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Comparing 'Asian Giants': Exploring the Factors Accounting for Hong Kong and Singapore Students' Academic Achievement

Kerry J Kennedy
Xiaoxue Kuang

The Education University of HongKong

The HEAD Foundation

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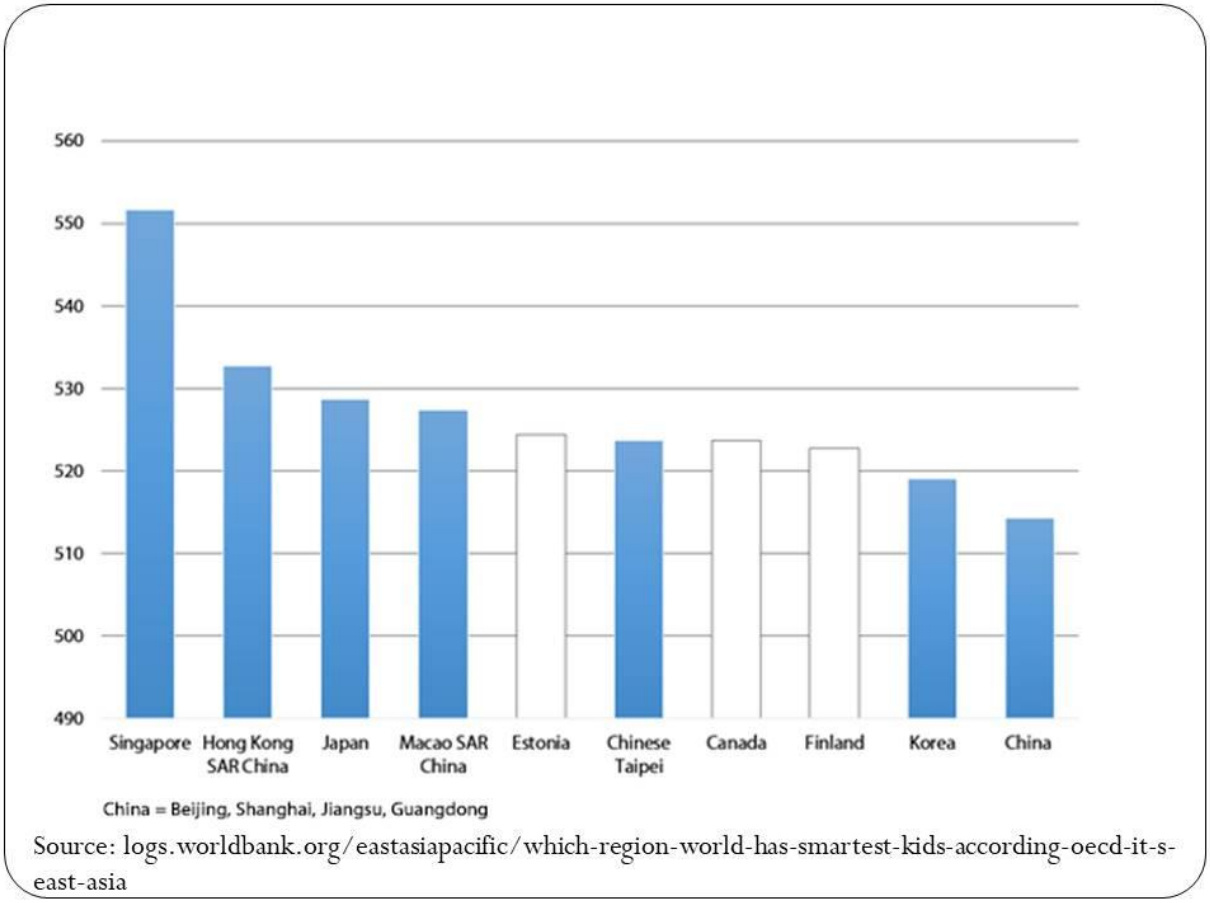
In an analysis of PISA 2015 results in Reading, Science and Mathematics (OECD, 2016), Patrinos, Hasan and Pan (2017) demonstrated that averaging the results across the three assessments produces the rankings shown in Table 1.

Table 1: PISA 2015 *Top 10 performers averaged across science, math and reading* [From Patrinos, Hasan & Pan (2017)]



Singapore and Hong Kong were ranked 1st and 2nd respectively and seven of the ten top performing societies were located in Asia. This leads the authors to speculate that the success of these societies is due to "hard work and good policy". They point to such government priorities as "smart investments in basic education and scaling up effective early reading programs…cost-effective use of

private provision with public finance helps make up gaps". This explanation focuses on the macro environment is perhaps typical of the focus of education economists but it ignores the micro environments of schools including student attributes, teacher quality and parent engagement (issues the authors did, however, highlight in their references to Vietnam that did not make it into the top ten). If it can be assumed at the macro level that there has been a similarity of approach to building successful school systems, what can be made of the micro level? What factors there account for success in an international assessment such as PISA?

The purpose of this paper is to address this issue with particular reference to the results for Singapore and Hong Kong students since as Table 1 shows, they topped the list of top performing students in 2015. Can factors at the level of individual students and schools be identified that go some way towards explaining the success of Singapore and Hong Kong students? In order to pursue this question the following issues will be addressed:

- Hong Kong and Singapore: similarities and differences;
- Choosing a comparative research methodology;
- Individual level student attributes
- Identifying school level factors;
- Discussion of results and conclusions

Hong Kong and Singapore: Similarities and Differences

A basic tenet of any comparative research is that the proposed comparison will yield information that will help to account for either the variation in or similarities between the units of comparison. Thus an important rationale for any set of comparisons is that similarities and/or differences are so marked that the results will shed light on the research question being addressed. In the current case the research question is relatively simple:

- What are the factors accounting for the success of Hong Kong and Singapore students' achievement in PISA 2015?

Before proceeding to the comparison, the question is whether Singapore and Hong Kong are valid units for comparison? This question can be addressed by identifying the characteristics of the two cities that highlight their similarities and differences.

Historically, each city has a rich indigenous history that was eclipsed by British colonialism in the nineteenth century. One outcome of the British presence was the establishment of Western style education systems recognized as the eventual drivers of the economic development that has characterized both cities. While both systems have undergone considerable changes over time it is generally recognized that the opening up of educational opportunity somewhat ahead of other countries in the region was an important factor in the overall development of the cities. From a comparative perspective, therefore, the importance attached to education is an important similarity between the two cities.

Culturally, the two cities share a Chinese heritage. In Singapore some 74.3% of the population are classified as Chinese with Malay the second largest group (13.4%), Indian (9.1%) and others, including Eurasians and Whites (3.2%) (Index Mundi, 2017). For Hong Kong, 92% of the population are of Chinese ethnicity. Of the remaining 8%, 4.6% are Filipino and Indonesian domestic helpers, by far the largest non-Chinese ethnic groups in the city, but with no prospect of permanent residential status and subject to ongoing contractual

arrangements for their continuing stay. 0.6% are of South Asian origin (Indian, Nepalese, and Pakistani), 0.5 are classified as White, and the remainder are of different Asian origins including those of mixed race (Census and Statistics Department, 2017a, p. 46).

Singapore's diversity is much more marked than that of Hong Kong in the sense that while the Chinese are the dominant ethnic group the size of the other groups is not insubstantial. This has meant that multiculturalism has been an important feature of the city's development and politics. Such has not been the case in Hong Kong. The very large majority of ethnic minorities must retain their home country citizenship even if families have been resident for several generations. This has led to an emphasis in government policy on integration strategies meant to include ethnic minorities as part of the mainstream culture. Thus while both cities are characterized by cultural diversity Singapore's might be said to be a more affirming approach of ethnic distinctiveness while Hong Kong's tends to gloss over differences in the quest for a more uniform and harmonious social fabric.

Economically and socially, Singapore is ranked number 5 on the Human Development Index (HDI) with a value of 0.925 while Hong Kong is ranked number 12 with a value of 0.917 (UNDP, 2016, p.22). Both are within the band labelled 'Very High Human Development' along with 49 other countries. The HDI is a composite index used by the United Nations Development Agency to provide a measure of the standard of living in countries as reflected in the Gross National Income (GNI) per head of population, life expectancy at birth, and educational opportunities. Thus the HDI is not just about economic growth that can more easily be measured by the Gross Domestic Product (GDP) of a country, it is about the use of financial resources to achieve a sustainable life style for individuals.
If the interest was only in GDP, then both Singapore and Hong Kong do very well (in 2016 Singapore's GDP was USD 296,966 compared to Hong Kong's USD 320,916,00 (Country Economy.com, 2017). What the HDI tries to do, however, is reflect how well resources are utilized on behalf of individuals. As shown above, both by the banding and each city's individual HDI value, the cities do very well

and are two of only three Asian societies in the 'Very High Development band (the other one being the Republic of South Korea). Another measure that supports this view is that in 2016 educational expenditure represented 19.96 % of Singapore's total budget outlays and 18.61% of Hong Kong's (Country Economy.com, 2017). These figures compare with 14.55 % in the United States and 15.53% Switzerland. Commitment to education is an important feature in both Singapore and Hong Kong.

Politically, there are significant differences between the two cities. Singapore is a sovereign country managing its own affairs as a member of the international community. Its institutions are democratic in orientation including its electoral system, its judicial system and its legislature. Hong Kong, on the other hand, is a subnational unit within the People's Republic of China. It has a high degree of autonomy (for example it is solely responsible for policy domains such as education, immigration, tax collection, social security, housing and transport) but the Chinese Central government maintains control of Defence and Foreign Affairs. The Central government also controls the pace of electoral reform and has the final say over the appointment of senior government officials.

Singapore and Hong Kong are often ranked in different international ranking exercises. On measures of the extent to which countries are preparing their workforces for the future, especially in regard to the requirement of new technology, Singapore ranked 13th and Hong Kong 16th (Economic Intelligence Unit, 2015, p.8). Based on an index to measure whether education systems from different countries were preparing students for the future, Singapore ranked 5th and Hong Kong ranked 14th (Economic Intelligence Unit, 2017). In 2016, on a general measure of income inequality referred to as the Gini Coefficient (adjusted so as to be comparable), Singapore's was 0.402 while Hong Kong's was 0.401. This suggests that in both cities income inequality was moderately high, on a par with the United States, but greater than that of many European countries where the Gini tends to be in the low 0.300 range (Census and Statistics Department, 2017b).

Overall, based on the comparisons outlined above, it seems that there are more similarities between Hong Kong and Singapore than differences. The biggest differences seem to be in the diversity of the respective populations and the political structure. In most other ways the relative small cities with populations of 7.367 million in Hong Kong and 5.607 million in Singapore are recognized internationally for the strength of their economies, their commitment to social development, including education, and their capacity to move with the times. They have often been referred to as being among the 'the Asian tigers', first of the newly industrialized societies in Asia, first to rank with advanced economies and often providing a lesson for developing countries on how best to benefit from globalization. It is against this background of broadly similar macro contexts that we now turn to the specific aim of this study that is to explore factors that account for the success of Hong Kong and Singapore's achievements in PISA 2015.

Given that the macro contexts of the two cities are relatively similar, the study to be reported here will focus on the micro contexts of schools and students in order to identify possible influences on student learning at these levels.

Choosing a comparative research methodology

Comparative education is a distinctive area of study within the broader domain of education studies. Bray, Adamson and Mason (2014) have highlighted the range of research methods that can be applied to comparative studies including the full gamut from qualitative to quantitative. In recent years the latter has received something of a bad press with many advocates of qualitative research criticizing what they see as the narrow scientific orientation of quantitative research with its emphasis on establishing causality between variables and generalizability that allows the results of single studies to be applied to other populations. Such critiques are correct in identifying the issue as one of epistemology: what is our ultimate source of knowledge and how can we trust it? They miss the point, however, that that the scientific method is but one way of knowing but this does not mean it should be discarded. Rather, the focus should be on the research question being pursued and then on the methods that can

best answer that question. Sometimes quantitative methods of a statistical nature will best answer the question, at other times qualitative methods such as interviews and observations will provide the answer and at yet other times both methodologies and their methods will be used to provide the best. Selecting a research methodology should not be an ideological issue: it is a practical issue linked to the questions that need to be answered.

Having said that, there has been a tendency on the part of many quantitative researchers to assume that numbers speak for themselves: they do not! There must be a strong theoretical base to any study and the results, whether they are a set of statistical calculations (or, in the case of qualitative research, a series of case studies) must address theoretical issues and concerns and hopefully advance theoretical considerations. Given the quantitative nature of the PISA results, the present study will use a quantitative comparative framework and its specifics will be described below. While there will be a focus on statistical comparisons of the key variables that are shown the influence student learning, there will also be an analysis of these results in theoretical terms. The emphasis will be on understanding what the numbers mean and what can be learnt about the influence of school and individuals contexts in Hong Kong and Singapore?

As Kuang (2016, p. 63) pointed out in relation to a similar international comparative study, the key issue is that "there are students nested in schools, and school nested in countries and countries nested in regions". We therefore need a way to untangle the effects of these different levels since each level itself might be a distinctive influence on students. Statistically a method to do this has been has been offered by Goldstein (1987) and extended by others; multilevel modelling is now widely accepted as a way to handle hierarchical data such as that of PISA. Given that there are only two societies involved it is not possible analyze influences at that level with any degree of reliability (Bryan & Jenkins, 2013). Yet it is possible to make comparisons of the effects of schools and individual students because sample sizes were substantial (138 schools in Hong Kong and 176 in Singapore; 5,359 students in Hong Kong and 6115 in Singapore) (OECD, 2016, p.295). Thus a two level conceptual model can be developed to

estimate the combined effects of schools and individual student attributes on student learning outcomes as reflected in PISA scores. The model is shown in Figure 1. In order to operationalize 'learning outcomes', students' scores in Reading and Mathematics will be taken as the outcome measures. This also adds another comparative dimension to the study since these are two key areas of the school curriculum in both Hong Kong and Singapore.

Data for the study was obtained from the PISA 2015 Database that provides "the full set of responses from individual students, school principals, teachers and parents" (OECD, 2017) along with the codebooks that can be used to identify participating societies, student characteristics and key variables etc. Secondary data analysis was conducted using MPlus8's multilevel regression function to develop the measurement model based on the conceptual model shown in Figure 1. Using common variables, separate models were developed for Singapore and Hong Kong.

Individual level student attributes

A common set of student attributes related to Reading and Mathematics achievement was identified. Some exerted a small but negative effect on achievement for both Hong Kong and Singapore students ('test anxiety', 'perceptions of unfair teachers' and 'gender' in relation to Mathematics [indicating an effect in favour of boys - although the score point difference for the latter was minimal]). Two student attributes ('motivation' and 'enjoying cooperation')[1] exerted positive effects on both groups of students but with marked differences in terms of effect. For Hong Kong students 'motivation' was a stronger influence (β[2]=0.159 for Reading and 0.14 for Mathematics) than it was for Singapore students (β=0.027 for Reading and 0.049 for Mathematics). 'Enjoying cooperation' showed the reverse relation, stronger for Singapore students (β=0.132 for Reading and 0.097 for Mathematics) than Hong Kong

[1] Given the importance of these measures, the items that make up the scale have been included in Appendix 1

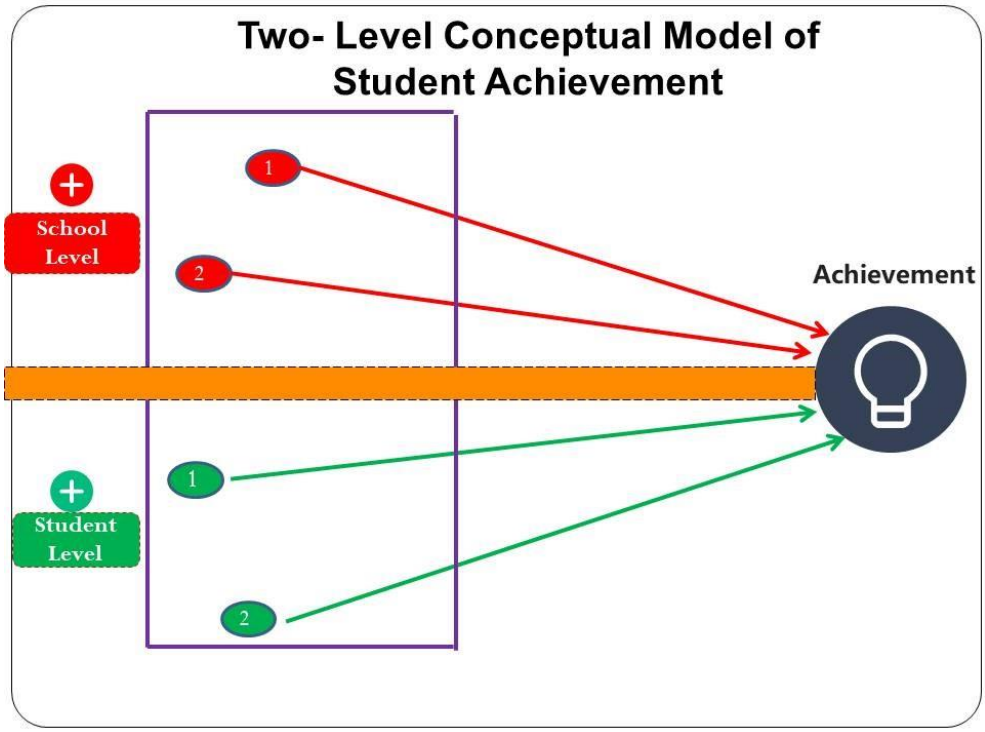
[2] This is the statistical symbol for the regression coefficient indicating the amount of change in the dependent variable (in this case Reading or Mathematics achievement) that is due to the independent variable included in the regression equation (in this case 'test anxiety' and 'perceptions of unfair teachers' are the independent variables).

students (β=0.033 for Reading and 0.008 for Mathematics). The gender effect on Reading was also positive, favouring girls in both cities. Score point differences on Reading were larger for Hong Kong (29) than Singapore (20).

Socioeconomic status (SES), a measure of the influence of parents' social and economic capital, has always been an important indicator in educational research. The results reported here justify that interest. In Hong Kong across both Reading and Mathematics the effects of individual students' SES are minimal (β=0.034 and 0.068 respectively) whereas in Singapore the effects are much larger and might be considered moderate (β= 0.256 and 0.242 respectively).

Figure1

Multilevel Model of Student Achievement



Identifying school level factors

There are at least two ways of identifying those factors that might be considered as "school level" influences rather than the individual attributes of students as discussed in the previous section. One is to analyze the responses provided in Principals' Questionnaire (OECD, 2017) since those responses are considered to represent whole school responses that characterize the way the school is

managed. The second way is to take measures of the individual student attributes and average all the individual measures within a school. This creates what is called a "school averaged measure" (see Krull and MacKinnon, 2001, p. 255 for a discussion of such measures). Each participating school is then regarded as a single unit with a unique measure. The school averaged measure is then regressed on the average measure of the dependent variable to assess the relationship between the two.

From a comparative perspective the identification of common school level effects on Reading and Mathematics achievement proved problematic. In the full model (see Figure 1), that included both individual and school level variables, it was only possible to identify school level effects that operated in Singapore schools and those that operated in Hong Kong schools. For example, 'teacher leadership' exerted a negative effective in Singapore (β= -0.147) and was not significant in Hong Kong while 'teacher participation' exerted a negative effect in Hong Kong (β= -0.131) but was not significant in Singapore. 'Staff student ratio' was significant in Hong Kong (β= 0.445) but not in Singapore. School size and class size exerted a significant effect in Singapore (β= 0.299 and 0.137 respectively) but not in Hong Kong.

The one school level effect that Hong Kong and Singapore shared in common was the school averaged effect of SES. That is, each school was represented by an average measure of SES calculated as the sum of individual student SES measures divided by the number of sampled students in the school. When regressed on average measures for Reading and Mathematics this produced the respective results for Singapore (β= 0.649 and 0.509) and Hong Kong(β= 0.512 and 0.472) results.

For both cities, the results show that schools as "units of SES" directly exert an effect on student learning. To recall the results at the individual student level discussed earlier, for Singapore there was a direct and moderate effect of student SES on learning outcomes (β= 0.256 for Reading and 0.242 for Mathematics) but the effect of SES in Hong Kong was minimal (β=0.034 and 0.068 respectively).

School level effects within both cities are more similar, with the surprising result that in Hong Kong SES exerts its effects in the schools that students go to rather than from the families from which they come. This is different from Singapore, where both the social capital that students bring to school as well as the SES accumulated within schools, directly affect student learning. These are significant results and will be discussed in the following section.

Discussion of results and conclusions

The individual level results discussed above showed both random and fixed effects on students' learning outcomes. The positive random effects differed for Singapore and Hong Kong students with 'motivation' playing an important role for the latter and 'enjoying cooperation' for the former. There were also negative random effects, 'test anxiety' and 'unfair teachers', and identified by both Hong Kong and Singapore students. SES, a fixed effect, exerted a moderate influence on individual students' learning in Singapore but only a minimal effect on Hong Kong students. At the school level it was only SES, a school averaged fixed effect measure that exerted relatively strong effects in both Hong Kong and Singapore.

It seems that the positive fixed effects on Hong Kong and Singapore students signal a possible difference in learning styles between the two groups of students with Hong Kong students being more competitive and Singapore students favouring more cooperative approaches to learning. There is certainly evidence that cooperative learning has been a feature of Singapore's education system for some time (Lee, Ng, and Phang, 2002; Wong, Lee, Kaur, Foong, and Ng, 2009), so such an interpretation is by no means without foundation. It is somewhat supported by the non-significance of motivation as a learning effect for Singapore students in the current study. Yet it must be a tentative finding that requires further research preferably of a qualitative nature so that a better understanding can be developed of students' learning preferences in the two cities.

If the above interpretation is correct, it suggests that different learning preferences can have the same or similar effect on learning outcomes. That is, there is no one 'correct' way to learn and context may play the decisive role. If

Singapore students are encouraged through pedagogy and experience to be more cooperative in their learning while Hong Kong students for whatever reason respond to more individually competitive approaches (they want to do well, they are ambitious etc.), it may simply be a response to the respective environments. If so, this speaks to the power of such environments and the way they can be used to influence learning.

It is important to note the negative random effects on students learning because they suggest once again that students are very susceptible to the environments they experience at school. If too much emphasis is placed on the importance of testing this may lead to test anxiety on the part of students and this will influence their learning. In the same way, if students perceive they are not being treated fairly this will create an environment of mistrust. The main implication of these results is that schools need to be positive places to assist students cope with their daily work including assessments that always represent a challenge whether they are international tests or classroom quizzes. Based on the results of this study this is as true for students in Singapore as it is in Hong Kong.

The effects of SES on individual students' learning provides a key difference between Singapore and Hong Kong students. For the latter, the minimal effects of SES have been noted in most international large scale studies but there is no agreed explanation. Chiu and Ho (2006), for example, have suggested that the lack of effect of SES on Hong Kong students may be the result of the government's equal school funding policies and the collective culture that sees all family members involved in supporting the education of children in the family. If this is the case, then why are similar effects not shown in Singapore that has similar policies and social characteristics to those of Hong Kong, but where the effects of SES have been shown to be moderate? Cheng and Fung (2018) sought an explanation in social cognitive motivation theory. For some time now theorists have argued that the learning culture of Hong Kong with its emphasis on Confucian values, hard work, honouring parents etc. produces highly motivated students who pursue learning as a goal and who attribute success to effort rather than ability. Could these hardworking students wash out

the effect of SES? It is an interesting hypothesis and there is research evidence to support the kind of student attributes discussed by Cheng and Fung (2018). Yet again, given the predominance of the Chinese population in Singapore, why would the same effect not operate there? More research is needed on this issue both in Singapore and in Hong Kong. Stratification exists in both societies, the issue is why does it have such a pronounced effect in Singapore but not in Hong Kong?

If Hong Kong students are not affected by the social capital they carry with them from their homes to their schools, the same cannot be said for the effect of those schools where accumulated SES has relatively strong effects on their learning. In this Hong Kong students are similar to their Singapore peers who are equally influenced by the schools they attend. This phenomena is not confined to these two Asian examples as shown by the PISA 2015 results (OECD, 2016) where the schools effects of SES are shown to be very strong in many countries. Neither are these effects only with this particular PISA study. It was pointed out in the report of the PISA 2003 results (OECD, 2004, p.163) that "there is an added value associated with attending a particular school".

Very often the explanation for the strong effects schools exert is attributed to tracking policies where students with different academic abilities are directed to particular schools (OECD, 2016). Such 'tracking' creates school environments of different kinds with high ability students clustered together and similarly students of so called low ability grouped together. In Hong Kong at the end of primary school students are tracked into Band 1, 2 and 3 schools and in Singapore into Special, Express, Normal academic and Normal technical schools. There is much debate about whether this is actually 'tracking' as opposed to 'streaming' but the results are the same: both Singapore and Hong Kong have highly differentiated secondary education systems in which the schools students attend can directly affect their learning outcomes. Yet how does this work? How does accumulated SES exert such an impact?

Krull and MacKinnon (2010, p.255) have pointed out that aggregate measures used in multilevel modeling "may reflect quite different constructs at the various levels":

> …individual student level responses regarding parental occupation and education may serve as indicators of home background and reflect parental commitment to the student's learning, while school level aggregates of the same responses more likely indicate the wealth and urbanism of the community, which may determine the level of school resources…Aggregate measures may also represent contextual influences, which can operate differently than the individual measures on which they were based.

That is, when we use school averaged measures of SES, as we did in this study, the argument above is that we were measuring more than 'accumulated SES'. Rather, based on Krull and Mackinnon's (2010) view above, we may well have been measuring the random effects that accrue to 'high ability' schools that attract 'high SES' students, and importantly their parents' financial support. Such effects may be related to teacher quality ('the best teachers for the best schools'), leadership ('the best principals for the best schools'), resources ('the capacity of high achieving schools to attract additional resources, especially through their parent body"), school ethos ("successful schools breed a culture of success") and the provision a of extracurricular activities ("enabled by parents resources"). In this scenario, 'high ability schools' become the focal points for resource accumulation (human, financial and cultural) that translates into a conducive learning environment with a positive impact on student learning.

If the above analysis is correct there are important lessons for policymakers in both Hong Kong and Singapore. As Caldas and Bankston (1997, p.271) have pointed out, researchers and policymakers have "generally treated inequalities in outcome as results of the family resources that individual students bring to school". In Singapore's case, and that of many countries, such an approach is understandable, but it may not be enough. The Hong Kong case is a good

example of why more is needed since individual student SES has only a minimal influence on learning outcomes. Policies must, however, address the issue of school level SES and its effects since this is where SES exerts its greatest effect in the Hong Kong context. The best teachers, the best leaders and additional resources must be made available to those schools where the level of student learning needs most improvement. That is, school environments need to be created for Band 3 schools in Hong Kong and Normal academic schools in Singapore to create learning environments that will support improved student learning. Supporting individual students in these schools may also help, but the results of the study reported here suggest that direct support to schools will have a larger effect.

Singapore and Hong Kong students do well when it comes to international assessments. There is strong evidence to suggest that even when students from these societies are ranked towards the bottom of their respective cohorts, they still do better than the OECD average (OECD, 2016). Yet there is no room for complacency. Learning environments were shown in this study to be important at both individual and school levels in both Singapore and Hong Kong. Such environments can help all students, but particularly those who can make the most improvement.

Policymakers are in a good position to assist schools and it is recognized in both cities that there has been a commitment to do so. The future will require even more support so that the school a student attends will not determine his/her learning outcomes. Equalizing school learning environments will go a long way towards equalizing outcomes: this is the message from this study and the challenge for policymakers in Singapore and Hong Kong.

Finally, the limitations of this study need to be recognized. The PISA survey is a one off cross sectional exercise that severely limits any claims about causality. Such claims need to be based on longitudinal studies. In addition, secondary analysis limits the range of variables that can be examined so there may well be additional variables of more importance that were not included in the PISA data.

This would require new surveys and measures. Measurement issues themselves must be considered and the amount of measurement error in the PISA measures must always be kept in mind, especially when the focus is on self-reported data. These limitations mean that the claims made as a result of this study need to be treated cautiously although there is little doubt that there is an agenda for future research. Hopefully the current study has made a contribution to this agenda.

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Appendix 1

PISA Scales

ENJOY COOPERATING	MOTIVATION
• I prefer working as part of a team to working alone • I find that teams make better Decisions than individuals • I find teamwork raised my own efficiency • I enjoy cooperating with peers	• I want top grades • I want to be able to select from among the best opportunities when I graduate • I want to be the best whatever I do • I see myself as an ambitious person • I want to be one of the best students In my class