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School Socioeconomic Composition and Student Outcomes in Australia: Implications for Education Policy

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Abstract

It is established that the socioeconomic status (SES) of individual students is strongly associated with academic achievement. However, less is known about this relationship when both student and school socioeconomic status are considered. To examine these associations at a finer grain, with the intent of informing educational funding policy, we subjected Australia's 2003 PISA dataset to secondary analysis to better understand the reading and mathematics achievement of students with varying SES, across a range of school SES groupings. Our descriptive analyses show that increases in school SES are consistently associated with increases in students' academic performance, and that this relationship holds regardless of individual students' SES. In Australia, the socioeconomic profile of the school matters substantially in terms of academic achievement. We discuss the implications of these findings in the context of the current discussion around federal school funding policies, with particular attention given to the association of school composition with student achievement.

Introduction

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, perhaps under utilized strategy, this paper describes a retrospective, secondary analysis of an existing large-scale dataset that potentially adds value to educational policy evaluation. Specifically, as a member of the Organisation for Economic Cooperation and Development (OECD), Australia participates in the Programme for International Student Assessment (PISA) that every three years assesses the literacy of 15-year old students in reading, mathematics and science. PISA is administered on a cyclical 3-year schedule beginning in 2000 with a focus on reading, followed in 2003 with a focus on mathematics and 2006 with a focus on science. The PISA surveys have made an important departure from other international assessments by decoupling the instruments from school curricula; rather, the assessment instruments are based on holistic definitions of discipline-specific literacies—the skills and knowledge deemed necessary for personal and working life in industrialized countries with 21st century economies—in the core learning areas of reading, mathematics, and science (OECD, 2004). PISA datasets are housed and managed by the Australian Council for Educational Research (ACER) and it is the 2003 dataset that is the subject of our secondary analysis here.

Australia's Commonwealth government has begun consideration of applying a so-called "socioeconomic status (SES) model" within its policies guiding school funding. For the current study, we suggest that the secondary analysis of extant large-scale datasets can provide important input to the discussion of Commonwealth school funding policy by shedding light on previously obscured or possibly unexamined relationships. In particular, it is already well established in the educational research literature that the socioeconomic status of individual students is strongly associated with educational achievement 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 achievement (OECD, 2004; Rumberger & Palardy, 2005; Sirin, 2005).

On the other hand, 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 retrospective secondary analysis to better understand the reading and mathematics literacy performance of secondary school students from different SES backgrounds, across a variety of school SES strata. This analysis therefore

contributes to our understanding in two important ways. First, from a methodological perspective, the study demonstrates the process and potential usefulness of a secondary analysis approach using a large-scale dataset as a contributor to national policy evaluation. Second, the study adds value from a substantive perspective in shedding light on a key policy question currently facing the Commonwealth. Specifically, the findings presented will add to data-informed decision making around the appropriate federal funding of public education, as well as the use of public funds in the support of Independent and Catholic systems of schooling across Australia. In these two ways, this secondary analysis 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.

Socioeconomic Status and Student Outcomes

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

For school SES, 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, Coleman and colleagues (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 suggested that the association between achievement and school SES 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 is similarly strong for all students.

Similarly, the relationship between individual student SES and academic achievement is well established (Jencks et al., 1972; Marjoribanks, 1979; Noel & de Broucker, 2001; OECD, 2004). This association has been shown to be strong and positive; typically, higher student-level SES is associated with stronger educational outcomes, on average. For example, in a meta-analysis of 74 studies examining SES and academic achievement, Sirin (2005) confirmed that student-level SES is one of the strongest correlates of academic performance. Higher SES students typically have higher scores on standardized achievement

tests, and are more likely to complete secondary school and university than their peers from lower SES backgrounds (Blossfeld & Shavit, 1993; Willms, 1999).

However, despite these established understandings, questions remain. In particular, our understanding of how academic achievement varies when profiled in the context of both student-level and school-level SES remains incomplete. Some studies suggest that the association between achievement and school SES is stronger for lower SES students than for their higher SES peers (Kahlenberg, 2001; Thrupp, 1995), while others posit that the association is similar across the full range of student-level SES (OECD, 2004; Rumberger & Palardy, 2005). Here, we examine this tripartite association for disaggregated groups of students and schools—our aim being to shed light at a finer grain and thereby better inform policy making around federal school funding. Our main questions are: 1) to what extent is the association between school SES and student achievement consistent for all students regardless of their individual SES?; and 2) to what degree does student achievement increase in a linear fashion as school SES increases (i.e., is the relationship uniformly linear, or does it depart from linearity, perhaps suggesting that the relationship tapers off as school SES increases or conversely, that there are thresholds that must first be crossed before the strongly positive relationship between SES and academic performance is seen)?

Method

Our 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 disaggregated relationship among individual and school SES and achievement in Australia (Perry & McConney, *in press*). Specifically, we used secondary analysis of the 2003 PISA dataset for Australia. Within this secondary analysis, we drew on disaggregated descriptive statistics and graphical representations to compare the literacy performance of secondary students in two subject areas (reading and mathematics) across various student SES backgrounds, and across a range of school SES profiles. Our aim is not to show the extent to which school SES explains variation in student achievement, which has already been done in the primary analyses of PISA. Rather, our aim is to show how the association between school SES and student performance varies for different students and across different schools in a simple but powerful way that is meaningful to policymakers and readers without advanced statistical expertise.

As noted above, PISA is a major international assessment of 15 year-olds' literacy performance in three subject areas: mathematics, reading and science (problem-solving was also included in the 2003 round) developed by the OECD as an assessment of students' ability to apply their skills and knowledge in particular subject areas and to communicate their findings when they do so. The

objective of PISA is to support member countries' educational systems in the development of the skills and knowledge necessary for personal and working life in industrialized countries. PISA therefore assesses students' literacy in the three subject areas rather than achievement tied to a specific curriculum to which students may have been exposed in school. Test questions derive from hypothetical situations or problems that students could reasonably be expected to encounter in their adult lives (OECD, 2004).

For the 2003 PISA round, all OECD member countries and 11 partner (or non-OECD countries) participated. In total, the sample from the member countries included over 250,000 students, increasing to over 275,000 students with the inclusion of partner countries. Each country's sample is drawn to be statistically representative of the total number of students enrolled in different types of schools (e.g., private or public, college preparatory or vocational schools, etc.) and locations (e.g., urban or rural). The Australian sample included 312 schools and just over 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.

PISA's measure of student-level SES is a composite index of the following variables: highest parental occupational status, highest parental educational attainment (years of education), and economic and cultural resources in the home. PISA has named this variable ESCS (economic, social and cultural status), and each participating student completes a questionnaire that allows an individual ESCS score to be assigned.

To calculate aggregated school-level SES, we averaged the ESCS scores of every student who participated in PISA from a given school. However, we hasten to underline that PISA is designed for administration to 15 year-old students. This means that in no case did we have the individual ESCS for *every student* in a given school participating in PISA 2003. For the 321 schools that did comprise the Australian data, the size of the student group ranged from a low of 5 students to a high of 61 students. Importantly, 305 (95 percent) of the 321 schools participating for Australia had student groups of more than 20, with the average student group size being about 39 students. We have termed this measure of school-level SES "mean school group SES" and consider it a relatively stable *proxy measure*, given the absence of the latter variable in the Australian dataset.

Briefly, the methodology we used in computing reading and maths achievement means across student and school SES bands is as follows:

1. the Australian subset (about 12,500 students) was extracted from the 2003 PISA data housed at the Australian Council for Educational Research (ACER);

2. we constructed student-wise average literacy performance scores in reading and maths using the sets of “plausible values” for these subjects provided in the dataset;
3. using the individual student SES variable, (called ESCS in PISA) we sorted the dataset according to SES and determined the quintile cut-scores to divide the dataset into five parts, based on student SES;
4. 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;
5. we determined the quintile cut-points on this mean school group SES variable;
6. each student therefore carried average scores in reading and maths literacy performance, individual SES; unique school identifier; and, mean SES of the school group to which he/she belonged;
7. the overall Australian dataset was cut into 5 quintiles, based on individual student SES (these subgroups each contained about 2500 students and are the 5 rows represented in Tables 1 and 2);
8. each of the 5 groups thus formed were further disaggregated into 5 subgroups using the quintile cut-scores associated with the mean school group SES variable;
9. these procedures left us with 25 subgroups organized by individual SES and by mean school group SES; these subgroups ranged in size from a low of 88 students to a high of 1212 students);
10. we computed the group-wise mean scores in reading and maths for each of these 25 subgroups which are given by subject in Tables 1 and 2.

Empirical Findings

As portrayed in Tables 1 and 2, the aggregated SES of the school group matters. Put another way, the SES school context in which the student finds herself is strongly associated with academic performance, on average. For example, as shown in Table 1, for the typical student in the 1st SES quintile, being part of a high SES school group versus a low SES school group is associated with a difference of about 57 points (0.6 of a standard deviation) in reading achievement.

For readers interested in a statistical yardstick for appraising the magnitude of the differences among school group means within individual student SES quintiles, we have also provided the standard errors associated with each student-level SES quintile. The commonly used standard error of the mean is a yardstick for judging how much the value of any sample mean may vary from sample to sample taken from the same distribution. It can be used to roughly compare an observed mean to a hypothesized value (for instance, one can

conclude the two values are statistically different if the ratio of the difference to the standard error is less than -2 or greater than +2).

For the current case, however, we are of the view that the more relevant question is how much *the difference between any pair of means*, drawn from a common source, may vary from sample to sample. We have therefore provided the standard error associated with sample-mean differences for each of the five quintiles based on individual student SES. So, for example, within the first student SES quintile, the mean difference in reading between high and low SES schools is 57.2 (516.0 minus 458.8). Divided by the standard error (12.8), this equals 4.47; being substantially more than +2 this indicates that this is a statistically "real" difference between the two sample means.

Table 1. *Mean Reading Scores by Individual Student SES and School Group Mean SES for PISA 2003 Australia*

Individual Student SES (ESCS)	School Group SES					Standard error of sample-mean differences
	1 st Quintile	2 nd Quintile	3 rd Quintile	4 th Quintile	5 th Quintile	
1 st Quintile	n = 984 458.8	n = 690 466.0	n = 490 471.5	n = 231 503.3	n = 88 516.0	12.8
2 nd Quintile	n = 591 486.2	n = 681 496.0	n = 596 503.5	n = 425 531.3	n = 195 543.9	9.6
3 rd Quintile	n = 416 498.1	n = 492 504.2	n = 639 515.1	n = 568 541.7	n = 348 560.9	8.6
4 th Quintile	n = 213 520.3	n = 377 525.1	n = 516 529.8	n = 682 557.2	n = 693 577.2	9.1
5 th Quintile	n = 99 547.8	n = 199 543.0	n = 362 549.4	n = 602 576.1	n = 1212 601.7	10.9

Similarly, in maths as depicted in Table 2, for the typical student in the 1st SES quintile, being part of a high SES school group versus a low SES school group is also associated with a difference of about 57 points (0.6 of a standard deviation). It is also evident that the pattern of association between increases in average performance and increases in school group SES holds consistently across

the quintiles based on individual student SES. For example, as seen in Table 1, for mid-SES students the difference in average reading achievement associated with being in a low SES school group as compared to a high SES school group is about 63 points (or about 0.7 standard deviation units). For high SES students the difference in average reading performance associated with being in a low SES school group as compared a high SES school group is 54 points (0.6 of a standard deviation). As portrayed in Table 2, similar comparisons in maths yielded differences of 67 (for mid-SES students) and 56 points (for high SES students), respectively.

Furthermore, consistent with other research and as we previously knew, individual student SES also matters. For example, as depicted in Table 1 in the case of reading, the difference between the average low SES student in a low SES school and the average high SES student in a similar school is about 90 points, or just about one standard deviation. For school groups in the mid-SES range, the reading achievement difference between the average low SES student and the average high SES student moderates somewhat to about 78 points, or 0.8 standard deviations, but for high SES school groups the difference in average reading achievement again stretches to 86 points, or close to one standard deviation.

Table 2. *Mean Mathematics Scores by Individual Student SES and School Group Average SES for PISA 2003 Australia*

Individual Student SES (ESCS)	School Group SES					Standard error of sample-mean differences
	1 st Quintile	2 nd Quintile	3 rd Quintile	4 th Quintile	5 th Quintile	
1 st Quintile	n = 984 458.8	n = 690 459.8	n = 490 475.3	n = 231 497.9	n = 88 515.8	12.3
2 nd Quintile	n = 591 485.5	n = 681 494.9	n = 596 505.0	n = 425 529.4	n = 195 546.4	9.8
3 rd Quintile	n = 416 495.4	n = 492 501.3	n = 639 513.6	n = 568 538.5	n = 348 562.2	8.8
4 th Quintile	n = 213 521.6	n = 377 521.1	n = 516 530.5	n = 682 554.8	n = 693 575.0	9.5
5 th Quintile	n = 99 543.1	n = 199 535.4	n = 362 545.9	n = 602 570.9	n = 1212 599.5	11.7

These patterns of substantial difference in average achievement associated with changes in individual student SES are also observed for mathematics. For example, in maths the difference between the typical low SES student and the typical high SES student, both in mid-SES school groupings, is 71 points. Similar to the case for reading, the observed difference in maths achievement between the average high SES student and the average low SES student, both in high SES school groupings, is about 84 points.

Our purpose in systematically disaggregating these data has also been to provide a finer-grained portrait of the relationships among individual student and school SES and academic literacy performance, including such issues as whether there are evident “school SES thresholds” that must first be crossed before the positive relationship between SES and academic performance is seen, and whether observed patterns continue to be strongly positive across the entire range of student and school group SES. Figures 1 and 2 that follow are provided to offer beginning answers to these questions.

First, from these two figures the strength and consistency of the association between mean school group SES and academic literacy performance across the quintiles representing individual student SES, as well as across reading and mathematics, are remarkable. In no case is there overlap among the lines representing the academic literacy performance of different SES cohorts across the two subjects. In other words, for both reading and maths, literacy performance as measured by PISA almost universally show steady and consistent increases for each of the five student-level SES quintiles.

Second, consistently across the two subjects, but perhaps most notably in reading, there does appear to be something like a school group SES threshold—located at around the 3rd school group SES quintile—below which the relationship between school group SES and academic attainment is positive but quite moderate, and beyond which the relationship becomes strongly positive. For the Australian sample, this may reflect the transition from lower and middle-SES public schools to private and/or more affluent public schools.

Third, we point out the phenomenon evident in both reading and maths for students in the highest individual SES quintile (represented by the uppermost line in each chart). These lines show that for students in this highest SES cohort, there is a small but noticeable fall-off in average academic performance when comparing 2nd (and sometimes 3rd) quintile school group performance against 1st quintile school group performance; we refer to this phenomenon as “the hockey stick” and note that it appears for no other quintile in the dataset. We suspect that what we are seeing here is perhaps a type of “regression to the mean” effect for the 2nd and 3rd quintiles in that the size of the group of high SES students in the lowest SES school groups is relatively small in comparison to other groups, and as a result its mean may be artificially higher than would be expected.

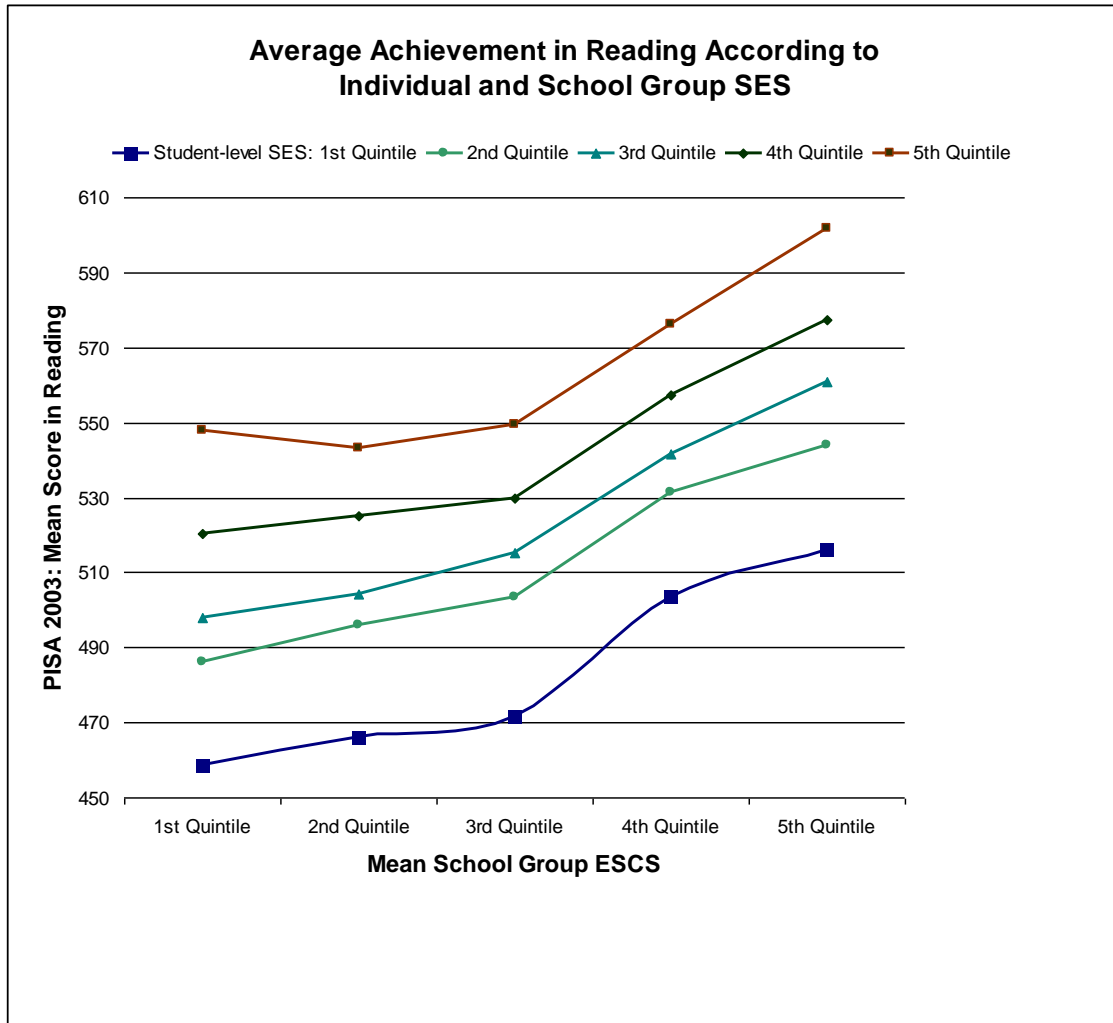


Figure 1. Average Literacy Performance in Reading by Individual Student and School Group SES for PISA 2003 Australia

Overall, the message resulting from our secondary analysis of the 2003 PISA dataset for Australia is clear and consistent. As detailed in Tables 1 and 2 and portrayed by 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 is strongly and consistently associated with academic performance, across all student SES groupings. Similarly, and in concert with what was previously known, it is also the case that individual student SES matters greatly in the Australian context. For the core subjects of reading and maths, higher individual

student SES is positively associated with higher academic literacy performance on average, and this patterning was consistently observed across all five school-group SES quintiles.

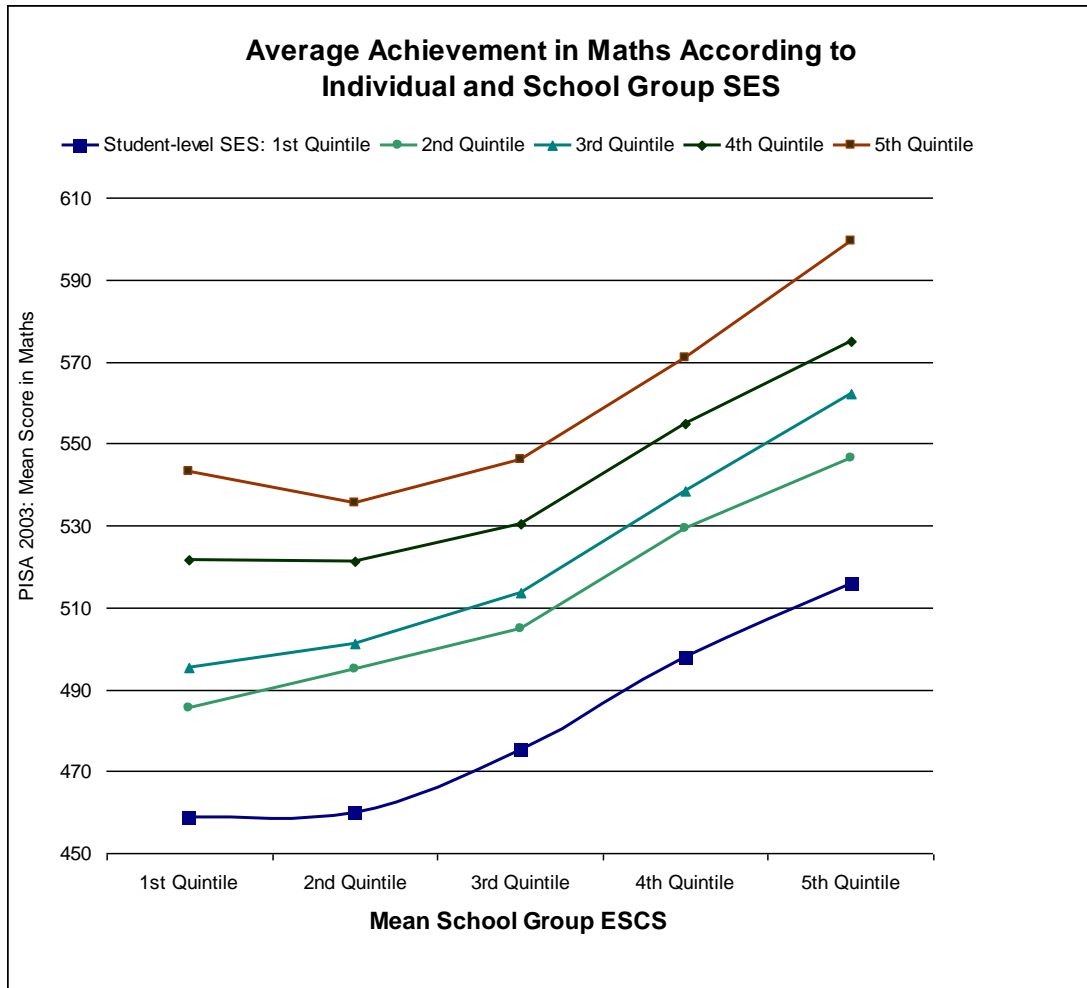


Figure 2. Average Literacy Performance in Mathematics by Individual Student and School Group SES for PISA 2003 Australia

Educational Policy Implications

The Australian educational system can be characterized as relatively equitable and effective, with high levels of school choice and privatization (Perry, 2009; Thomson, Cresswell, & De Bertoli, 2003). 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 which students are most affected by school composition can help shape policy options. For example, if high SES students are relatively immune to the influence of school SES, then there is no policy disincentive to fostering the socioeconomic integration of schools. If, on the other hand, low SES students are strongly influenced by school SES, then policies need to take that into account.

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 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. 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 exists 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, 2005; Orfield, 1996; Willms, 1999).

While reducing school socioeconomic segregation is not an easy task, a number of innovative approaches have been tried by schools and districts in different countries. No single approach will dramatically reduce segregation but taken together they have the potential to make a meaningful impact. The first group of approaches relates to reducing real or perceived differences in quality between high and low SES schools. This means paying attention to the inputs and resources available to schools. The second group of approaches relates to providing incentives to attract high SES students to lower SES schools.

One way to minimize differences in quality between low and high SES schools is to adopt a funding model that provides similar resources to all schools,

and additional funding to schools with high needs (e.g., schools that are located in rural and remote areas, that enrol a high percentage of students with learning disabilities, from disadvantaged social backgrounds, etc.). Funding models used in New Zealand and the United Kingdom could potentially minimize differences in educational resources between schools. In these countries, all private and public schools are entitled to the same funding based on the number and type of students they enrol as long as they do not charge student fees. Schools that charge fees relinquish their right to receive public funds. This funding model provides an equitable distribution of resources to schools but also promotes diversity and choice within the educational system. Such a model is also simpler and more transparent than the current funding model in Australia, which commentators have described as opaque and overly complex (Dowling, 2008). This model could also be politically feasible to implement since it would save many families thousands of dollars in school fees without compromising the quality of education on offer at their school. The main 'losers' in this model would be high-fee Independent schools that are currently receiving public funds and the families whose children attend them. Without Commonwealth funding, it is likely that fees at these schools would increase to maintain the same quality of education provision. Fees at such schools in the US and UK are significantly higher than in Australia, at least in part because they do not receive any public funds.

Another way to reduce differences among schools is to ensure that 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 exams. Currently, high quality academic programs tend to be concentrated in private schools and in public schools in higher SES communities (Edwards, 2006; Lamb, Hogan, & Johnson, 2001). Rather than maintain this financially and geographically selective access to high quality academic programs, availing such programs to all students regardless of their financial resources or place of residence could improve educational opportunities for lower SES students. Increased funding to lower SES schools could be used to support in-service training of teachers in these programs, recruit experienced and successful teachers, or subsidize program costs.

Increased investment to lower SES schools can help them introduce or improve programs that will make them more attractive to higher SES families. Such programs could include high quality university preparatory programs, intensive or immersion foreign language programs, and specialized curriculum such as the International Baccalaureate program. Another approach is to establish partnerships between low SES secondary schools and local universities to permit

able students to enrol in university classes for free. Yale University, for example, has such partnerships with low SES schools in New Haven, Connecticut, the seventh poorest city in the continental United States (see http://www.yale.edu/onhsa/youth_partnerships.htm). Similarly, some lower SES school districts in the US have been able to attract higher SES students by providing financial incentives upon graduation. For example, the Kalamazoo Promise, an initiative “funded into perpetuity by a small group of anonymous donors” (www.kalamazoopromise.com), provides scholarships to graduates of the Kalamazoo, Michigan public school district to attend any of the 15 public universities in the state, including the prestigious University of Michigan.

While balanced school compositions can be facilitated by making lower SES schools more attractive to higher SES families, we also acknowledge that all students who are struggling in school require extra support and resources, regardless of the school that they attend. We agree with other researchers who have called for increased support to students who are falling behind their peers academically (Lokan, Greenwood, & Cresswell, 2001). Based on our findings, however, we also believe that policy measures should target schools and school funding to reduce the association between school SES and student achievement.

Conclusion

Many of the policy measures we have recommended here, such as increased funding to low SES schools, are supported by the current federal Labor government. We support their stance that low SES schools in all sectors (i.e. government, Catholic and Independent) need to be better supported. The socioeconomic composition of schools has a significant influence on all children’s academic performance. For the benefit of most children and the larger society, balanced school socioeconomic composition should be a primary aim of educational policy, and should be used as a criterion against which other policies are evaluated. Reducing socioeconomic school segregation is not only equitable but also effective. For example, the association between school SES and student achievement is lower in Canada and Finland than in Australia, and both countries outperform Australia on PISA (OECD, 2004). As these countries show, reducing socioeconomic school segregation and differences between schools promotes higher overall achievement for all students without decreasing the achievement of high-performing students. Reducing school socioeconomic segregation 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 reduce the educational opportunities and outcomes of students from socially disadvantaged backgrounds.

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