

Country Reports

Singapore

1.1 Relevant Policy

Singapore has prioritised education, training and human capital development at a policy level.¹ Education in Singapore is managed by the Ministry of Education, which administers state schools using government funding and supervises private schools.² Mathematics and science are core subjects that every learner must take. The country's solid foundation in mathematics and science for all learners in the elementary grades is a core part of students' later success at the primary and secondary levels. Learners receive teaching from maths and science specialists from upper primary onwards. After this there exist a range of specialised maths courses for interested students. At tertiary level, more than half of programmes are orientated towards science and technology.³ All Singaporean teachers receive the necessary training to deliver this curriculum.

Given the comprehensive approach that Singapore takes to its vocational education, it is difficult to separate out policies that focus on mathematics for two main reasons. First, the need to improve maths skills is less necessary than elsewhere given the deep grounding that young people have received at school - which is already tailored for the type of progression to which the learner is likely to proceed. Second, maths skills are an important and integral part of the vocational teaching experience in Singapore and are required to succeed. Part of the reason for the success of technical education is that learners obtain a strong academic foundation with which they can acquire more sophisticated skills required by employers.⁴

1.2 Institutions and Courses

GENERAL SYSTEM

Singapore's education system has six years of primary, four years of secondary and two years pre-university. There is a common curriculum for the initial four years of primary schooling. In the last two years of primary school, students can follow one of two 'orientation' curricula, one of which is 'a reduced curriculum at a slower pace'.⁵

The aim of secondary education is to provide learners 'with a broad-based education which aims to prepare students for various pathways and specialisation at the post-secondary/upper-secondary level'.⁶ There are three routes: 60% of pupils follow an 'express course' leading to an O-level in four years, 25% follow the Normal (Academic) course leading to an O-level in five years and 15% take the Normal (Technical) course leading to N-level. Around a quarter of secondary leavers go on to university.⁷

Upper secondary education covers ages 16-20 in four types of school:⁸

1. Junior colleges: two-year pre-university courses leading to the Singapore- Cambridge General Certificate of Education Advanced Level (GCE 'A' Level).
2. Centralised institute: three-year pre-university courses leading to the Singapore-Cambridge GCE 'A' Level and tertiary education.
3. Polytechnics: three-year courses leading to a diploma.
4. Institute of Technical Education: one to two year technical or vocational courses leading to skills certification.

VOCATIONAL COURSES

In the Normal (Technical) course, learners study between five and seven subjects. The aim is to prepare learners for the Institute of Technical Education (see below). The curriculum strengthens proficiency in English and maths which are compulsory subjects.⁹ Students also undertake four to five hours of maths learning a week. It should be noted that this is more than the Normal (Academic) course, which requires only two and a half to three hours a week.¹⁰

¹ <http://heearp.org/sites/default/files/Vocational%20Technical%20Education%20and%20Economic%20Development%20-%20The%20Singapore%20Experience.pdf>

² <http://www.moe.gov.sg/about/files/moe-corporate-brochure.pdf>

³ <http://www.moe.gov.sg/about/files/moe-corporate-brochure.pdf>

⁴ <http://asiasociety.org/benchmarking/singapore-innovation-technical-education>

⁵ http://www.nuffieldfoundation.org/sites/default/files/files/Towards_universal_participation_in_post_16_maths_v_FINAL.pdf

⁶ http://www.nuffieldfoundation.org/sites/default/files/files/Towards_universal_participation_in_post_16_maths_v_FINAL.pdf

⁷ <http://www.moe.gov.sg/about/files/moe-corporate-brochure.pdf>

⁸ http://www.nuffieldfoundation.org/sites/default/files/files/Towards_universal_participation_in_post_16_maths_v_FINAL.pdf

⁹ <http://www.moe.gov.sg/education/secondary/normal/>

¹⁰ http://www.iea.nl/fileadmin/user_upload/IRC/IRC_2013/Papers/IRC-2013_Kaur.pdf

There are effectively two vocational routes at upper secondary level: polytechnic schools, which blend academic and career-oriented studies, and purely vocational studies at an Institute of Technical Education.¹¹

POLYTECHNICS

Learners study for a three year diploma at polytechnics. This is a practical qualification in subjects such as engineering, many of which require an advanced understanding of maths. Polytechnics offer training to equip graduates with skills and knowledge as 'middle-level professionals'. They offer a range of courses at Diploma level in different areas.¹² Those who do well at an ITE (below) can proceed to a polytechnic to pursue diploma studies.

INSTITUTES OF TECHNICAL EDUCATION

Vocational education was regarded, until the 1990s, as a second rate option in Singapore. The government undertook a wide ranging set of reforms to change this. Efforts were focused on the creation of the Institute of Technical Education (ITE).¹³ Dr Law Song Seng led work to transform the content, quality and image of vocational education. His goal was to build a world-class technical education institution that is 'effective, relevant and responsive to the knowledge-based economy' and to combat the prejudice against those taking vocational courses.¹⁴ Measures included hiring visionary leaders and staff committed to learning; curriculum reform; workforce certification; courses focused on new industries; consolidation of existing technical campuses into three 'mega-campuses' with a sophisticated technology base; and close ties to international corporations.¹⁵

ITE learning comprises of a series of four types of module: core, specialisation, life skills and elective. Learners need to pass all the core modules and take specialist courses to obtain full certification.¹⁶ The ITE offers four certification levels: Higher, Master and Technical Diploma. The first two are for secondary school leavers.¹⁷ Maths modules are elective except for Higher certificates where some are core - for example, Engineering Mathematics is a core module and Calculus is an elective module for those studying Plant Design. Statistics is elective module and accounting is core in some courses in Business and Services.¹⁸

Although difficult to prove causation, the new ITE system unrolls twice as many students since 1995, which in total accounts for a quarter of the post-secondary cohort.¹⁹ In excess of 82% of learners in 2009 completed their training and found jobs.²⁰ Close to 90% of ITE graduates are employed within six months of graduation and about one fifth move on to the Polytechnics to pursue further studies.²¹ ITE graduates are well paid, and the ITE track is perceived by learners as 'a legitimate path to a bright future'.²²

1.3 Practice and Pedagogy

It is difficult to separate maths teaching in VET from the overall approach to maths education in Singapore. The country is known to have one of the most successful methods of teaching maths skills to everybody - which lays the foundations for the mathematics contents of those who progress from school to study for vocational courses. It has been reported that Singapore gained its current PISA league table position by abandoning a traditional approach to teaching maths lessons and instead focusing on developing creativity.²³ The result is that Singaporeans leaving the sixth grade have 'approximately the same math skills as US students leaving the eighth grade, and have already been exposed to basic concepts in algebra and geometry'.²⁴

Singapore's new approach to teaching mathematics was developed in the 1980s. It focuses on the mastery of central mathematical concepts. Teachers instil 'math sense' in students, so they know how to approach unfamiliar mathematical problems. Teachers rely on visual aids, and take the approach that 'there is no one right approach to solve a problem'. In maths, Singapore's schools teach fewer subjects in greater depth before learners are able to move on.²⁵ Using this method, teachers cover less material but what they do cover is done so with greater depth in order to master concepts more thoroughly.

The school maths curriculum is based around five ideas linked to mathematical problem solving:²⁶

¹¹ <http://www.washingtonpost.com/blogs/worldviews/wp/2012/12/11/heres-why-other-countries-beat-the-u-s-in-reading-and-math/>

¹² <http://www.moe.gov.sg/about/files/moe-corporate-brochure.pdf>

¹³ <http://www.tvetsingapore.com/pdf/Mr-Bruce-Poh.pdf>

¹⁴ <http://www.tvetsingapore.com/pdf/Mr-Bruce-Poh.pdf>

¹⁵ <http://www.tvetsingapore.com/pdf/Mr-Bruce-Poh.pdf>

¹⁶ <http://www.moe.gov.sg/about/files/moe-corporate-brochure.pdf>

¹⁷ <http://www.moe.gov.sg/about/files/moe-corporate-brochure.pdf>

¹⁸ http://www.nuffieldfoundation.org/sites/default/files/files/Towards_universal_participation_in_post_16_maths_v_FINAL.pdf

¹⁹ <http://asiasociety.org/benchmarking/singapore-innovation-technical-education>

²⁰ www.nuffieldfoundation.org/sites/default/files/files/Towards_universal_participation_in_post_16_maths_v_FINAL.pdf

²¹ http://www.nuffieldfoundation.org/sites/default/files/files/Towards_universal_participation_in_post_16_maths_v_FINAL.pdf

²² http://www.nuffieldfoundation.org/sites/default/files/files/Towards_universal_participation_in_post_16_maths_v_FINAL.pdf

²³ www.independent.co.uk/news/education/schools/box-clever-singapores-magic-formula-for-maths-success-1727053.html

²⁴ <http://www.ncee.org/programs-affiliates/center-on-international-education-benchmarking/top-performing-countries/singapore-overview/singapore-instructional-systems/>

²⁵ <http://www.oecd.org/countries/singapore/46581101.pdf>

²⁶ http://www.iea.nl/fileadmin/user_upload/IRC/IRC_2013/Papers/IRC-2013_Kaur.pdf

- **Attitudes:** beliefs, interest, appreciation, confidence and perseverance.
- **Metacognition:** monitoring one's own thinking and self-regulation of learning.
- **Processes:** reasoning, communication and connections; thinking skills and heuristics; and applications and modelling.
- **Concepts:** numerical, algebraic, geometrical, statistical, probabilistic and analytical.
- **Skills:** numerical calculation, algebraic manipulation, spatial visualisation, data analysis, measurement, use of mathematical tools and estimation.

Teachers meet regularly to review and improve lessons.

Instruction in science and the humanities also draws on the lessons from the Singapore maths curriculum: learning is viewed as a form of inquiry, and teachers promote the idea of '*no one right answer*', particularly in disciplines such as humanities. Learners are encouraged to view academic subjects as useful outside of school, and so teachers place emphasis on how scientific concepts affect everyday life.²⁷ Extra maths tutorials are also reported to be commonplace.²⁸

1.4 Key Points of Learning

Key differences between Singapore and the UK include stronger foundations in primary education, the high status of vocational education with importance accorded to maths within this, a more creative approach to teaching, and an emphasis on not progressing before each concept is mastered. The school maths curriculum is based around five ideas linked to mathematical problem solving: attitudes, metacognition, processes, concepts and skills.

Teachers meet regularly to review and improve lessons. They instil '*math sense*' in students, so they know how to approach unfamiliar mathematical problems. Crucial to the success of the system is the creative approach taken to maths, typified by the encouragement of the view that there is '*no one right answer*' to a given problem. The emphasis on ensuring that fundamental concepts are learned before moving on also constitutes a key strength of the system.

²⁷ <http://www.ncee.org/programs-affiliates/center-on-international-education-benchmarking/top-performing-countries/singapore-overview/singapore-instructional-systems/>

²⁸ <http://www.washingtonpost.com/blogs/worldviews/wp/2012/12/11/heres-why-other-countries-beat-the-u-s-in-reading-and-math/>
www.theresearchbase.com