Skills for the Future: Analyses of Singapore's Graduate Labour Market and its Upper Secondary Education and Training System in Comparative Perspective

Non-Technical Short Report

Francis Green, Andy Green, Golo Henseke, Neil Kaye and Hao Phan

LLAKES Centre, UCL Institute of Education

This short report is an abridged, non-technical version of the longer report of the same title, available to download at the LLAKES website. The full version contains technical details, a more detailed policy discussion and additional sections reporting further findings.

Introduction: Research Objectives

At the heart of this report lies a fundamental issue for successful modern economies: how to ensure that all the workforce have adequate, growing skills, while also minimising the risks that some workers' skills become underutilised. It is widely held that growing skills – including knowledge, technical and social skills, and abilities – are essential for a competitive 'knowledge economy' in which innovation is the driving force. The problem, however, for many modern economies is that the ideal of the knowledge economy is rarely achieved. Education systems vary greatly in how effective they are at generating the skills needed. Many systems result in undesirably high skills inequalities among 15-year-old school children and later among adults. Among those young people who succeed in education and gain university degrees, many fail to gain employment in graduate jobs, spending years in low-level jobs that do not make use of the skills they have acquired. The problem of "graduate under-employment" has been rising, both in Europe and in many East Asian systems where forceful drivers towards expanded participation in higher education have not been checked either by market forces or by government controls.

Singapore has been of long-standing interest worldwide for those interested in skills issues. This small city state has broadly succeeded over decades in maintaining a balance between the skills demanded in the economy at successive stages in its development and the levels and types of skills being supplied by schools, polytechnics and through workplace training, supplemented by a substantial segmented migrant workforce. Singapore also stands out for the successes of its school system, with the pupils in its schools being ranked among the highest globally in skills tests.

For the decade leading up to 2018, Singapore continued to grow rapidly for a fully developed economy. One significant feature of the growth of skills in this period is the substantive ongoing rise in the enrolment of students in Singapore's universities and consequent growth in the flows of graduates into the Singapore workforce. By 2020, four out of every ten young Singaporeans transiting from education into employment were going through higher education. This level of enrolment in itself is not exceptional by international comparison, but the expansion in recent years prompts the question as to whether there are, and will be, sufficient graduate jobs to occupy the many new graduates, especially if the participation rate continues to rise as expected.

Another feature of this latest decade is a substantive alteration in the focus of the government's approach to skills policy. Starting in 2015 with the introduction of its SkillsFuture programme, Singapore radically changed its mainly supply driven, industry-specific skills development model to one that places twin emphases on skills utilisation and the quality of skills supply. SkillsFuture transforms skills development from a previously targeted piece-meal, on-demand and segmented approach to one that embraces the full-notion of lifelong learning. Learning, education and training are encouraged and provided for all citizens, irrespective of employment status or age. In this scenario, not only university graduates but also the rest of the population who achieve post-lower-secondary education and training qualifications are also going to be important. The problem encountered in many countries is not only the low skill levels sometimes achieved, but also the inequalities of core skills gained by fifteen-year-olds. It is generally the case that skills inequalities decrease somewhat by the stage, a few years later, when each cohort is entering the workforce; however, there are very considerable differences between countries at the 15-year-old stage and in the extent to which inequalities change over the ensuing years through the post-secondary system.

Certain features of Singapore's educational system – its tracking within lower and upper secondary education, and its high rate of participation in vocational programmes in upper secondary institutions

and in work-place training – would lead one to expect relatively successful skills outcomes as indicated by the mean levels of skills, but potentially high levels of skills inequality. However, research on the role of post-lower-secondary systems worldwide, and in particular on Singapore's position in the spectrum of post-lower-secondary education and training systems, is relatively scarce. Given the strong evidence that skills inequalities are one of the more important factors underpinning socio-economic inequalities, an understanding of how those inequalities are altered in the post-secondary phase is needed.

This report aims to make two specific contributions towards a better understanding of Singapore's overall skills system. The first part seeks to understand the utilisation of rapidly rising graduate skills in Singapore. In the second part, the report seeks to contribute new understanding surrounding upper secondary education and training. This is a crucial stage of education during which the primarily academic skills of 15-year-olds are added to in uneven ways and start to be transformed into useful work skills and life skills, potentially increasing or decreasing the inequalities that have developed during schooling.

1. Singapore's Graduate Labour Market

The aim of this part of the report is to examine the utilisation of graduates' skills in the labour market. To set the context, we consider the supplies of graduates that emerge from Singapore's education system and note what earlier analyses have concluded about Singapore. We elucidate and draw on the concept of a graduate job, then develop the classification further using task-based analysis before applying it to recent representative survey data about the use of graduate skills.

1.1 The Context of Singapore's Graduate Labour Market

The supply of high-skilled labour

As an advanced knowledge economy, it could be expected that there would be a high and growing demand for high-skilled labour in Singapore. To meet this demand the country is traditionally distinctive in that it has a well-developed short-cycle tertiary education sector led by its five polytechnics, which has delivered a considerable proportion of employers' high-skill needs. Yet those educated to degree level have now become an important segment of Singapore's tertiary labour force, not least because university graduates are expected to be an essential component of the 'skills deepening' effort. To meet future demands for graduate labour, there are now six autonomous universities, which institutions have a collective enrolment of more than 100,000 students. In addition, there are many private transnational campuses offering qualifications from foreign higher education institutions.

In 2019, the size of the workforce was 3.7 million, of whom 2.3 million were Singapore citizens or permanent residents. Some 31 percent of these had professional qualifications, diplomas or post-secondary but non-tertiary education qualifications, while 38 percent were university graduates. The remaining 1.4 million non-residents are highly segmented, between ex-patriate graduates, diploma holders and the rest of the non-resident workforce. The analysis here applies solely to the resident workforce.

Increasing focus on higher education

The need for a new analysis of Singapore's graduate labour market arises both from the recent rapid rise in supply of graduates in the labour force, but also from its expected continued rise in the context

of Singapore's evolving skills policy – the inauguration of SkillsFuture, with programmes designed for students, individuals, employers and providers. The shift of policy emphasis has naturally led to an increased emphasis on the sort of high-skills flexibility for which university education is most suited. The combined intake at Singapore's six autonomous universities grew by four per cent per year since 2008. Even without these rising enrolments, a growth in the proportion of graduates in the labour force would be expected during the 2020s decade, as older less qualified workers retire.

1.2 Task-Warranted and Task-Unwarranted Graduate Jobs

A graduate job is defined as one where "…a substantial portion of the skills used are normally acquired in the course of higher education, including many of the activities surrounding it, and of its aftermath—the years after higher education when skills are acquired in work through graduates' acquired faculty for learning them". With this concept it is important that an indicator of graduate jobs should be based on skills utilisation.

Having defined a graduate job, a graduate is said to be 'under-employed' (or 'overeducated') if doing a non-graduate job. For any individual graduate, not to attain a graduate job is associated typically with substantively lower pay and job satisfaction, compared with similar graduates who are in graduate jobs. In evidence from other countries, immigrant graduates are more likely to be underemployed than indigent graduates; typically, graduates' risk of being underemployed varies across socio-demographic groups, field of study, and achieved skill level. High-skilled jobs have been increasing, but in a number of countries the rate of increase has been slower than the increase of graduates in the labour force, and under-employment has been increasing.

Graduate jobs can be further distinguished between those jobs that involve doing tasks that are normally associated with degree-holders, and jobs which do not involve such tasks to a significant extent. We term the former 'task-warranted' graduate jobs. In the latter, which are termed 'task-unwarranted' graduate jobs, applicants are required to have degrees, but this is because there are unobserved tasks requiring high skill levels, and the relevant unobserved abilities are signalled by the achievement of a university degree. As the prevalence of degree-holders in the population rises, more employers may require a degree qualification as a signal of their applicants' unobserved skills. It could be prediced, however, that task-warranted graduate jobs are likely to pay higher wages than task-unwarranted jobs – which, in turn would still pay more than non-graduate jobs.

1.3 Research Objectives

In light of the above, to characterise the state of the graduate labour market for Singapore residents, the report sets out to examine the following questions:

1: What proportion of the jobs held by Singapore resident graduates are self-reported to be graduate jobs? Among those graduate jobs, what proportion are task-warranted, involving the performance of identifiable graduate tasks, and what proportion are task-unwarranted? And how are these proportions changing over time?

2: Second, complementary to the changes in these proportions and the growing share of graduates, what is the wage premium in Singapore for graduates as compared with non-graduates? What are the wage penalties for graduates who are either in non-graduate jobs or task-unwarranted graduate jobs, compared with those in task-warranted graduate jobs? And how are the premium and penalties changing over time?

3: What are the socio-economic background determinants of obtaining a graduate job in Singapore?

1.4 Data

The primary sources of data are the Skills Utilisation 2 Survey 2013 (SU2) and the Singapore Skills and Learning Study 2017 (SLS). SLS and SU2 are the second and third iterations of the Skill Utilisation series which aims to track skills utilisation in Singapore, respectively. Both surveys built on the design of the British Skills and Employment surveys. They collected rich, comparable data on job tasks and qualification and learning requirements.

SU2 is a representative quota sample of 3,422 employed Singapore citizens and permanent residents. SLS used the more satisfactory method of random probability sampling of adult citizens and permanent residents, with a response rate of 68%; the achieved sample was 6,298, of whom 77% were in paid work. In both cases, interviews were conducted face-to-face. The surveys were combined into a pooled sample of workers aged 20 to 65.

1.5 Variable Measurement

To measure jobs' educational requirements, SU2 and SLS asked workers "If they were applying today, what qualifications, if any, would someone need to get the type of job you have now?". Workers could select all applicable qualifications from a list of nationally recognised qualifications. Although some measurement error is possible, experience elsewhere suggests that workers can generally accurately report both their highest attained qualification and the qualification requirements to get their jobs. A graduate job is defined as one where the respondent would need a higher education qualification.

The definition and selection of job task items follows previous research. The surveys ask participants about the importance of more than 45 job tasks including manual, literacy (reading and writing short/long documents), numeracy (calculations using addition/ fractions/ statistics), problem-solving (spotting problems, working out solutions), orchestrating others (planning others, persuading, negotiating) or computer use (importance and complexity). Each item measures the importance of the job task in the respondent's job in five steps from "essential" to "not all important/ does not apply". To study the demand for graduate skills, we concentrate on job tasks around high-level information processing, orchestration, interpersonal tasks and computer use. Each task variable is given a value of one if a job task is deemed essential and zero otherwise. We then used statistical methods to distinguish between task-warranted and task-unwarranted graduate jobs.

1.6 Key Findings

1.6.1 Singapore's dynamic graduate labour market, 2013-2017.

According to Figure 1, the share of graduates in the employed workforce rose from 32 per cent to 38 per cent in the four years between the surveys. Yet the impressive growth of the graduate workforce was more than matched by a 9.6-point increase in the per cent of jobs that required a university degree upon entry. There is thus a dynamic balance over this period between the supply of graduates and graduate jobs.

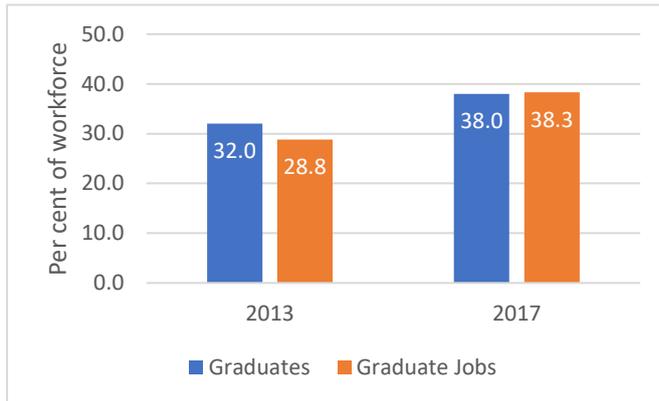**Figure 1. Graduates and graduate jobs in Singapore, 2013 and 2017.**

Figure 2 plots the findings from the job-task analysis. According to this analysis, 7.6 points out of total 9.6-point rise of degree requirement is 'task-warranted', that is, it can be attributed to shifts in the job task mix. Thus, almost all of the surge in degree requirements over this period in the Singaporean labour market was grounded in job upskilling. The proportion of jobs which appear to have been re-designated as jobs requiring degrees without any change in graduate job content is small, and insignificantly different from zero. The net result was that the proportion of graduates who were in task-warranted graduate jobs rose from 56.5% to 66.3%. We thus conclude that, assuming these two surveys have captured representative samples of the employed residential population, the 2013 to 2017 period was one of substantive upskilling in Singapore's jobs.

Figure 2 The majority of the growth in graduate jobs is task-warranted
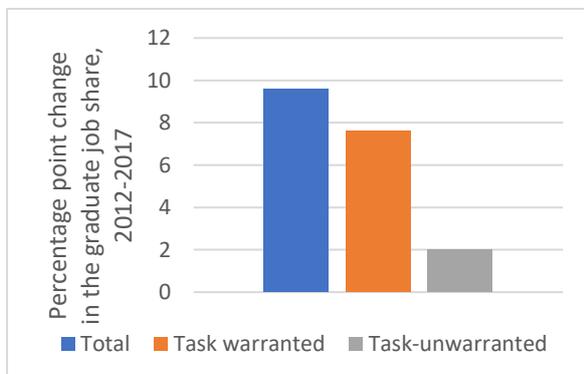
1.6.2 Graduate wage premiums and penalties

Changes in graduate demand and supply are thought to influence the wage premium associated with higher education; but since both rose to a broadly similar extent, one might expect to see some stability. Stability is also predicted because the institutions and processes underpinning wage determination for graduate jobs are not expected to change rapidly. Wages are to an extent regulated across Singapore, with a strong influence coming from the 'going rate' in each industry.

We measure the higher education wage premium as the differential in the log of hourly wages between university educated workers and otherwise similar workers with at most secondary-level qualifications. Figure 3 shows the estimates of the wage premium for 2013 and 2017.

Figure 3: The hourly pay premium for graduates relative to those who had attained at most secondary-level qualifications


Figure 3 shows that higher education is associated with a very substantial wage premium in Singapore. Across the whole resident workforce in 2017, graduate hourly pay was more than twice (= exp(1.104)) the mean pay for secondary school leavers. Further analyses show that the wage premium was similar in the male and female workforce but it is larger in the age-bracket 35-65 years than for younger workers – a finding that is consistent with international evidence that higher education leads to faster wage growth over the course of careers. Over time the very high graduate wage premium held its ground, which is consistent with the balanced expansion of graduate supply with the demand for graduate skills.

Changes in the graduate wage premium are unlikely to provide a full account of pay dynamics over time within the graduate labour force. With rising higher educational attainment, graduate labour markets tend to diversify. Both underemployment and skills underutilisation have been found to come with a significant pay penalty. The incidence and the wage 'costs' associated with underemployment and underutilisation should depend on the changes in graduate supply and demand. If the growth of graduate labour supply exceeds the additional demand for high skilled labour, graduates move into non-graduate positions.

Consistent with the earlier findings of a growing excess demand for graduate skills, we expect to find at least a stable wage penalty associated with underemployment and underutilisation.

Figure 4. Graduate pay by job match status
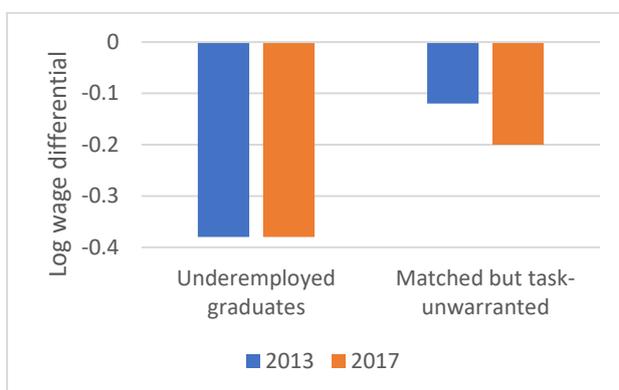
Note: Mean log wage differential by job match status of graduates adjusted for gender, 5-year age-groups, indicator for the presence of dependent children under 16 in the household, and cohabitation status.

Figure 4 displays the mean pay penalty associated with underemployment and underutilisation for graduates. Two key findings stand out. First, underemployment carries a heavier wage penalty than

being in a task-unwarranted graduate job. In 2017, average hourly pay for task-unwarranted graduates was about 18 per cent lower than for their well-matched peers. Its magnitude is notably less than the penalty experience by underemployed graduates, who earned on average 31 per cent (=1-exp (-0.38)) less than graduates in task-warranted graduate jobs. The same ranking in earnings is found for all demographic subgroups in the data.

Second, we find no significant change in the wage penalties associated with underemployment and underutilisation. The finding of stable underemployment wage penalties in Singapore is consistent with trends in most European graduate labour markets.

In all, our analyses show a graduate labour market in good health. The surge in higher educational attainment in the workforce from 2013 to 2017 was met by a rising share of jobs with degree requirements. The proportion of jobs with degree requirements rose by almost 10 percentage points between surveys. Almost all of the shift towards more degree requirement was found to be task warranted and thus routed in job upskilling. The positive picture is complemented by a substantial and stable graduate wage premium and no sign of increasing pay inequality by job match status.

1.6.3 The determinants of achieving a graduate job in 2017

Notwithstanding the overall picture just described, the inequality of wages is an ongoing issue. Even though more graduates were matched in task-warranted graduate jobs in 2017 than in 2013, there remain many graduates who were not so matched. As we have also seen, this matters for their pay. because matched graduates typically earn more than graduates in non-graduate jobs. Moreover, in other countries the probability of graduates working in graduate jobs is rarely equally distributed among socio-economic groups. Differences in this probability therefore often point towards wider inequities in the access to top jobs and in income.

Here, we compare how the likelihood of working in a well-matched job differs among graduates according to three socio-economic categories. Figure 5 depicts the percentage point differences by gender, migration status and parental education. It shows substantial differences in higher education leavers' likelihood of working in graduate jobs in Singapore. Women graduates were more than 10 percentage points less likely to attain a graduate job than their male counterparts, a gap that was statistically significant. Further detailed analysis suggest that the gender gap exists both in the younger workforce below 35 and more established workers aged 35 or above.

Figure 5. The likelihood of attaining a graduate job, according to gender, migration status and whether 'first-in-family'.
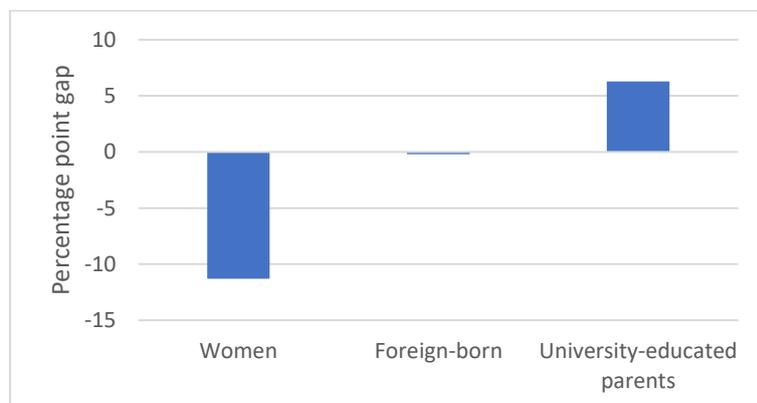
In Singapore, as in many other countries the chances of completing a university education differs significantly by parents' educational attainment. But even among graduates, some differences in job destinations appear to persist. Our analysis suggests that there is a 6-point advantage for graduates

with university educated parents to attain a graduate job, compared with peers of the same age whose parents did not complete university (sometimes referred to as 'first-in-family' graduates). By contrast, we find no differences between Singapore nationals and permanent residents in the likelihood of attaining a graduate job.

1.7 Policy Implications

The period before the COVID-19 pandemic appears from our evidence to have been one where a successful dynamic balance was being maintained in the graduate labour market for Singapore citizens and residents.

Looking to the future, however, this dynamic balance does not mean that there is no risk that an underutilisation of graduates could develop in the coming years. The growth in university enrolment, supplemented by the retirement of older, less qualified workers, implies that the supply of graduates is likely to continue to rise substantially through the current decade, unless there were to be a strict pause on enrolments. Whether and how fast the proportion of graduate jobs will continue to grow, however, is more difficult to predict. To be sure that medium-term policy levers are used to best effect, it is recommended that ongoing efforts are made to monitor the growth and distribution of graduate jobs. Future waves of the Skills and Learning Study should be able to deliver this intelligence, for informing educational policymakers and university plans. We would also recommend that all segments of the workforce should be considered in the analysis, in order to gain the best picture of the evolving supplies and demands for graduate labour.

In this study, we have also found that women, and those whose parents had not been university graduates, are two important groups who are more likely to find themselves in jobs that do not match their attained qualifications. These differences contribute therefore to the gender pay gap in Singapore and reduce somewhat the social mobility that should be made possible through university education for those from less-advantaged backgrounds. Policies that can reduce the gap would therefore be beneficial for reducing socio-economic inequalities.

It must be noted finally that the failure to match graduates' qualifications and skills with jobs, where this occurs, does not mean that students' degree education is wasted. Under-employed graduates do have a chance of upgrading their job in subsequent years; and, even if they do not do so, their university education can have other benefits for those individuals – such as better health, and better well-being from non-work activities – and many 'external' benefits for others in Singapore society. Nevertheless, university education is costly, and the aspiration to obtain a graduate job is typically among the primary objectives of students. Ensuring that the higher education system and the economy retain their dynamic balance over time is likely therefore to continue to be an important consideration for the foreseeable future.

2. The Effects of System Type and System Characteristics on Skills Acquisition in Upper Secondary Education and Training

The second part of this report examines the effects of upper-secondary system types and characteristics on skills acquisition during the upper secondary phase of education and training and considers the implications for Singapore. We use data from a large sample of countries in waves 1 and 2 of the OECD's Survey of Adult Skills (SAS), and from PISA tests of 15-year-olds, and employ a variety of statistical methods.

Throughout the report we refer to 'skills' as 'core skills' defined by OECD. We are, however, aware that non-cognitive skills are also important for graduates to enter the labour market and these skills are not necessarily linked to or predicted by the levels and distributions of core skills.

The research involved:

- a review of the literature on education system effects on skills during the lower and upper secondary phases of education and training;
- the development of a new typology of upper secondary education and training systems for the period under scrutiny (roughly 2008-2012);
- the construction of a descriptive dataset of education system characteristics and measures of skills levels and distributions at ages 15 and 18-20;
- a statistical analysis of the effects of system types and characteristics;
- a consideration of the policy implications of the research for Singapore.

2.1 Typology of Upper Secondary Education and Training Systems

On the basis of the literature review and our newly collected data, we identified six broad types of upper-secondary education and training systems in OECD countries relating to how they were during the period when the 18-20 years olds tested in SAS (in 2011-2014) were going through upper secondary education (i.e., roughly between 2008 and 2014).

Type 1. These are predominantly school-based systems with general academic and vocational provision in different types of dedicated upper secondary institution and with apprenticeships representing separate but residual systems. Programmes normally last for two or – more usually – three years, and end with a qualification which gives access to general university higher education (ISCED 5A), in the case of general education students, and vocational tertiary education (at ISCED Level 4 or 5B) for vocational students. The curricula in different general and vocational programmes generally share certain common core elements but programmes are typically organised around a cluster of subjects specific to the disciplinary or vocational orientation of programme. Diplomas are normally based on externally administered 'grouped awards' which require passes in a range of subjects, including core areas of language, maths (and sometimes civics). *Type 1b.* A subset of Type 1 countries (Denmark, Netherlands, Finland and Singapore) is also distinguished by having high rates of participation on vocational programmes, often with a substantial element of work-based training as part of their vocational school provision.

Type 2. These are predominantly comprehensive, school-based systems with academic and vocational provision within the same institution and with, again, apprenticeships representing a largely residual alternative form. Provision is organised either as a standardised, core-plus-options programme, as in most North American high schools, or in differentiated programmes with distinctive subject specialisms but overlapping cores of general education, as in Norway or Sweden. Study durations tend to be standardised at two or three years across all tracks in the US and Canada and at three years in the Nordic countries. These systems share most of the characteristics of Type 1 systems but tend to have a higher degree of integration of curricula and assessment across the range of provision. They can be regarded generally as relatively standardised on one level – since there is only one main type of upper secondary institution and all programmes tend to have long cycles. However, governance and regulation vary considerably between the US and Scandinavian contexts, with school choice and diversity policies in the federal US system leading to much greater institutional variation than would be found in the more standardised and unitary Nordic systems. Because of differences in governance

and regulation systems are best divided between **Type 2a** for the North American variant and **Type 2b** for the Nordic variant.

Type 3. These are systems with participation distributed relatively equally between school-based general education and employment-based Dual Systems of apprenticeship and are found exclusively in 'social market' type political economies (Hall and Soskice, 2001). In this kind of system, the provision at upper secondary level may be of similar duration across the different tracks (as with the normatively three-year apprenticeships and final stage *Abitur* courses in Germany), and the vocational track contains significant mandatory components of general education in all Dual System apprenticeships (Solga et al., 2014). However, the general and vocational tracks remain very distinctive, with sharp differences in forms of regulation, curricula, and assessment, and with clearly differentiated final qualifications and subsequent progression possibilities in education, training and work. Apprenticeship systems are closely integrated with labour market institutions and the world of work, and this has important effects on the labour market value of the qualifications they offer and the consequent incentives this provides for apprentices. Dual System apprenticeships are generally considered to be of high quality and the programmes attract a large number of students. With such apprenticeship systems, it is argued there will be greater parity of esteem between the academic and vocational tracks, and consequently expectation and achievement in the vocational tracks will be higher.

Type 4. These are 'Mixed Systems' which include many different school- and employment- based programmes of variable length and quality but with dominant academic tracks. Systems of this type tend to have pronounced status gaps between academic and vocational programmes with the most qualified students entering academic programmes and the least qualified entering vocational programmes which are often shorter in duration and do not necessarily offer progression routes into higher level programmes or high-quality jobs. Low rates of participation in vocational tracks, which are relatively under-funded by comparison with the academic tracks, offer further evidence of status gaps between general and vocational provision. Mixed systems are also notable for their lack of curriculum standardisation across programmes since they lack a common core curriculum and do not mandate the study of maths and the national language across all tracks. Regulation and governance in mixed systems is generally more liberal and market-oriented than in other systems, with much diversity in programmes and types of providers, including private training organisations and, in the case of the UK, private awarding bodies. Systems in this group tend to have lower participation rates among 17- and 18-year-olds and relatively high rates of early school leaving (defined by the European Commission as those who leave education without qualifications above the ISCED 3C (short) level).

Table 1 lists the countries classified by the above types.

Our hypotheses regarding the effects of system types on changes in outcomes during upper-secondary education and training were as follows:

- Type 2b and Type 3 systems will perform well in enhancing average skills levels, because they combine a degree of standardisation in key areas (e.g., core curricula, long-cycle programmes) with an emphasis on vocational and work-based learning and high teacher quality.
- Type 2a and Type 4 systems will perform less well in raising mean skills levels because of the lower rates of participation in vocational learning and the relative lack of parity of esteem between academic and vocational tracks.
- Type 4 systems will be additionally disadvantaged by the lack of curriculum standardisation in core areas.

System Type effects on skills inequality:

- Type 2b systems and Type 3 systems will reduce skills inequality because of curriculum standardisation in key areas (mandatory literacy and language provision; length of courses) and due to relative parity of esteem between academic and vocational tracks (particularly in Type 3 where work-based learning raises skills of vocational students).
- Type 4 systems will be less effective in reducing skills inequality because of system fragmentation and lack of curriculum standardisation in core areas, both of which undermine normative standards. Comparatively low recruitment to vocational programmes seen to be of low quality, and the large status gaps between these and academic programmes, will also tend to sustain skills inequalities in the upper secondary phase.
- Type 2a systems will be less effective in reducing skills inequality because of the relative absence of vocational learning.

Table 1. Countries included in the sample

Country	Country code	System Type	PISA wave	PIAAC round	Country	Country code	System Type	PISA wave	PIAAC round
Australia	AU	4	2006	2011/12	Italy	IT	1	2006	2011/12
Austria	AT	3	2006	2011/12	Japan	JP	1	2006	2011/12
Canada	CA	2a	2006		Korea	KR	1	2006	2011/12
Canada (English)	CA-en	2a		2011/12	Lithuania	LT	1	2009	2014/15
Canada (French)	CA-fr	2a		2011/12	Netherlands	NL	1b	2006	2011/12
Chile	CL	4	2009	2014/15	New Zealand	NZ	4	2009	2014/15
Czech Republic	CZ	1	2006	2011/12	Northern Ireland (UK)	UK-ni	4	2006	2011/12
Denmark	DK	1b	2006	2011/12	Norway	NO	2b	2006	2011/12
England (UK)	UK-en	4	2006	2011/12	Poland	PL	1	2006	2011/12
Estonia	EE	1	2006	2011/12	Russian Federation	RU	1	2006	2011/12
Finland	FI	1b	2006	2011/12	Singapore	SG	1b	2009	2014/15
Flanders (Belgium)	BE-fl	1	2006	2011/12	Slovak Republic	SK	1	2006	2011/12
France	FR	1	2006	2011/12	Slovenia	SI	1	2009	2014/15
Germany	DE	3	2006	2011/12	Spain	ES	4	2006	2011/12
Greece	GR	1	2009	2014/15	Sweden	SE	2b	2006	2011/12
Ireland	IE	4	2006	2011/12	United States	US	2a	2006	2011/12
Israel	IL	4	2009	2014/15					

2.2 Descriptive Data on Skills Outcomes

The following descriptive analysis first looks at the average skills outcomes in literacy and numeracy for 18-to-20-year-olds, as measured in SAS, and their relation to PISA scores at age 15. Grouping countries by system type allows us to identify some underlying trends:

- Type 4 systems score lower, on average, than those in other system types, and below the average for all systems by 7 points in literacy and 12 points in numeracy.
- Type 2a systems (the US and the two regions in Canada) score, on average, below the country average in both literacy and numeracy, and below the average for other types, except Type 4.

Anglophone Canada performs better than the other systems in the group in literacy, but all systems in the group perform below the system average in numeracy.

- Type 1b systems perform, on average, higher than other system types in both domains, with average scores respectively 11 and 13 points higher in literacy and numeracy. This group includes Singapore, the Netherlands, Denmark, and Finland.
- Type 1 systems – the largest group of countries/territories – perform at around the average seen across the sample in both literacy and numeracy.
- Type 3 systems (Austria and Germany) perform similarly in both domains. Their average is close to the system average in literacy scores, but five points above the system average in numeracy.

Changes in inequality of skills outcomes

To measure the inequality in skills scores, we calculated the Gini coefficient. In principle, this index could range from 0 to 1, with higher scores indicating greater skills inequality. Figure 1 shows that all countries, with the exception of Chile, managed to reduce inequality in literacy scores during the upper-secondary stage, although there is considerable variation in the magnitude of this reduction. For numeracy, six countries see an increase in inequality, whilst for countries that see a reduction in inequality, these are typically more modest than those seen in literacy scores.

Figure 1. Inequality in literacy and numeracy scores by country/territory (PISA – 15-year-olds and PIAAC – 18-20-year-olds): Gini coefficients.
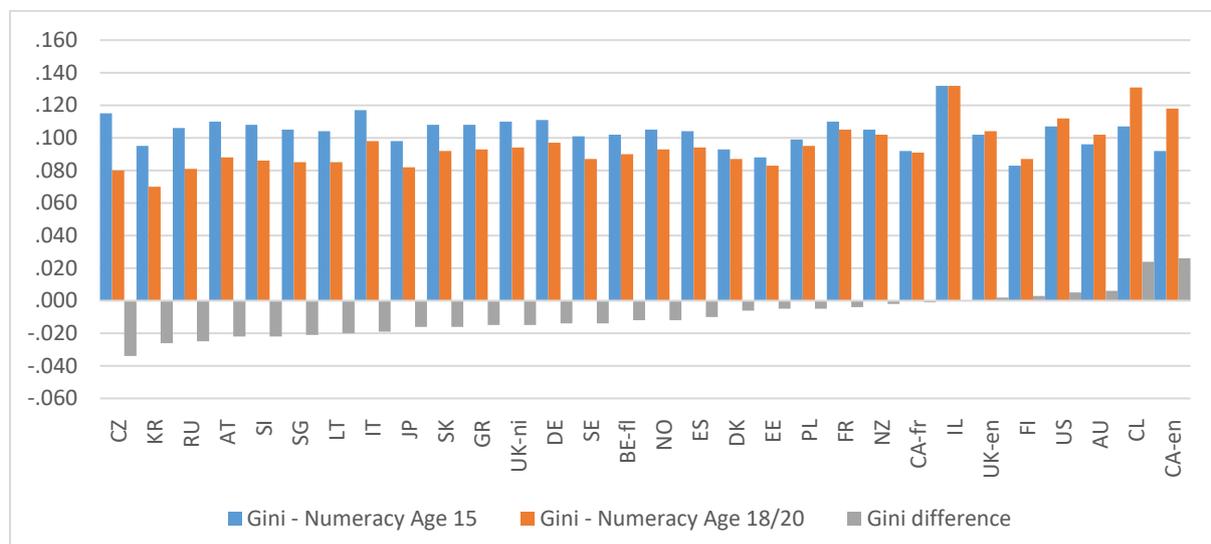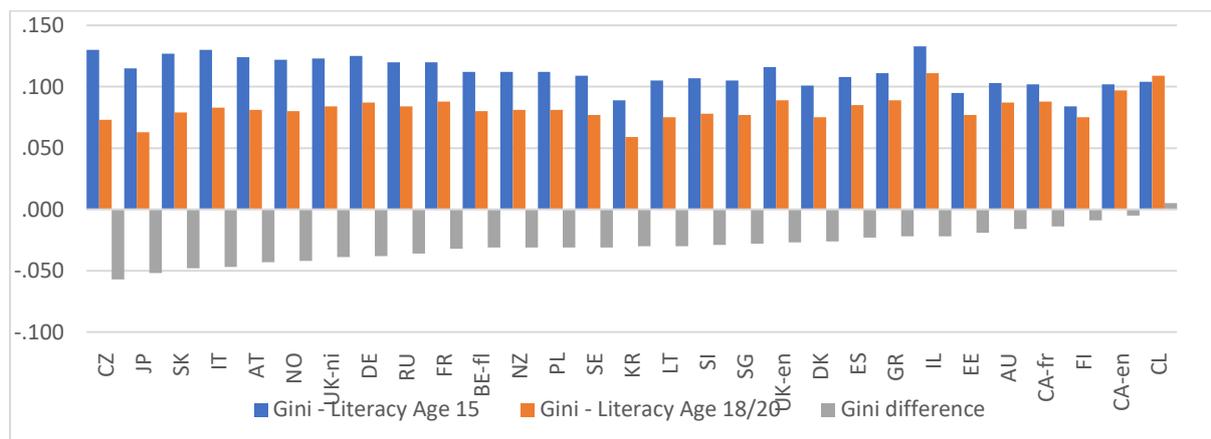
The countries seeing the greatest reduction in inequalities for literacy (Czech Republic, Japan, Slovakia, and Italy) are in Type 1 systems, whilst Type 3 systems (Austria and Germany) also improve their relative inequality of scores. At the other end of the spectrum, the pattern is less clear-cut with the smallest reductions (or even increases) in inequality being seen in Chile and Australia (Type 4), Canada (Type 2a) and Finland (Type 1b).

Similarly, for numeracy, countries with Type 1 systems (again the Czech Republic, but also this time Russia, Korea, and Slovenia) see the greatest reduction in inequality, along with Austria and Singapore. The same countries that perform relatively badly in literacy are also those seeing increases in inequality for numeracy – Canada (English-speaking), Chile, Australia, and Finland. In addition, the United States and England also experience small increases in inequality for numeracy scores in upper-secondary education.

Comparing levels of inequality between PISA scores at age 15 and SAS scores among 18-to-20-year-olds by system type (Table 2), we can see that overall, for both reading/literacy and maths/numeracy, the distribution of scores has become less unequal. This reduction in inequality is notable in Type 1 and Type 2b systems and, particularly, in Type 3 systems, which see the most unequal scores at age 15, yet have substantially less unequal distribution of scores at the end of upper-secondary education. By contrast, Type 2a North American systems see a smaller reduction in inequality in literacy and an increase in inequality in numeracy. Type 4 mixed systems see a reduction in literacy inequality but flat line in numeracy inequality.

Table 2. Gini coefficients of inequality in relation to scores in reading/literacy and maths/numeracy by system type (PISA – 15-year-olds and PIAAC – 18-20-year-olds)

	Age 15 (PISA)	Age 18-20 (SAS)	Age 15 (PISA)	Age 18-20 (SAS)
	Reading	Literacy	Maths	Numeracy
Type 1: Differentiated systems	.113	.077	.104	.088
Type 1b: Differentiated systems, with school-based apprenticeships	.097	.076	.094	.086
Type 2a: Comprehensive systems – North American	.102*	.090	.097	.107
Type 2b: Comprehensive systems – Nordic	.115	.079	.103	.090
Type 3: Dual systems	.125	.084	.111	.093
Type 4: Mixed systems	.114	.091	.108	.107
TOTAL	**.112***	**.082**	**.104**	**.095**

*The values exclude the US (as there are no data available)

2.3 The Effects of System Characteristics and Types on Skills Acquisition

We analysed the extent to which different system types (and individual system-characteristic indicators) are associated with better or worse performance in literacy and numeracy at the end of upper secondary education, after accounting in various ways for system-level PISA scores in (respectively) Reading and Maths at age 15 as control variables.

Table 3 shows the literacy and numeracy scores in each of the education system types, relative to the scores for Type 1. The significant findings are:

- There is, as expected, a strong correlation between country-level average scores for Reading and Maths at age 15 with scores, respectively, in literacy and numeracy at age 18-20.
- In comparison to Type 1 systems, average scores for literacy are significantly lower in Type 2a comprehensive systems (North American) and in Type 4 mixed systems.
- A similar relationship can be seen in numeracy scores, with comprehensive systems (North America) and mixed systems having significantly lower average scores compared with Type 1 differentiated systems. Type 1b systems have higher average scores than Type 1 in literacy and lower in numeracy but the difference is not significant.

We used a variety of statistical methods to confirm the robustness of these findings.

Table 3. Analysis of the effects of system type on literacy and numeracy scores

	Literacy – Age 18-20 (Standardised values)	Numeracy – Age 18-20 (Standardised values)
	Estimate	**Estimate**
System type (ref: Type 1 – Differentiated systems)		
Type 1b	.024	-.282
Type 2a	**-1.210****	**-1.074*****
Type 2b	-.147	.119
Type 3	-.292	-.010
Type 4	**-.765****	**-.709*****
Literacy – Age 15 (standardised values)	**.654*****	
Numeracy – Age 15 (standardised values)		**.745*****
Constant	.329	.306*
Observations	32	32
R-squared	.566	.762

All scores are standardised to have a standard deviation of 1 and a mean of 0.
The asterisks show if the finding is statistically significant, in other words that it is unlikely to have come about by chance through the random selection of survey participants: * $p < .05$; ** $p < .01$; *** $p < .001$

2.4 The Effects of System Characteristics on Skills Outcomes

What system-specific characteristics, then, can account for these relative differences in performance between system types? The subsequent analysis sought to model the effect of individual characteristics of educational systems at upper secondary level to allow for a more fine-grained examination of specific indicators that may influence some systems to improve their performance more than others.

The Effect of System Characteristics on Average Skills Outcomes

Our findings suggest that what appears to matter most is the proportion of students in a system who are enrolled on vocational programmes. Those systems with relatively more students in vocational education at upper secondary see modest improvements in literacy and numeracy outcomes. Moreover, for countries with more vocational students, later selection on entry to upper secondary education or during this stage, is associated with better outcomes.

The Effect of System Types and Characteristics on Inequality of Skills Outcomes

The next analysis looked at the effect of system types and characteristics on changes in inequality of skills outcomes. System type also appears have a significant effect on changes in inequality in the distribution of these outcomes. In particular, compared to the most-common Type 1 systems, Type 2a comprehensive (North American) systems and Type 4 mixed systems become relatively more unequal between age 15 and post-upper secondary in both literacy and numeracy outcomes. In addition, for literacy outcomes, Type 1b systems are significantly more unequal at the end of upper secondary education, compared to the Type 1 group.

The theoretical duration of upper secondary has a small negative effect on inequality in numeracy score, which implies that systems with longer programmes in mainstream upper secondary education return less-unequal skills outcomes. There are small positive effects on literacy and numeracy inequality from later selection within an education system. There is evidence for an increasing positive effect on inequality as selection happens later – with the largest effect size being seen for systems selecting during upper secondary, as compared to those selecting on entry to lower secondary. There is a small positive effect of teacher workload on inequality in both literacy and numeracy scores – teachers under greater workload pressure being associated with worsening inequalities in score distributions.

Systems with less-standardised curricula have greater inequality of skills scores for both literacy and numeracy. The magnitude of this effect appears to be greater for numeracy than for literacy, which may be explained by the fact students continue to practise their language skills across subjects more than will be the case for numeracy even when there are no mandatory classes.

Finally, there is evidence that skills acquisition is more equally distributed in systems with higher levels of vocational provision.

2.5 Overview of System Effects

The most notable finding from our statistical analysis is that the Type 2a (North American comprehensive) systems and the Type 4 (mixed) systems perform consistently poorly relative to other system types in both literacy and numeracy skills acquisition between age 15 and age 18-20. They also do less to mitigate skills inequalities during the upper secondary phase than other system types.

We also identified five system characteristics (some with multiple indicators) with broadly consistent effects across countries in both raising skills levels and mitigating skills inequalities during upper secondary education. These relate to the length of upper secondary study; the proportion of the cohort completing long cycle level 3 courses; curriculum standardisation; vocational prevalence; and teacher workload. Taken together, these characteristics seem to go some way towards explaining the variations across countries and between system types in changes in skills levels and distributions during the upper secondary phase.

Systems are expected to perform better when the participation in vocational learning is relatively high and where greater parity of esteem between the vocational and general tracks is established through the provision of consistently high-quality apprenticeships and/or through system integration measures which promote standardisation in key areas of the curriculum. The same characteristics seem to improve skills acquisition and reduce inequalities in skills outcomes.

Countries in the system types (Types 1, 1b, 2b and 3), which do better in raising core skills levels and mitigating inequalities, have comprehensive or tracked systems; they also generally exhibit key forms of standardisation and achieve relatively greater parity of esteem between general and vocational

learning than other systems. These types of system generally have high rates of participation in long-cycle upper secondary education and training leading to level 3 qualifications; most require continued learning of maths and the national language across all programmes; and all have relatively high rates of participation in vocational programmes, often including work-based learning.

2.6 Implications for Singapore

The final part of the report considers the implications of the cross-country comparison for upper-secondary education and training in Singapore. From our analysis of the research literature and our data on system characteristics, we categorise Singapore as a Type 1b system, together with Denmark, the Netherlands, and Finland.

We find that:

- Singapore performs highly in mean scores for Reading/literacy and Maths/numeracy both at age 15 (PISA) and at ages 18-20 (SAS).
- At age 18-20 in SAS, among the countries with values in our sample, Singapore ranked first in numeracy and sixth in literacy.
- According to our analysis of relative changes in skills between age 15 and age 18-20, Singapore maintains its high position relative to other countries in both literacy and numeracy skills, although it does not significantly improve on it during the upper secondary phase.
- Given the tracked nature of its lower and upper secondary systems - often associated across countries with greater inequality in skills - Singapore also has rather less-unequal skills outcomes that might be expected.
- In PISA 2009, Singapore's country rank position on the skills Gini measure of inequality was low-to-average – 20th out of 28 countries for Reading and 15th out of 30 countries for Maths. Notably, Singapore had a very low proportion scoring at below level 2 in Reading (12 percent against the OECD average of 19 percent), with only five countries scoring better on this measure.
- Skills inequality at age 18-20 in SAS was again quite low in both skills domains, with Singapore ranked 23rd out 32 countries on the skills Gini measure of inequality for literacy and 26th out of 32 countries on that measure for numeracy.
- Singapore was less successful than many countries in reducing inequality in literacy, with 17 countries doing better and 11 worse. However, in numeracy it was among the most successful in inequality mitigation, with only five of 32 countries doing better.
- In common with most other countries which perform relatively well in raising skills levels and reducing inequalities, Singapore has high rates of participation and completion in long-cycle upper secondary and training, with a high proportion of students in vocational programmes. However, the proportion of vocational students undertaking work-based learning - through work-experience placements, internships or school-based apprenticeships - remains comparatively low.

This part of the report concludes by discussing potential policy implications from the comparative analysis that would address the problem of persistent literacy inequality through the upper secondary education and training stage, and in particular highlights the potential advantages of offering compulsory English/language courses taught as separate subjects by specialists in the ITEs and Polytechnics and making apprenticeships more widely available for low-achieving students.

Conclusion

This report has presented the findings of research on important questions surrounding the articulation of Singapore's skills and employment systems, of potential interest both in Singapore and to a wider global audience. The successes of its school system, at least as measured by international comparative tests of core skills at the end of lower-secondary education, are well known. This new research was prompted by the realisation that, in the latest period of Singapore's development, the changing way that skills are developed, sustained and utilised after the end of lower secondary schooling is central to the support of a successful knowledge economy. Many questions arise following the introduction of a new orientation to skills development policy under the SkillsFuture programmes. Two issues, in particular, have been examined in depth in this report: the dynamic matching of the rapidly growing supplies of university graduates with graduate jobs, and the changes in the level and inequality of skills during the post-lower-secondary phase.

Each part of the report has noted its own policy suggestions. Part 1 notes the success of Singaporean planning and labour market institutions in coordinating skills supply and demand and the ongoing importance of this and of ensuring the full utilisation in the workplace of the knowledge and skills acquired through the education system. It also references the ambition of SkillsFuture to provide a more comprehensive approach to lifelong learning by ensuring its availability to all individuals at different stages in their lives. As part of this SkillsFuture has been promoting new ways of integrating learning, work and earning through the provision of 'work-study' programmes as part of continuing education and training. The ongoing dynamic matching of supply and demand in the graduate labour market is a promising sign, but, as noted in this part of the report, we advise against complacency in respect of this growing part of the labour market and advocate ongoing monitoring of the issue.

Part 2 of our report also underlines the substantial benefits to be reaped from integrating forms of work-based learning in upper secondary education and training, even where this is predominantly school-led, as in Singapore. Our comparative analysis, based on new evidence that incorporates data from many other countries, indicates that it is not only in countries with Dual systems of apprenticeship where these benefits are realised. Other countries with largely school-based systems manage to incorporate substantial elements of work-based learning in their upper secondary provision, through the use of work-experience placements, internships or hybridised types of state-led apprenticeship. There would seem to be much scope for extending the reach of the SkillsFuture work-study ethos into both adult working life and initial vocational training.