>
<td>46.38***</td>
<td>3.58</td>
<td>7.77</td>
<td>0.63</td>
</tr>
<tr>
<td>HISEI</td>
<td>3.38***</td>
<td>0.29</td>
<td>−0.49</td>
<td>−0.04</td>
</tr>
<tr>
<td>Gender</td>
<td>10.20</td>
<td>1.06</td>
<td>5.02</td>
<td>0.42</td>
</tr>
<tr>
<td>Language at home</td>
<td>80.77***</td>
<td>4.81</td>
<td>25.92*</td>
<td>2.18</td>
</tr>
<tr>
<td>Number of computers at home</td>
<td>−2.05</td>
<td>−0.16</td>
<td>−9.98</td>
<td>−0.75</td>
</tr>
<tr>
<td>Number of books at home</td>
<td>4.01</td>
<td>0.54</td>
<td>10.05</td>
<td>1.03</td>
</tr>
<tr>
<td>School community</td>
<td>21.58*</td>
<td>2.10</td>
<td>17.04</td>
<td>1.40</td>
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<tr>
<td>School size</td>
<td>−14.88</td>
<td>−1.53</td>
<td>−0.87</td>
<td>−0.09</td>
</tr>
<tr>
<td>Shortage of instructional materials</td>
<td>1.29</td>
<td>0.15</td>
<td>−11.59</td>
<td>−1.58</td>
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<tr>
<td>Shortage of computers</td>
<td>9.47</td>
<td>0.82</td>
<td>3.96</td>
<td>0.53</td>
</tr>
<tr>
<td>Shortage of qualified teachers</td>
<td>−8.03</td>
<td>−0.92</td>
<td>15.61*</td>
<td>2.07</td>
</tr>
<tr>
<td>Proportion of qualified teachers</td>
<td>−8.31</td>
<td>−0.46</td>
<td>−14.05</td>
<td>−0.69</td>
</tr>
<tr>
<td>Proportion of certified teachers</td>
<td>17.39</td>
<td>0.46</td>
<td>15.62</td>
<td>0.78</td>
</tr>
<tr>
<td>Student–teacher ratio</td>
<td>−19.32</td>
<td>−0.70</td>
<td>−50.91</td>
<td>−1.82</td>
</tr>
<tr>
<td>Total</td>
<td>29.08***</td>
<td>8.00</td>
<td>32.71***</td>
<td>9.67</td>
</tr>
</tbody>
</table>

Note: Calculations were performed using weighted PISA 2009 data. Standard errors were calculated at the school level.

*p ≤ .05. **p ≤ .01. ***p ≤ .001.
This is in contrast to Australia, where the reading achievement gap between Indigenous and non-Indigenous students appears to be explained in relatively equal portions by differences in home-based resources and differences in resources in the schools (Table 5). Furthermore, differences in the explained and unexplained portions of the decomposition analysis indicated that for Australia, unequal allocation of resources plays a more substantial role than rates of return (i.e., the translation of affordances into educational benefit for students) in accounting for the gap in reading performance between Indigenous and non-Indigenous students. This was different in New Zealand, where the translation of affordances into educational benefit plays the more substantial role in accounting for the gap in reading achievement. For New Zealand, the ratio of explained to unexplained roles for student and school variables combined was about 2:3, whereas for Australia it was approximately 1:1.

Discussion

Three important questions are posed in this study. First, how do student and school factors differ between Indigenous and non-Indigenous students in Australia and New Zealand? Second, what factors explain the substantial difference between Australia and New Zealand in the size of the reading achievement gap between Indigenous and non-Indigenous students? Third, to what extent are student- and school-level resources differently converted into positive educational outcomes by Indigenous and non-Indigenous students in Australia and New Zealand? Our analyses show that the answers to these questions relate to unequal levels or allocations of student and/or school resources between Indigenous and non-Indigenous students. As well, our findings suggest different rates among the four groups for the conversion of resources into reading achievement. In this section, we interpret these findings and discuss potential implications for education policy and future lines of research.

In both countries, we observed that a large portion of the reading achievement gap between Indigenous and non-Indigenous students is associated with substantial inequities in student resources. On average, parents of Indigenous students have lower levels of education, lower occupational status, and fewer books and computers at home compared to their non-Indigenous peers. In New Zealand, the regression and decomposition analyses show that the reading achievement gap is associated almost entirely with student-level differences in resources, favouring non-Indigenous students. In Australia, however, the regression and decomposition analyses showed that school variables played a much larger role in explaining the achievement gap between Indigenous and non-Indigenous students than in New Zealand. This is not surprising since our analyses also showed that school resources are allocated less equitably in Australia than in New Zealand.

These differences between the two countries are related to the size of the gap between Indigenous and non-Indigenous achievement. The achievement gap in reading between Indigenous and non-Indigenous students is large in both Australia and New Zealand. Our findings show, however, that the gap is substantially larger in Australia than in New Zealand (79 vs. 55 score points, respectively). Song (2011) reported similar results in his study of the educational achievement gap between Turkish and native students in Austria, Germany, and Switzerland. Two studies, therefore, show that achievement gaps are smaller between socially marginalized ethnic minority groups and ethnic majority groups when resources are distributed more equally among schools.

Our analysis is not able to explain why school resources are allocated more equitably in New Zealand than in Australia, but we can offer some possibilities. Socioeconomic segregation between schools is higher in Australia than in New Zealand (OECD, 2010). This
high level of segregation in Australia is associated with large differences in school resources, especially the ability to recruit and retain qualified and experienced teachers. Perry and McConney (in press) have shown, for example, that principals of schools that enrol primarily students from low-socioeconomic backgrounds report that learning in their school is hindered by teacher shortages to a much greater extent than principals of other schools. And Indigenous students in Australia are concentrated in these low-socioeconomic schools (Rorris et al., 2011; Teese, 2011). Low-socioeconomic schools in Australia are often small schools, even when located in large cities (Lamb, 2007; Perry & Southwell, 2013), and as our findings show, school size is related to academic performance for Indigenous students in Australia. Research from the US, which has a similar level of school segregation as Australia, has also shown that low-socioeconomic schools have more difficulty recruiting and retaining qualified and experienced teachers (see, e.g., Darling-Hammond, 2010; Guarino, Brown, & Wyse, 2011; Muijs, Harris, Chapman, Stoll, & Russ, 2009).

For educational policymakers, these findings suggest that school resources need to be allocated more equitably in Australia. This suggestion supports the work of Indigenous leaders in Australia who have called repeatedly for better schooling in Indigenous communities (Hind, 2012). Further, as described earlier in this paper, the per-pupil funding of schools is much more equitable in New Zealand than in Australia. Almost all schools in New Zealand (96%) receive the same per-pupil funding from public authorities, and do not charge tuition fees. As noted by a recent report commissioned by the federal government, however, per-pupil funding varies widely across schools in Australia (Australian Government, 2011). This is largely due to federal funding mechanisms that provide substantial subsidies to private schools while also allowing them to charge tuition fees. As countless studies have shown, the inequitable allocation of resources usually privileges socially advantaged groups (Berliner, 2001; Chiu & Khoo, 2005; Tate, 1997; Teese, 2007). It is also likely that structurally inequitable funding in Australia is a driver of the high levels of social segregation noted above. Even if a low-socioeconomic school is well resourced (and many of them are), it will remain a “hard to staff” school and likely experience all of the challenges that accompany that designation (Kahlenberg, 2001).

Our decomposition analysis also suggests that, overall, student-related resources are more effectively translated into more equitable outcomes for Indigenous students in Australia than in New Zealand. This difference is not likely due to urban-rural residential patterns. Most Indigenous students in both countries live in urban communities or towns. Sixteen percent of Indigenous people in New Zealand live in communities with fewer than 1,000 residents (Ministry of Social Development, 2010). Comparable census data from Australia show that 26% of Indigenous people live in “remote” and “very remote” communities (Australian Bureau of Statistics, 2007). This is a larger number than in New Zealand, but “remote” also includes large but geographically isolated towns, such as Alice Springs with a population of 24,000 people. Many of these towns have large populations of Indigenous people. It is therefore likely that the number of Indigenous students who live in communities with less than 1,000 residents is similar in both countries. The reasons behind this finding are probably multiple and could be related to differences in economic opportunities available to Indigenous people in both countries.

Additionally, the “rates of return” (unexplained portions of the decomposition analysis) associated with parental education and occupational status are stronger for Australian non-Indigenous compared to Indigenous students, with regard to reading achievement. Although the observation of this phenomenon is difficult to explain, and certainly requires further examination, some insight may be found in the work of Coleman (1988), who
argued that social capital may be necessary for human capital to flow through in detectable fashion from parents to children.

Thus, although much more needs to be unpacked, it appears that Indigenous families in Australia and more so in New Zealand are constrained in their ability to maximize potentially positive educational benefits of socioeconomic and occupational status. Further research about the cultural, linguistic, social, and economic dynamics that influence the relationship between socioeconomic status and educational outcomes for Indigenous students is warranted.

The limitations of our study should be noted. First, we are unable to establish causal relationships among predictor and outcome variables since we are using a cross-sectional dataset. We have described associations but are unable to say categorically that particular factors cause particular outcomes. Second, the PISA dataset does not measure teacher experience or teacher effectiveness. It is likely that we would be able to explain a larger part of the Indigenous achievement gap within and between the two countries if we were able to measure this feature of teacher quality.

Achievement gaps between ethnic minority and majority students are common throughout the world, in large part due to social forces that are outside the control of education policymakers. At the same time, however, education policies can either exacerbate or ameliorate these achievement gaps. This analysis has shown that the achievement gap in reading between Indigenous and non-Indigenous students is 1.5 times larger in Australia than in New Zealand, and that this is accompanied by greater inequities in the allocation of school resources, especially shortages of teachers, in Australia. We therefore argue that education policymakers in Australia should work to ensure a more equitable allocation of school resources between Indigenous and non-Indigenous students. Researchers and practitioners should also examine how Indigenous families can be better supported in translating their familial, cultural and social resources into strong educational outcomes for their children.

Notes
1. Currency exchange rates as at December 5, 2013.
2. The standard errors for the regression and Oaxaca-Blinder decomposition test were clustered at the school level.
3. For a more detailed and technical explanation of the Oaxaca-Blinder decomposition, refer to the following articles: Blinder (1973), Neumark (1988), and Oaxaca (1973).
4. With the exception of the proportion of certified teachers in New Zealand and proportion of qualified teachers in Australia, all mean and proportional differences between Indigenous and non-Indigenous students in Australia and New Zealand differed significantly at $p \leq .05$.

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Dr Andrew McConney is Associate Professor of research and evaluation in the School of Education at Murdoch University. Andrew’s research interests include the secondary analysis of large-scale datasets to inform educational policy and practice, and the evaluation of science, maths, and environmental education programmes.
References


