

Secondary analysis of large-scale international datasets in the service of national education policy evaluation: The case of PISA Australia

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Abstract

National educational policy analysis and evaluation is a complex endeavour that would seem to demand empirical data gathering efforts that are of appropriate scale and high quality. However, mounting such data-gathering efforts can be resource and time-intensive. As an alternative strategy, this presentation describes the secondary analysis of an existing large-scale dataset that potentially adds value to educational policy evaluation. In particular, as a member of the Organisation for Economic Cooperation and Development (OECD), Australia participates in the Programme for International Student Assessment (PISA) that every few years assesses the educational attainment of 15-year old students in the core learning areas of reading, maths, science and problem solving. PISA datasets are housed and managed by the Australian Centre for Educational Research (ACER) and it is this dataset that is the subject of our secondary analysis here.

For the current policy question, Australia's new Commonwealth government has begun consideration of applying a so-called "socioeconomic status (SES) model" to public school funding. We suggest that the secondary analysis of extant large-scale datasets can provide important input to the discussion of school funding policies by shedding light on previously obscured or possibly unexamined relationships. For example, it is already well established in the educational research literature that the socioeconomic status of individual students is strongly associated with educational attainment as measured by standardized assessment systems, whether local, national or international. In addition, various international studies have shown that the aggregated socioeconomic profile of a school is also positively associated with students' academic attainment.

However, less is known about the nature of these relationships when both individual student and school socioeconomic status are disaggregated. To uncover these finer-grained associations, we subjected Australia's 2003 PISA dataset to secondary analysis to better understand the reading, mathematics and science achievement of secondary school students from different SES backgrounds, across a variety of school SES strata. This finer-grained secondary analysis shows that increases in the aggregated SES of a school are consistently and strongly associated with increases in students' academic performance, and that this relationship holds for all students regardless of their individual SES. In the Australian case, the aggregated socio-economic profile of the school matters greatly in terms of academic performance. We conclude the presentation with a discussion of the implications of these findings for Australia's federal school funding policies with particular attention given to the influence of school composition on student attainment.

Justification

The conference theme focuses on ways in which evaluation theory and practice can add value to the examination, understanding and improvement of public social and educational policies and programs. In particular, this presentation demonstrates value-adding in two important ways that both reflect the conference sub-theme of "optimising value." First, from a methodological perspective, the presentation demonstrates the process and usefulness of a secondary analysis approach with a large-scale dataset. The secondary analysis of extant data as a feasible evaluation strategy has perhaps previously been under-utilised in national educational policy evaluation, and this presentation would therefore provide a useful example for the evaluation community. Second, the presentation adds value from a substantive

perspective in shedding light on a key policy question facing the Commonwealth. Specifically, the findings presented will add to data-based decision making around the appropriate federal funding of public education, as well as the use of public funds in the support of so-called “independent” and Catholic systems of schooling in Australia. In these two ways, this presentation demonstrates a strategy that holds potential for optimising the value of public policy evaluation through the enhanced use of extant large-scale, high quality datasets in the consideration of important national policy questions.

Purpose

School socioeconomic composition is a strong predictor of student academic achievement in most countries (OECD, 2004; Rumberger & Palardy, 2005; Sirin, 2005). However, although studies in numerous countries have shown that the socioeconomic profile of schools is strongly associated with achievement our understanding of how the association may vary across groups of students, schools, or national contexts remains incomplete. As with class size (AERA, 2003) it is likely that the association between school SES and achievement varies by student characteristics, institutional arrangements, or national context.

Previous studies have examined variations in the association between school composition and achievement for students from different racial and socioeconomic backgrounds. For example, four decades ago, the Coleman report (Coleman et al., 1966), found that lower SES African-American students benefited from attending a racially integrated school, whereas the achievement of their middle-class white peers did not change. More recent studies have implied that the association is strong for all students (Caldas & Bankston III, 1997; OECD, 2004; Tate, 1997), but many of these have not disaggregated students by SES to show conclusively that the association holds for all. To understand more clearly how the association may vary, Perry and McConney (*in press*) conducted a secondary analysis of the Australian data from the 2003 Programme for International Student Assessment (PISA) and found that the association between school SES and achievement is highly consistent for all student groups, regardless of their individual SES.

Our current analysis builds on these findings by adding self-efficacy—an individual’s belief that she can successfully complete a task or solve a problem (Bandura, 1977). Self-efficacy influences motivation, effort and persistence in solving problems and this construct is positively associated with achievement (Chiu & Xihua, 2008; Lent, Brown, & Larkin, 1984; OECD, 2004; Siegel, Galassi, & Ware, 1985). In some countries, including Australia, self-efficacy has been shown a stronger predictor of academic achievement than either student or school SES (OECD, 2004).

Method

In his study we used secondary analysis of the 2003 PISA dataset for Australia. We used descriptive statistics and graphical representations to compare the achievement of secondary students in three subject areas (reading, mathematics, and science) across various student SES and self-efficacy backgrounds, and across a range of school SES profiles.

Our study’s methodological approach is similar to that recently used to compare the effectiveness of private and public schooling across student SES groups in the US and Chile (Lubienski & Lubienski, 2005; Matear, 2006), and to examine the relationship between school SES and achievement in Australia (Perry & McConney, *in press*). Briefly, our general methodology for computing performance means across student and school SES bands, and across varying levels of self-efficacy is:

1. the Australian subset (about 12 ½ thousand students) was extracted from the 2003 PISA data housed at the Australian Council for Educational Research (ACER);
2. we constructed average student achievement scores in maths, reading, and science using the sets of “plausible values” for each student provided in the dataset (this procedure was first checked with the project director for PISA Australia);
3. using the individual student SES variable (labelled ESCS in the PISA dataset) we sorted the dataset according to SES and determined the quartile cut-scores to divide the dataset into four parts, based on student SES;
4. the overall Australian dataset was cut into 4 quartiles of just over 3,000 students each, based on individual SES;
5. for each subject, each of these student SES-based quartiles was further subdivided into four quartiles based on self-efficacy, quartile cut-scores having been determined on this variable using the overall Australian dataset;
6. again using the individual SES variable, as well as the unique school identifier variable (321 schools in the Australian dataset), we computed a “mean school group SES” variable and added it to the dataset;
7. we determined the quartile cut-points on this mean school group SES variable;

8. each student therefore carried average scores in reading, maths, and science; individual SES; individual self-efficacy for each of the three subjects; unique school identifier; and, mean SES of the school group to which he/she belonged;
9. each of the groups formed through disaggregation according to student SES and self-efficacy were then further disaggregated into 4 subgroups using the mean school group SES variable;
10. we computed the subject-specific mean achievement scores for each of these 64 subgroups;
11. given the limitations of space for this summary, we provide here—in Tables 1 and 2, and Figures 1 and 2—selected representative tables and figures for mathematics only, organized by individual student SES quartile.

Empirical Findings

For this study, we used the 2003 PISA dataset for Australia. The Australian sample includes over 320 schools and more than 12,500 students representative of the population of 15-year old students across the country. The sample statistics generated from this dataset are therefore representative of the Australian population of 15-year old secondary students, and subgroups within that population.

In the current study, we compared the maths achievement of high SES students across four bands (quartiles) of self-efficacy, and across 4 bands of schools representing low through high school-level SES. We then replicated these comparisons for students with moderate, low and very low SES backgrounds. In the first instance, consistent with what we already knew from previous studies (e.g., Chiu & Xihua, 2008; Perry & McConney, *in press*) the individual SES of students matters greatly in terms of their academic attainment. For example, in maths, the typical very low SES student performs a full 100 points (just over 1 standard deviation) below the typical high SES student.

Second, and more pertinent to our current analysis, subject-specific student self-efficacy also matters greatly in the Australian context, as is the case more generally (e.g., Chiu & Xihua, 2008). In maths, for example, within the very low student SES group, students with high self-efficacy performed on average 120 points (1.3 standard deviations) higher than students with low self-efficacy. Similarly, within the high individual SES group, the typical student with low maths self-efficacy performed 115 points below the typical student with high maths self-efficacy.

Third, and most critical for the purposes of this analysis, the socioeconomic profile of schools also plays a non-trivial, unique role in the academic attainment of students. For example, in the case of mathematics, as depicted in Tables 1 and 2, and in Figures 1 and 2, for the typical student in the first SES quartile, being part of a high SES school group (as compared to a low SES school group) is associated with improvements in achievement ranging from 0.4 to 0.8 standard deviations. Similarly, for students from high SES backgrounds, being part of a high SES school group (as compared to a low SES school group) is associated with improvements in achievement ranging from 0.3 to 0.6 standard deviations.

Overall, the message resulting from the secondary analysis of the 2003 PISA dataset for Australia seem clear and consistent. As portrayed in Tables 1 and 2 and Figures 1 and 2, the aggregated SES of the school group matters substantially. Put another way, the SES context in which the student finds herself seems strongly and consistently associated with academic performance, across both student SES and self-efficacy groupings.

Educational Policy Implications

The research literature has shown that the socioeconomic composition of a school is strongly associated with student academic achievement. However, our understanding about how this relationship may vary for different students and in different countries is just emerging. This study develops our understanding about the relationship between school SES and student achievement by examining the association in the context of two variable student-level characteristics, socioeconomic status and self-efficacy.

The study examines data from Australia, whose educational system can be characterized as relatively equitable and effective, with high levels of school choice and privatization. As many previous studies about school socioeconomic composition and student achievement have been conducted in the US, studies of other national contexts can illuminate the ways in which educational policies and structures influence the relationship. From a policy point of view, understanding who is most affected by school composition can help shape policy options. For example, if high SES students are relatively immune to the influence of school composition, then there is no policy disincentive to fostering the integration of schools by SES. If, on the other hand, low SES students are strongly influenced by school composition, then policies need to take that

into account. Our current study is therefore an early step in developing a larger comparative understanding of the relationship between school socioeconomic composition and student achievement.

The findings from our secondary analysis of the Australian PISA 2003 data are clear; all students—regardless of their personal SES—benefit strongly and relatively equally from schooling contexts in which the SES of the school group is high. Our findings similarly show that all students, regardless of their individual SES, perform considerably less well on measures of academic achievement in school contexts characterised, in the aggregate, as low on the SES continuum. Thus, the segregation of schools according to SES provides further benefits for students whose economic circumstances allow attendance at high SES schools, and also further handicaps students who lack this socio-economic advantage. That is, schooling that is segregated by SES is most likely to benefit students who are already educationally privileged, but harm students who find themselves at educational disadvantage, associated with low SES backgrounds. Rather than mitigating or mediating educational inequity, school segregation exacerbates it. For the equitable educational benefit of all students therefore, schools with large concentrations of students with low SES backgrounds should be discouraged, and likewise, schools with large concentrations of students with higher SES backgrounds should be accessible and open to all. Put another way, educational policies that work against the segregation of students and schools based on SES should be vigorously pursued, on the simple basis of better and more equitable educational outcomes for all, rather than for an economically privileged few. For these reasons, a strong consensus seems to exist among educational researchers and policymakers that the minimization of school segregation based on SES should be a central outcome of educational policy (Lamb, 2007; Oakes, 2000; OECD, 2004; OECD, 2005; Orfield, 1996; Willms, 1999).

In Australia, school segregation by SES is created in part by the way in which schools are funded. Individual Australian states hold the main responsibility for funding government (public) schools, although they also subsidize private schools. The federal Commonwealth government provides “topping-up” funding to both government and non-government (private) schools, including parochial and alternative schools, and federal funding for private schools has been growing over the last three decades. In 2004, two-thirds of Commonwealth school funding was directed toward non-government schools (Ryan & Watson, 2004), even though these schools enrol only one-third of all students. Ryan and Watson (2004) show that the increase in the proportion of federal funding directed to private schools has led to increased enrolments in this sector. Moreover, increasing enrolments in the private sector tend to exacerbate SES-based segregation between public and private schools, because most of the new private school enrolments come from the middle and upper-middle classes.

Ryan and Watson (2004) also show that private schools have used Commonwealth funding to improve the quality of schooling rather than access. In other words, private schools have used these additional public funds to hire more and better teachers, reduce class sizes, and improve their facilities, not reduce fees. By focusing on quality over access, private schools have improved their ability to attract higher SES students and at the same time effectively obstruct the enrolment of lower SES students.

Numerous past and current studies have shown that school funding has only a minor independent effect on student achievement. Over forty years ago, classic studies by Coleman (1966) and Jencks (1972) and their associates showed that school resources and funding play a minor role in explaining differences in educational attainment or achievement. Current international studies, such as PISA, have shown the same (Lokan, Greenwood, & Cresswell, 2001; OECD, 2004). Yet, it would be misleading to argue that school funding has no effect on student achievement. While studies have shown that school funding has a very small direct effect on educational outcomes, it likely has a large indirect effect. Increasing a school's funding and resources makes it more attractive to higher SES families, which leads to a more favourable school socioeconomic profile. As the findings from our study show, this in turn seems to catalyse synergies that manifest themselves in increased academic achievement for students at that school, and exacerbates observed differences in academic performance between high-(typically private) and lower-SES (typically public) schools. School funding indirectly influences student outcomes via the socioeconomic composition of a school's students.

It would therefore seem sensible to consider ways in which the funding of schools can be better balanced to meet the overall policy aim of providing a quality education for all students. A recent report by the Independent Schools Council of Australia showed that private schools received approximately \$6,246 per student from public funds, while government schools received \$10,715 (Ferrari, 2007, p. 3). These figures do not include private funds, however, such as school fees. Average annual fees at an independent school are \$6,000 (Ryan & Watson, 2004, p. 17), while the independent schools with the most flattering reputations charge at least \$10,000 per year in fees. Thus, once public and private funds are combined, many private schools collect substantially more per-pupil funding than their public school counterparts.

In defence of the status quo, the Independent Schools Council of Australia argues that private schools annually save taxpayers almost \$5 billion in funds that the government would otherwise spend to build and run public schools (Ferrari, 2007). However, rather than consider this a windfall to be used to fund projects in health or transportation, we argue that it should be used as a vehicle for investing in schools (public or private) and students that are at risk of not meeting their educational potential.

We advocate a four-pronged approach to reduce school segregation by SES and therefore improve educational quality for all students. The first approach is to reduce real or perceived differences in quality between high and low SES schools. In the Australian context, this means attending to differences between sectors since most high SES students attend private schools, and most low SES students attend public schools (Ryan & Watson, 2004). This is not to say that low SES private schools and high SES public schools do not exist, but they are exceptions that prove the rule.

As noted earlier, current funding formulas for Australian schooling are leading to increased segregation based on social and economic criteria. We therefore argue that increased funds should be reinvested in lower SES schools and in public schools generally. Increased investment will allow these schools to modernize their facilities and introduce or improve programs that will make them more attractive to higher SES families. For example, high quality university preparatory programs, intensive or immersion foreign language programs, or specialized curriculum such as the International Baccalaureate program could be built through increased investment in public and low SES schools to support these programs and the specialized teachers and coordination that they require.

The second approach that we recommend is to ensure that the core curricular and programmatic offerings are relatively similar across all schools. Marks and associates (2006) have shown that the educational advantage that high SES students enjoy is mediated primarily through the curriculum that they receive. High SES students are likely to attend schools that have rigorous and demanding academic programs oriented toward university entrance. Currently, high quality academic programs tend to be concentrated in private schools and in public schools in higher SES communities (Edwards, 2006). Rather than maintain this financially and geographically selective access to high quality academic programs, we argue that such programs should be offered in all schools. Increased investment in public and low SES schools could be targeted toward meeting this goal. For example, funds could be used to support in-service training of teachers in these programs, recruit experienced and successful teachers, or subsidize program costs.

Third, we argue that a range of incentives targeted toward schools and parents could facilitate more balanced social compositions within schools. Public funding bodies could exert financial leverage on higher SES schools to enrol lower SES students. Related to this, an important mechanism to reducing the real or perceived gap in quality between public and private schools is holding all schools that receive public funds to the same accountability measures. There is a widespread and common perception in Australia that private schools offer a higher quality of education than their public counterparts. Publicly available data on a range of student outcomes would allow this perception to be evaluated on a school-by-school basis, and would more generally enhance transparency within the education system, and across the public, Catholic and Independent sectors.

While balanced school compositions can be facilitated by making lower SES schools more attractive to higher SES families, we acknowledge in our fourth recommended approach that all students who are struggling in school require extra support and resources, regardless of the school that they attend. The increased investment that we recommended earlier could again be targeted toward meeting the needs of at-risk students and their schools.

The social composition of schools, as reflected in measures of socioeconomic status, has a significant influence on all children's academic achievement. For the benefit of most children and the larger society, balanced school composition should be a primary aim of educational policy, and should be used as a criterion against which other policies are evaluated. This does not mean that other foundational objectives, such as diversity and choice, should be ignored. Rather, they should be pursued in ways that do not further privilege only higher SES students.

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Table 1. PISA 2003 Australia Mean Maths Scores for Very Low SES Students by Maths Self-Efficacy and School Group SES

Individual Student SES: Q1 (very low individual SES)				
Maths Self Efficacy	School Group ESCS			
	1 st Quartile	2 nd Quartile	3 rd Quartile	4 th Quartile
1 st Quartile	n=586 427.2	n=440 438.6	n=209 442.4	n=53 464.6
2 nd Quartile	n=426 467.7	n=255 474.7	n=151 489.3	n=47 521.7
3 rd Quartile	n=220 507.0	n=178 510.8	n=118 520.1	n=48 577.7
4 th Quartile	n=130 544.9	n=102 558.4	n=65 571.5	n=33 581.8

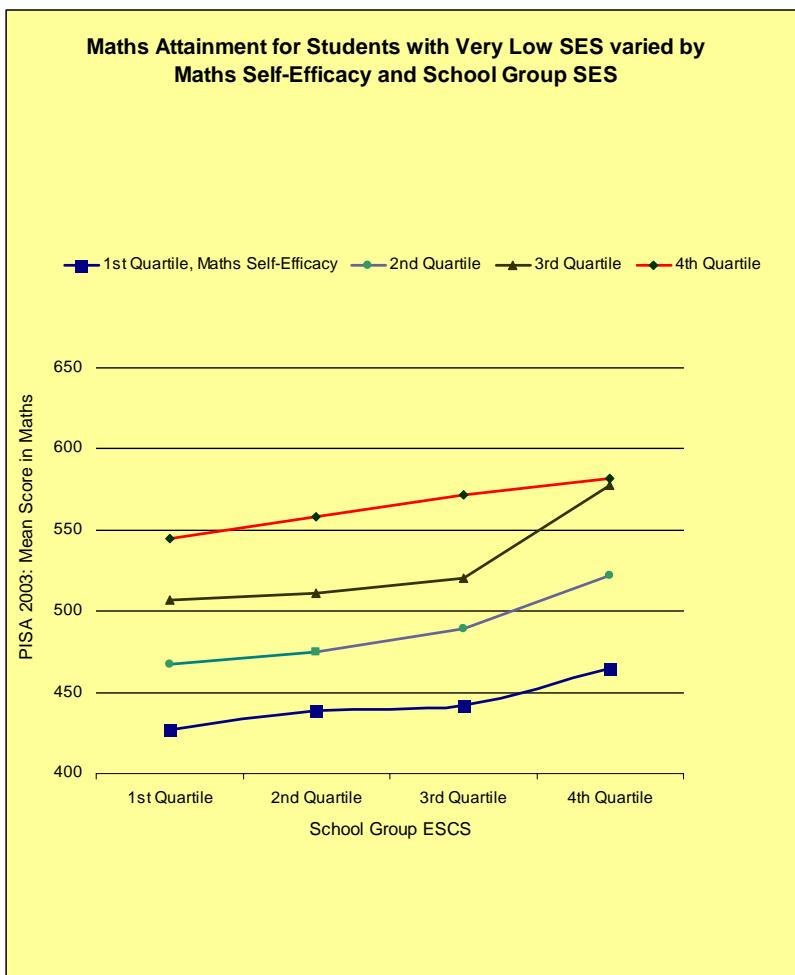


Figure 1. PISA 2003 Australia Maths Mean Scores for Very Low SES Students grouped by Self-efficacy and School Group SES.

Table 2. PISA 2003 Australia Mean Maths Scores for High SES Students by Maths Self-Efficacy and School Group SES

Individual Student SES: Q4 (high individual SES)				
Maths Self Efficacy	School Group ESCS			
	1 st Quartile	2 nd Quartile	3 rd Quartile	4 th Quartile
1 st Quartile	n=32 489.7	n=91 492.9	n=146 497.2	n=185 520.3
2 nd Quartile	n=37 507.7	n=97 521.5	n=207 536.0	n=344 562.1
3 rd Quartile	n=59 554.6	n=124 550.2	n=239 563.3	n=489 594.6
4 th Quartile	n=59 583.3	n=118 581.7	n=245 608.4	n=619 635.4

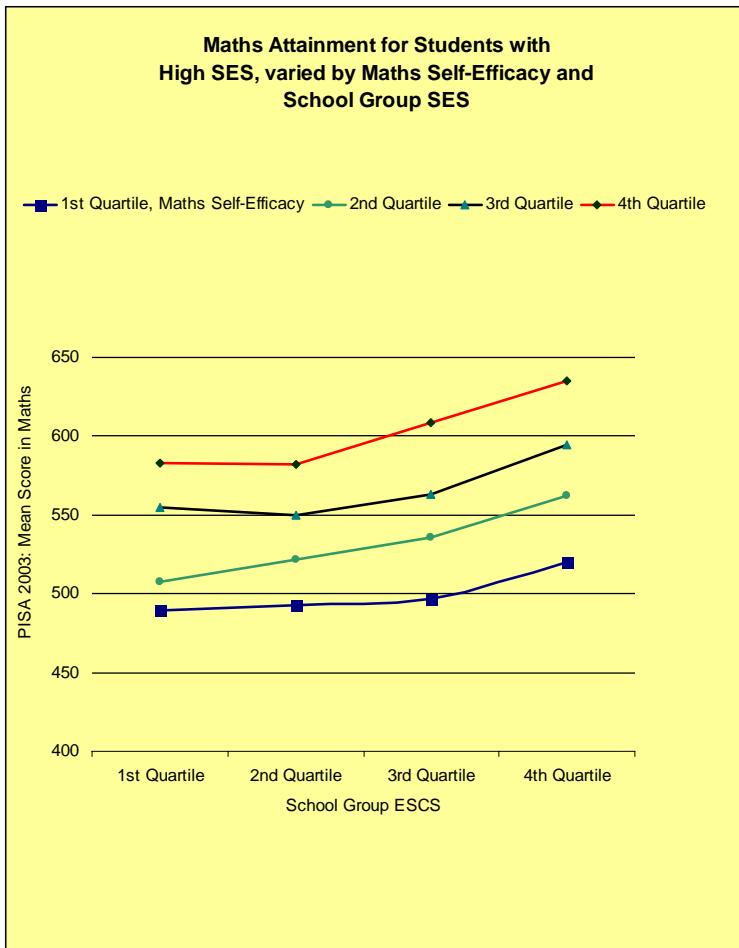


Figure 2. PISA 2003 Australia Maths Mean Scores for High SES Students grouped by Self-efficacy and School Group SES.