

“I SAY TO YOU
NOT JUST
GOODBYE,
BUT ALSO
SEE YOU AGAIN
ON CAMPUS.”

PRINCIPAL & CEO SOH WAI WAH
TO GRADUATING CLASSES OF
SINGAPORE POLYTECHNIC



FOR ALL AGES **SP70**

FOR ALL AGES

SP Singapore
Polytechnic

**SINGAPORE
POLYTECHNIC
AT SEVENTY**

SP Singapore
Polytechnic

FOR ALL AGES



FIRST POLY
FUTURE INSPIRED
EST 1954

COMMEMORATING THE
70th ANNIVERSARY OF
SINGAPORE POLYTECHNIC



FOR ALL AGES

SINGAPORE
POLYTECHNIC
AT SEVENTY

KOH BUCK SONG

SP Singapore
Polytechnic



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FOREWORD

CHAN CHUN SING
Minister for Education

Singapore Polytechnic (SP) was established in 1954 as Singapore's first polytechnic, and was a forerunner for the development of technical training to meet our manpower needs. Since then, the applied education sector in Singapore has grown from strength to strength. From the inaugural cohort of 192 SP graduates in 1961, we now have five polytechnics training over 20,000 graduates each year with industry-relevant and industry-recognised skills.

Our polytechnics have seen their operating context and attendant challenges evolve over the years. Rapid technological change has meant that skills and knowledge gained today are becoming obsolete faster. Disruption is a constant. The education sector has a responsibility to equip students with both deep technical skills and broader life skills, and support learning throughout life.

SP and our polytechnics have risen admirably to these challenges.

They have grown and expanded their course offerings, in response to demands for more and diverse skillsets. From the initial 30 diploma courses offered by SP in 1958, our polytechnics today offer over 170 diploma courses across a wide range of disciplines, from engineering to the humanities and social sciences.

Our polytechnics have also transformed the way they teach, embracing the use of new technology, and equipping students with a broader range of skills. SP is no stranger to adopting new educational technology. For example,



SP recently led the polytechnics in implementing “flipped learning”, which incorporates a blend of online and in-classroom learning, and uses data analytics to customise classroom discussions to students' learning needs. Moving forward, as we continue to welcome more diverse groups of learners into our polytechnics, such models of learning will be increasingly critical.

To support lifelong learning, our polytechnics have developed a wide range of Continuing Education and Training (CET) programmes, from post-diploma programmes to short modular courses. From an initial set of a few extra-mural courses in areas such as ship construction and naval architecture in 1978, SP has grown their CET offerings and hosts over 400 CET programmes today. These programmes provide opportunities for working adults to upskill and reskill, and are vital in creating and sustaining multiple pathways of success for all Singaporeans within our education system.

Our polytechnics have played a key role in our national innovation and enterprise efforts. Our polytechnic lecturers and students have made positive impact on our local industry, be it in the areas of training, developing new solutions or helping companies implement new technologies. SP's industry collaborations have also grown over the decades.

As we reflect on 70 years of applied education in Singapore, I am confident that SP and our applied education sector will continue to prepare Singapore well for the economy of the future, and the future of learning and work. Congratulations SP, on your 70th birthday! I look forward to your continued innovations and achievements in the years to come.

SECTION ONE

A NEW LIFE OF LEARNING

POLYTECHNIC EDUCATION in Singapore was formally established on 27 October 1954. On this day, the Singapore Polytechnic Ordinance was passed in the Legislative Council, the precursor of today's Parliament – “for the purpose of providing studies, training and research in technology, science, commerce and arts”.

Much has developed since then. As the 70th anniversary arrives in 2024, it is only apt that this milestone comes amidst yet another major paradigm shift. A sea change is underway in the polytechnics' mission, and even, in the very nature of learning.

And yes, once more, life will never be the same, in many ways.

But then again, such reinvention is nothing new for Singapore Polytechnic, an institution that has always worked to advance the development of polytechnic education, together with Singapore's four other polytechnics – Nanyang, Ngee Ann, Republic and Temasek.

Singapore Polytechnic is committed to being ever-open to embracing change, adjusting, adapting to whatever the future might bring, at every age Singapore enters into. This is at the core



of its cultural DNA as an organisation, a future-ready institution that focuses on preparing learners to be, as its tagline goes, “life-ready, work-ready, world-ready”.

Singapore’s polytechnics facilitate learning at levels “higher” than secondary school, as “institutes of higher learning”, alongside the universities. Now, they are being called upon to evolve into “institutes of continuous learning”, places where learning never stops, even long after graduation.

This will require a fundamental shift from the old mindset of seeing a clear, clean break between formal education and any learning that follows during one’s time in the workforce. The new outlook is that, yes, a new phase of life does begin with a first full-time job, but learning must carry on thereafter, throughout working life, and even into retirement.

What this means is that graduation from a polytechnic marks not the end of formal learning, but just one more landmark on an ongoing journey, that will continue for five decades or more of life.

Previously, polytechnic graduates walked away with their diploma scrolls on graduation day, and thereafter, only a fraction of them would set foot on campus to be students again. This time, however, with a new mode of the campus as a place of continuous learning, many more graduates will keep coming back for more.

Being an alumnus, thus, becomes a lifelong relationship. Singapore Polytechnic Principal and Chief Executive Officer Soh Wai Wah typically closes his speeches at the Polytechnic’s graduation ceremonies with these words, as he did in 2023: “I say to you not just ‘Goodbye’, but also ‘See you again on campus.’”



Singapore Polytechnic's graduation ceremony 2023: With continuous learning, graduates will keep returning to campus to learn new skills throughout life.



“

I say to you not just ‘Goodbye’, but also ‘See you again on campus.’

”

Principal and Chief Executive Officer Soh Wai Wah at Singapore Polytechnic's 63rd graduation ceremony in May 2023

Moving into the future, the Polytechnic's graduates will be more welcome than ever to keep returning to campus to update their skills. Indeed, this will become much more of a necessity, because of the way the world is changing, with the skills demanded in many jobs becoming increasingly more varied and interrelated. As Mr Soh says: “When the world demands cross-disciplinary skills, we cannot just rely on one main domain skill.”

One of the ways in which Mr Soh motivates his colleagues at Singapore Polytechnic to embrace an even more expansive notion of continuous learning is to remind them of the “one-in-10” idea – that about 10 per cent of each cohort of children born in Singapore every year is a student of Singapore Polytechnic. These are students coming from secondary schools and the Institute of Technical Education – what is referred to as the PET (Pre-Employment Training) student body.

What's more, when taken together, the five polytechnics would in total look after some 50 per cent of every birth cohort of Singaporeans for PET education. “When you think in those terms, you feel what a sense of responsibility there is in what we do, and what a privilege,” says Mr Soh.

In addition to PET for students before they join the workforce, the polytechnics also provide Continuing Education and Training (CET) for the workforce.

In this new world of never-ending learning, the Polytechnic's graduates will not just take one last selfie with their academic gowns on campus at graduation. Instead, they will become life members of a learner community that includes the Polytechnic's more than 230,000 alumni, who will keep on returning to their alma mater (and also elsewhere) to learn new skills all through life.

With the entire population of working and retired adults as potential students, the CET student body is set to expand as the Polytechnic becomes more of an “institute of continuous learning”.

NEW TERM, NEW MISSION

THE NEW TERM “institutes of continuous learning” to refer to Singapore’s post-secondary educational institutions has been used since 2018. For example, at a grassroots event in February 2018, Mr Chan Chun Sing, then-Secretary-General of the National Trades Union Congress and Minister (Prime Minister’s Office), argued that institutes of higher learning should change their focus, and even their names.

The place to start, he suggested, was to replace the word “higher”. Doing so would then avoid all that the word “higher” implies of a hierarchy of knowledge, and of a shelf-life of some parts, and types, of knowledge that are made out to be more enduring than they actually are. “There is just learning, continuous learning,” he argued. “Hence, I would rather we call them ICLs – Institutes of Continuous Learning... May we all continue to be learners throughout our lives.”

The term “institutes of continuous learning” emerged more widely into current usage in 2022. This movement is being led by Mr Chan, who became Education Minister in 2021. The key ideas around this new approach were fully spelt out in his speech at the Institute of Policy Studies’ conference, *Singapore Perspectives*, in January 2023.

There, he argued that for an individual, success needs to be redefined, and everyone should keep learning continuously throughout



life. “Given the disruptions expected, no amount of frontloading will ever be sufficient to prepare our people for life,” Mr Chan said. “Instead, the first 15 years (in school) must build the foundations upon which learning continues for the next 50 years of life. The spirit of inquiry, the desire to create new knowledge and value, the ability to discover, discern and distil – these are our new competencies and benchmarks of success.”

Thus, for Singapore’s education system, success cannot be tied down to just how well it is able to produce a cohort of some 40,000 each year for the job market, but also, how well it can also provide retraining and skills upgrading for about half a million adult learners each year.

This shift to a new life of learning is necessitated by a world of endless disruptive change, as seen in ever-shortening product cycles of items such as smartphones, and the emergence of new technology and automation in areas such as artificial intelligence and robotics.

Minister Chan Chun Sing interacting with students from the Media, Arts and Design School during a visit to SP in August 2022. Source: Ministry of Education, Singapore.

“
No amount of frontloading will ever be sufficient to prepare our people for life. Instead, the first 15 years (in school) must build the foundations upon which learning continues for the next 50 years of life.

”

Education Minister Chan Chun Sing,
Institute of Policy Studies conference, 2023

Thus, any knowledge gained now is in danger of becoming obsolete in a short time. No one can even imagine today what the jobs of the future will be like. This leaves no option but to take up constant updating of knowledge and skills.

In the past, Singapore could be seen to have had a system of “credentialism”, in which people were valued mainly based on their highest formal educational qualifications. This system may overly advantage those with college degrees.

The call now, however, is for the country to evolve into a “broad and continuous meritocracy”, a culture in which merit is judged on one’s current skills at any age, rather than mostly on paper qualifications earned in youth.

The way to get the whole society to make this shift is through fostering a whole national culture of continuous learning.

REINVENTING CET: “A POLYTECHNIC FOR ALL AGES”

CONTINUING EDUCATION AND TRAINING (CET), which used not to be part of the polytechnics’ core mission, has become integral to what polytechnics do. This means that many aspects have had to be refreshed. For every polytechnic, there is now a whole new way of life ahead.

From 2015 onwards, Singapore started making a concerted push towards being a country of lifelong learners. This focus on continuous learning was deemed critical for the transformation of the country’s workforce and industry in the face of the digital revolution and globalisation, which would also bring about other fundamental changes in society and the world.

One key challenge comes from highly accelerated technological shifts, leading to the shortening of the “half-life” of skills, as well as hastening the redundancies of existing jobs, while also creating new jobs that require new skills.

Another long-term issue is to help address the impact of the demographic trends of a declining birth rate and a rapidly ageing population. Younger workers would need to become more plugged-in to developments in industry and global trends, and so, become more

adaptable. Meanwhile, older workers would need to take more initiative in their own retraining, to reinvent themselves for new careers.

The benefits of training workers include greater labour productivity, higher revenues for businesses, and, ultimately, also boosting national economic growth, as well as social mobility and cohesion.

Hence, to build up a workforce that is always equipped with the most updated skills, the polytechnics would take on enhanced roles as part of a holistic system supporting training for adult workers.

Singapore Polytechnic's Director of the Professional and Adult Continuing Education Academy Wong Jian Chang recalls the old days when CET was not part of the Polytechnic's core mission. Then, CET was seen mainly as what the polytechnics could do to help alumni upgrade their skills if they wanted to. Polytechnic lecturers, by and large, saw teaching CET as an optional activity.

As a response to the new national challenges, Singapore Polytechnic expanded its mission to include CET. For Financial Year* (FY) 2016, at Singapore Polytechnic, only about 10 per cent of its training total output was in CET, registering 0.98 million trainee-hours. The remaining 90 per cent of training output was in PET for students yet to join the workforce. About 25 per cent of Singapore Polytechnic lecturers participated in CET.

Singapore Polytechnic set the goal of increasing CET output by 0.2 million trainee-hours every year from FY2017 for the next five years. This was to be achieved in a financially viable manner, meeting the demands of industry and the workforce, without

*The Financial Year begins on 1 April of every calendar year and ends on 31 March of the next calendar year.



Adult learners coming for CET classes after work.

artificially lowering the costs by subsidising CET with resources originally allocated for PET.

As it turned out, the annual targets for increase in trainee-hours were overachieved, growing steadily to reach 1.76 million CET trainee-hours for FY2019, an 80 per cent increase from FY2016. This included a wide range of offerings to meet diverse needs, including:

- Formal part-time diploma or post-diploma courses attractive to upgraders;
- Modular courses that could be stacked up to achieve a formal qualification;
- Career conversion courses for those switching between industry sectors; and
- Short courses in demand by companies.



In the course of this development, lecturers' participation in CET also became an additional gauge of the relevance of their skills to industry. This change, in turn, also benefited PET teaching, by enhancing industry relevance there as well.

Dr Wilson Qiu Zixuan, a lecturer from the School of Computing, says: "I was initially apprehensive when I taught my first CET class in *Introduction to Python for Data Science*. However, as time progressed, my confidence flourished. The CET classes provided me with valuable insights into the practical challenges experienced by my adult students, and I incorporated these real-world case studies into my PET classes."

To cater to the busy schedules of adult learners, and also to maximise the efficiency of staff input, CET courses became "blended" (mixing conventional face-to-face teaching with online methods and materials), with about 30 per cent of the curriculum placed online, accessible anytime anywhere.

Staff who clocked the highest CET trainee-hours in FY2022: (behind, from left) Mr Tang Kah Heong from the School of Business, Mr Tun Saw from the School of Mechanical & Aeronautical Engineering, (front seated, from left) Captain Osman Sahwan, Captain Chit Htwe and Captain Peter Lee from the Singapore Maritime Academy.



Starting from a base of 0.98 million CET trainee-hours for FY2016, trainee-hours reached 1.76 million for FY2019, the highest among all the polytechnics for that year. In FY2019, about 30,000 persons benefited from the Polytechnic's CET training. Over 1,000 companies sponsored their employees for CET courses, some specifically customised for the companies' needs. Over three years, the proportion of lecturers conducting CET increased from 25 per cent to 64 per cent in FY2019.

Transformation continued into the Covid-19 pandemic period. In FY2020 and FY2021, the Singapore Government created the SGUnited Jobs and Skills Package to help Singaporeans affected by the pandemic disruptions. The Polytechnic responded swiftly, launching one of the highest number of SGUnited Skills (SGUS) programmes across all CET centres. As a result, the Polytechnic's five-year goal of doubling CET hours was achieved at the end of FY2021, with 2.13 million trainee-hours. On this attainment, Mr Soh says: "This was only possible because of the sacrifices made by the staff of the Polytechnic."

Together with these fundamental changes came a new tagline which was incorporated into Singapore Polytechnic's mission statement: *A polytechnic for all ages*. This tagline carries a double

meaning, signifying that the Polytechnic needs to achieve two overall aims:

1. To serve working adults through their different stages of life (all ages of a person); and
2. To stay relevant, and add value, to the country's needs for the workforce and the economy, through all its phases of history (all ages of the nation).

Recognising that these shifts of mindset and culture involved adaptive challenges of mobilising more than 1,400 staff on board, the key actions taken included:

1. Holding an inaugural workplan seminar in April 2017 introducing the concept of “a polytechnic for all ages”;
2. Making the following 12 months a “year of experimentation” to allow time for adjustment; and
3. Adjusting key aspects such as the Polytechnic's overall resource allocation to include a more significant proportion of CET, as well as staff performance management to cover the added work on CET.

With these adaptations, CET has been well and truly transformed. More adjustments and improvements are sure to follow. As Nanyang, Ngee Ann, Republic and Temasek polytechnics also embark on their journeys towards becoming more of “institutes of continuous learning”, shared insights and experience from all five polytechnics will take polytechnic education in Singapore to new heights.



Mr Lawrence Wong, then-Minister for Education (left), visited an SGUnited Skills programme at SP during the pandemic period. Source: The Straits Times © SPH Media Limited. Permission required for reproduction.

Following page: The Organisation Planning and Development Department annually conducts the Workplan Seminar where major shifts such as expanding the mission to include CET are shared.





UNENDING SEARCH FOR NEW KNOWLEDGE

THE CURRENT ERA of Singapore's polytechnics being called upon to become institutes of continuous learning can be read as the latest chapter in their ongoing quest to be vital providers of always-relevant knowledge and skills for the people, economy and society of Singapore, through different eras of national history.

In essence, this mission has remained consistent, at its core. In the words of then-Prime Minister Lee Kuan Yew, at the official opening of Singapore Polytechnic's Dover Road campus on 7 July 1979:

“The new campus marks our resolve to provide our young with the opportunities to climb higher up the technological ladder. The never-ending search for new knowledge, new skills, and the perfection of old skills, is what ensures that we progress.”

The need for an unending search for new knowledge was already crystal clear from the earliest days, with the opening of Singapore Polytechnic as the first polytechnic in Southeast Asia in 1954.

The raison d'être for polytechnic education in Singapore has always been to produce highly skilled members of the workforce, whose key value-add are their current skills and knowledge. The knowledge fields were, of course, simpler in those days – they were what was needed in those times. The supply of workers' skills must be prepared and provided, to meet the demand from industry, in each period of development – hence the need for continuous learning.

From its first home in a five-storey building on Prince Edward Road, Singapore Polytechnic started off running 58 courses for 2,800 students in five departments: Engineering, Building and Architecture, Science and Technology, General Education, and Commerce. These were then seen as adequate to serve the

Singapore's first dedicated premises for polytechnic education on Prince Edward Road, designed in 1957 and completed a year later. The design was by British architectural firm Swan and Maclaren (whose other buildings in Singapore include Victoria Theatre and Concert Hall, St Andrew's Cathedral, and Raffles Hotel). The five-storey building's façade is slated to be conserved.

workforce needs of a colony focused on trade and commercial activities. These economic activities were already providing a good livelihood during those last years of British colonial administration, before Singapore gained internal self-government in 1959.

Singapore's economy at the time hinged on entrepôt trade, but import and export, with shipping and other related services, were not sectors that typically could grow fast enough to create jobs for a rapidly growing population. So, along with the global wave of industrialisation, Singapore too had to industrialise, so that the people could continue to earn a good living. But this would require technical skills, which most of the population did not have.

Training options such as small-scale trade schools had always been around, but, further back in history, the requirement for technical education to be provided in a more structured, organised way, so as to supply the skills in demand, had been examined as early as 1902. That year, an appointed commission considered this question, and decided there was no need for it.

Another commission in 1917 came to a similar conclusion, that "the attractions of a commercial career were (still) so great in the colony" that such a technical school was unnecessary, as the economic conditions were seen as not justifying the administrative attention or the investment in building construction and staffing that would be required to build such a dedicated polytechnic.

In the intervening years, more trade schools were set up. Before the establishment of Singapore Polytechnic, Singapore's technical schools included Balestier Junior School (set up in 1930), St Joseph's Trade School (1938), Geylang Craft Centre (1952) and Malay Craft School (1953).

“

The never-ending search for new knowledge, new skills, and the perfection of old skills, is what ensures that we progress.

”

Then-Prime Minister Lee Kuan Yew, at the official opening of Singapore Polytechnic's Dover Road campus, 1979

It was not until after the Second World War that a fully equipped polytechnic was proposed. In August 1951, the idea of such a polytechnic was firmed up at a meeting, held at the roof garden of the Adelphi Hotel, of the Singapore branch of the Technical Association of Malaya, together with members of the service organisation the Rotary Club, lawyers, teachers, and representatives of the Singapore Improvement Trust, the housing agency during colonial times.

Later that year, an ad hoc committee presented a report to the Governor of Singapore, Sir John F. Nicoll, that a polytechnic was, indeed, needed to produce enough craftsmen, technicians and engineers to meet the growing demand.

This convinced the colonial government to appoint Professor E.H.G. Dobby from the University of Malaya to lead a study into this, culminating in the *Report of the Committee on a Polytechnic Institute for Singapore*, submitted on 17 September 1953. Prof Dobby's committee included senior civil servants and executives from companies such as Shell and Fraser & Neave.



As Singapore was then seeing a growing scarcity of technicians, there were also contributory factors brewing in the geopolitical backdrop. For example, more European managers and engineers based in the colony were returning home, amidst the uncertainties over expatriate life in Asia in the wake of the Second World War.

Thus, the setting up of a polytechnic, in hindsight, can be seen as something that turned out to be helpful later, as part of the unplanned “preparations” for the island state to embrace, and adjust to, the impact of full sovereignty that was to come a decade later in 1965.

Thereafter, things moved even faster. The Dobby Report’s conceptual case for a polytechnic was accepted, and the following year, Mr A.W. Gibson, Principal of Dudley and Staffordshire Technical College in England, was asked by Governor Nicoll to study, and advise on, the physical building and organisation of this new educational institution.

Gibson’s recommendations were presented in *The Singapore Polytechnic Report* on 10 May 1954, and Singapore Polytechnic was established with the passing in the Legislative Council of the Singapore Polytechnic Ordinance on 27 October 1954.

A 10-acre site on Prince Edward Road was identified, and this was where the new Polytechnic welcomed registration for the first student places in September 1958. British academic D.J. Williams was appointed the first principal. The campus was officially opened by Prince Philip, Duke of Edinburgh, on 24 February 1959, accompanied by Sir William Goode, then-Governor of Singapore.



Technology of an earlier age: A typewriting course at Singapore Polytechnic in the 1950s.

This was clearly a new phase of history, as *The Straits Times*’ report of the Polytechnic’s opening noted: “The popularity of the technical and craft courses in the Polytechnic marks the passing into history of the outmoded attitude of mind which had driven some of the best products of our schools inexorably into white-collar jobs”.

The first polytechnic graduation ceremony for professional diploma students was held on 26 August 1961 at the Victoria Theatre. The august venue reflected the national importance of the event, in recognition of the key role played by polytechnic education in Singapore’s economic growth and social development.

In the following decades, Singapore Polytechnic would lead the way, along with the other polytechnics, in constantly improving educational offerings to support the country’s industrialisation, from fledgling industries to ever-higher value-added sectors.



STILL SERVING WITH SKILL AND MASTERY

Singapore Polytechnic's crest was adopted by its Board of Governors on 17 May 1960. The Polytechnic's motto in Malay, *Berkhidmat Dengan Keahlian*, is usually translated as "To Serve with Skill", or "To Serve with Mastery".

The heraldic-style lion on a red background represents the Lion City, the extended pair of compasses indicates precision in execution, and the half-segment of an engineering wheel stands for a foundation in industry.

This image might seem a classic of its time, as one of the crest's co-designers, Mr Ong Teong Pin (who enrolled in 1958 with the first batch of architecture students), observes, with items like the compasses taken from an earlier age, while the Polytechnic's curricula have become much more comprehensive and high-tech since his time, and now cover a much wider range, from professional courses to humanities subjects.



However, some things prevail, even through relentless change: The crest's elements still express the Polytechnic's enduring vision and values – which is what will stand the institution in good stead through the current transformation towards becoming an institute of continuous learning, as well as all future game-changing shifts. To serve the community and country with skill and mastery is as relevant today as it has been through the ages.

Skilled manpower would always be a key input to the factor of production of labour – as Singapore’s only natural resource – for the rising number of multinational companies that were being attracted here by the Economic Development Board and other government agencies.

Along the way, other inflection points for polytechnic education came, for example, around 1970, when Singapore was moving full steam ahead – literally – with industrialisation. The Polytechnic’s expansion was needed with some urgency.

The revamped Polytechnic’s task then was to educate and produce half of the 13,000 technicians that the Government was projecting to add to the labour pool, as foreign investment into Singapore kept growing from strength to strength.

In the 1970s, Singapore Polytechnic was expanded to three campuses: its original campus at Prince Edward Road; a campus at Ayer Rajah Road; and a temporary Princess Mary campus, converted from a former British barracks, at Dover Road. The Princess Mary site was later demolished and replaced by a new campus which was completed in 1978, and became the Polytechnic’s permanent home till today.

As part of this journey of educational development, some other milestone changes also helped pave the way for today’s continuous learning, such as the introduction of advanced diploma courses for graduates in 1988, and the acceptance of mature full-time students in 1990.



Then-Prime Minister Lee Kuan Yew at the official opening of Singapore Polytechnic’s Dover Road campus on 7 July 1979. With him were (from left) Mr Ong Teng Cheong (Minister for Communications), Dr Ahmad Mattar (Acting Minister for Social Affairs and Minister-in-charge of Singapore Polytechnic), and then-Principal Khoo Kay Chai.



THE NATURE OF KNOWLEDGE TRANSFORMED

THE CURRENT MOVE for Singapore’s polytechnics to become institutes of continuous learning belongs within a longer history of game-changing shifts.

Towards the end of the 20th century, as Singapore advanced to become a “knowledge-based economy”, and later, simply a “knowledge economy”, the very nature of knowledge-gathering was being transformed totally, for good, with the advent of the Internet in the late 1990s.

Before that time, for students, the extent of human knowledge had severe physical constraints – it was limited by:

1. Which books, and how many copies of each title, were physically available in the real-life library of an educational institution;

2. What teachers and lecturers were willing and able to tell you; and
3. Whether you knew friends who could help you fill in any knowledge gaps, a situation perhaps best illustrated by the “Call a friend” lifeline on the TV game show “Who Wants to be a Millionaire?”.

All this changed with the invention, and widespread use, of the Internet. It became possible for anyone with network access to find new information seemingly from almost anywhere – to do an online search across practically the whole universe of human knowledge.

One consequence is that the authority of any teacher could now be challenged, as illustrated in the scenario of a student searching online for information during a lecture, and immediately challenging a lecturer in real-time with a contradictory detail.

Thus, one key aspect of continuous learning picked up momentum: learners becoming much more independent than ever before, when anyone anywhere could now access information any time from the Internet.

Also, as phone technology developed, with the advent of increasingly capable smartphones and mobile devices in the 2000s, this led to a new slogan of what was dubbed the “information super-highway”: *anytime, anywhere, any device*.

Educational institutions, of course, had to adapt. For example, around the millennium year 2000, Singapore Polytechnic introduced to staff and students the first online Learning Management System platform called Blackboard. On this platform, lecturers started hosting online teaching and learning materials, including formative online quizzes, to promote self-service access to learning materials and activities.

Former Deputy Principal (Academic) Lim Peng Hun recalls that he was a graduate student at Harvard University’s Graduate School of Education in the United States in the 1990s when he came across the Blackboard platform, saw its usefulness, and later recommended it for use at Singapore Polytechnic.

After it was implemented, this platform was upgraded progressively to support even more interactive learning packages, and also to secure summative assessments, which are used to evaluate student learning at the end of an instructional unit by comparing it against a benchmark.

Since then, digitalisation and other advancements in technology have accelerated the pace of change even more. Continuous learning will no doubt take these developments even further in the future, including pedagogical developments such as flipped learning, the subject of Section Two of this book.

ADAPTING TO NATIONAL REVIEWS

OVER THE YEARS, Singapore’s polytechnics have always refreshed their role, taking on new responsibilities with each national stocktaking of the country’s evolving manpower needs.

National reviews of Singapore’s economic strategies that also impact polytechnic education are a periodic exercise, most notably in the 21st century, prompted by the groundbreaking shifts brought by the Internet and digitalisation, and later, the Industry 4.0 revolution.

In 2001, against a global backdrop of optimism over the dawn of a new millennium and the advent of a “new economy” powered by digitalisation, then-Prime Minister Goh Chok Tong formed the Economic Review Committee (ERC), chaired by then-Deputy Prime Minister Lee Hsien Loong, to review policies and propose appropriate strategies to promote further growth in the Singapore economy.

The ERC Report of 2003 identified a number of sectors for growth and new jobs. A key strategy was to move Singapore away from direct competition with low-wage countries. Hence, a major structural change was to follow, supported by upskilling and reskilling the populace towards higher-value-added jobs.

To deliver the needed skills transformation, in 2003, the Singapore Workforce Development Agency (WDA) was established as a statutory board under the Ministry of Manpower. For the new national CET system, the WDA (now renamed Workforce Singapore) would act as a national body to strategically coordinate the country's upskilling and reskilling programmes, so as to boost worker employability in a globalised environment.

This system was fully established by 2009, to put in place a country-wide skills curriculum and national qualification framework, and to establish quality assurance for public confidence. The polytechnics were a key part of this new ecosystem of training providers.

By then, the world had witnessed another major shock – the global financial crisis of 2008. In response, the Economic Strategies Committee was set up in 2009, chaired by then-Finance Minister Tharman Shanmugaratnam. The national importance of CET was reflected in how “High-Skilled People” was the first item in the Committee Report's subtitle, and “Growing through Skills and Innovation” was top of its agenda. As the Report said: “Our people will have the skills, expertise and flair to take on higher-quality and higher-level jobs, across the whole range of occupations. It will put us in a virtuous cycle of better skills, better jobs and higher wages.”

About half a decade later, another set of key changes came about with the recommendations from two other national committees: the Committee on the Future Economy of 2016, and the Applied Study in Polytechnics and ITE Review (ASPIRE) Committee of 2014.



The Committee on the Future Economy, headed by then-Finance Minister Heng Swee Keat, set the directions for Singapore's future economic development for the next decade. The focus was on five areas: corporate capabilities and innovation, future growth industries and markets, connectivity, urban development and infrastructure, and jobs and skills.

The Committee's key recommendations pertaining to the polytechnics centred on two broad points:

1. Since technologies and jobs were going to keep changing throughout a lifetime, there was an important need to go beyond the pursuit of the highest possible academic qualifications early in life, to focus on acquiring and using knowledge and skills throughout life; and
2. As technology replaced more routine tasks, there was a need to acquire deeper skills to create value, and to apply skills even more effectively on the job.

Ms Indraneel Rajah, then-Senior Minister of State for Education, speaking at the inaugural student town hall meeting held by the ASPIRE review panel in January 2014, with Mr Tan Choon Shian, then-Singapore Polytechnic Principal and CEO (centre).
Source: The Straits Times © SPH Media Limited. Permission required for reproduction.

For the polytechnics, what was emphasised was the need to offer more modularised and technology-enabled training programmes, including courses that can be combined to build up to higher qualifications – thus paving the way towards becoming institutes of continuous learning and offering more micro-credentials, some of which will be stackable.

The ASPIRE Committee, led by then-Senior Minister of State for Education Indranee Rajah, had more than 30 representatives from government, business and academia, including then-Singapore Polytechnic Principal and CEO Tan Choon Shian. The committee advised on, among other aspects, how to enhance the role of polytechnics to support Singapore’s education system and economy.

In line with recommendations from these two Committees, Singapore Polytechnic launched Earn and Learn Programmes (later renamed Work Study Programmes), including one leading to an advanced diploma at the Polytechnic. This programme – modelled after the Swiss and German apprenticeship schemes – allows students to work and further their qualifications at the same time, with structured on-the-job training in the workplace, complemented with classes at the Polytechnic.

The Polytechnic also introduced Structured Internships, and developed Education and Career Guidance (ECG) modules on personal management and career exploration. It was the first polytechnic to set up an ECG Centre, which serves as a place for students to attend career-related workshops and talks, and ECG counselling sessions, as well as to access the latest resources related to careers and further education.

SKILLSFUTURE’S NEW PARADIGM

IN THE JOURNEY to foster a national culture of lifelong learning, 2015 – Singapore’s “SG50” year marking half a century of independence – was a landmark year.

That was the year that SkillsFuture initiatives were officially launched, to support Singapore’s next stage of economic advancement, by providing lifelong learning and skills development opportunities for all Singaporeans. The new initiatives included



Singapore Polytechnic at a SkillsFuture Roadshow at Suntec City mall in 2022.

more customised work-study programmes at the polytechnics, and more funding than ever before for Singaporeans to take up courses to learn new skills at their own time.

Since then, SkillsFuture has developed further into a national movement to provide Singaporeans with more opportunities to develop their fullest potential, regardless of where they started out in life. A national learning ecosystem is sustained, involving education and training providers, employers and unions.

Resources are made easily available to anyone in any stage of life – schooling years, early career, mid-career or silver years – to work towards mastery of skills, with a mindset of continuously striving towards greater excellence through knowledge, application and experience.

The national importance of SkillsFuture to enabling the country to move up the skills value chain is clear, with the movement having been described, for example, as Singapore’s “most important economic and social strategy in the long term” by then-Deputy Prime Minister Tharman Shanmugaratnam in a speech in 2019.

The objectives of SkillsFuture are realised through curricula curated into four main economic pillars: digital economy, green economy, care economy and Industry 4.0. Under these four pillars are 18 emerging domains such as data analytics, decarbonisation, wellness and robotics. These are aligned with a “whole-of-government” future economy perspective, and serve to signpost individuals and enterprises to growing industry sectors.

These subjects were developed in consultation with lead sector agencies as well as industry stakeholders. Into the future, they will



be continually refreshed with dynamic labour market and skills data, and industry feedback.

Beyond these Polytechnic-wide transformations in its effort to help upskill the workforce, Singapore Polytechnic has set up various centres to spur growth in a wide spectrum of industry sectors in recent years. These include:

- 5G & AIoT (Artificial Intelligence of Things) Centre, that assists enterprises in prototyping and adopting 5G and AIoT innovation solutions;
- Advanced Manufacturing Centre, to help companies evaluate and implement solutions in improving the productivity and quality of manufacturing operations, such as by deploying robotics and automation technologies in the framework of Industry 4.0 (the 4th Industrial Revolution, moving from high-volume,

Mr Steven Tan (centre), from the School of Mechanical and Aeronautical Engineering, with students working on industry projects at the Advanced Manufacturing Centre.

low-variety products to mass customisation of unique products at lower cost);

- Advanced Materials Technology Centre, housing two national-level innovation centres: Centre of Innovation for the Built Environment Advanced Materials, and National Additive Manufacturing Innovation Cluster Hub, to translate advanced materials solutions and technologies into new innovations which are commercialised through projects, consultancy services, technology licensing and training courses;
- Business Innovation Centre, which helps companies diagnose business capability gaps (process, skills and low-code technology), and provides end-to-end solutions to innovate enterprise's business, enhance productivity, build international connections and easy technology for sustainability, and develop human capital capabilities;
- Centre for Environmental Sustainability and Energy Efficiency, which drives consultancy projects and project-based training, covering areas including process engineering, data analytics, mechanical and ventilation systems, solar power, and buildings;
- Consumer Chemicals Technology Centre, a national-level centre of innovation for beauty and personal care that supports businesses in the beauty and personal care industry, from ideation to product commercialisation;
- Centre of Excellence in Maritime Safety, jointly launched with the Singapore Maritime Institute and other partners to develop human-centric technologies to enhance navigational and operational safety;



Ms Georgina Phua, Deputy Principal (Development) (third from left), with (from left) Mr Helmi Musthafa, Deputy Director of Industry and Partnerships, Mr Wong Jian Chang, Director of PACE Academy, and Ms Evelyn Ong, Director of the Food Innovation and Resource Centre.

- Data Science and Analytics Centre, which partners companies to drive data science and analytics through innovation, solutioning and training;
- Digital Building and Innovation Centre, a platform for learning, research and collaboration in innovation and integration in Building Information Modelling;
- Food Innovation and Resource Centre (see following page); and
- User Experience Centre, which uses humanity-centred innovation strategies to help companies design and drive sustainability and innovation through people (stakeholders who are impacted, directly or indirectly), products (innovative products and services) and profits (economic impact and benefits).

Deputy Principal (Development) Ms Georgina Phua says: “Through these centres, industry projects are identified that meet the needs particularly of the small and medium enterprises, which also provide real-world settings for student projects, while serving to hone the skills of staff and keep them relevant. Besides hard work and resilience, the staff at these centres must have vision and imagination to be able to join the dots and bring these different facets together.”

FOOD TECHNOLOGY: A TASTE FOR EXCELLENCE

One particular recommendation from the Committee on the Future Economy-ASPIRE nexus is for each polytechnic to be designated as the lead for specific key industry sectors, to strengthen linkages with industry and help enhance programme offerings. These sector leads are to work with relevant economic agencies, employers and other stakeholders to review and update industry-related components of the courses. This would enable them to keep pace with industry developments, and provide more internship opportunities for students.

Singapore Polytechnic became the lead institution for the food technology industry, which naturally built on its established track record in this field. In 1972, the Polytechnic was already the first institution to offer a Food Science & Technology programme (under the Diploma in Chemical Process Technology). Thousands of food technologists have been trained, specialising in food processing, food innovation and food safety.

In 2007, the Polytechnic launched its Food Innovation and Resource Centre (FIRC), as a joint initiative with Enterprise Singapore (previously SPRING Singapore, the government agency that helps Singapore companies to develop and internationalise, and supports Singapore's growth as a hub for global trading and startups). FIRC is a national-level centre of innovation established to provide food enterprises with holistic technical solutions in food product development, including formulation and process development, packaging, shelf-life testing, sensory evaluation and pilot production for market testing. The Centre also helps companies

FIRC food technologists developing noodle products for local manufacturers.



to improve shop floor productivity via automation and digitalisation. Director of FIRC Ms Evelyn Ong says well-known Singapore brand, Irvins Salted Egg Fish Skin snacks, benefited greatly from the research FIRC provided on how to package the product for longer shelf-life.

In 2015, the Ministry of Education appointed Singapore Polytechnic as the Sector Coordinator for Food Manufacturing. The main aim of the Food Manufacturing Sector Coordination Team is to play a central role in driving concerted industry engagement and coordinating the implementation of SkillsFuture initiatives amongst the polytechnics and the Institute of Technical Education, including providing training and internships.

The Future Food Innovation District is another initiative to build capabilities in future foods, bringing in an ecosystem network – with external partners from the food industry including BASF for, among other things, piloting healthier food options for elderly consumers – to solve manufacturing issues and adopt new practices for an increasingly sophisticated food and beverage market.

Diploma in Engineering with Business student, Lee Zheng De, became Singapore Polytechnic's 200,000th graduate at the 58th Graduation Ceremony in May 2018. From left, Mr Bill Chang, then-SP Board of Governors Chairman; Mr Teo Chee Hean, then-Deputy Prime Minister and Coordinating Minister for National Security; and Mr Soh Wai Wah, SP Principal and CEO.



Go Green SP Forum on 5 July 2023 – a student raising a question at the panel discussion.



SP Open House 2023 student volunteers.

MANY PATHWAYS TO SUCCESS

OVERALL, the recommendations of national review panels such as the Committee on the Future Economy are a culmination of a larger national movement over many years to broaden the scope of transition from school into work life.

As a vital part of this movement, the polytechnics are to play an increasingly larger, and more important, role in preparing skilled members of a dynamic future workforce.

On this topic, one key term is “pathways to success”. For example, Deputy Prime Minister and Finance Minister Lawrence Wong, speaking at the launch of the fourth-generation (“4G”) political leadership’s “Forward Singapore” consultative exercise in 2022, said: “We want those who come after us to also benefit from inclusion, from opportunities, from many more expanding pathways to success and fulfilment.”

Indeed, the very notion of such more coordinated and connected “pathways” is to prepare the path, as it were, for the current concept of continuous learning for life.

Thus, polytechnics are making crucial contributions in creating, and sustaining, these pathways to success, when they provide many opportunities, through adult learning, to advance in one’s career path, or to pivot to other options – not just once in one’s working life, but possibly a few times through more than one career switch.

Nurturing more pathways to success also lays the foundation for larger evolving socio-economic forces in society, including, for example, the government’s call for “a broader and more open” form of meritocracy, made at the opening of the second session of the 14th Parliament of Singapore in April 2023.

“

Credentials are... a very important motivator... we have to evolve so that you don’t just have one credential in life.

”

Tharman Shanmugaratnam, then-Senior Minister
and Coordinating Minister for Social Policies,
Global Lifelong Learning Summit 2022

TOWARDS MORE MICRO-CREDENTIALS

PART-TIME COURSES have been a part of Singapore’s adult education since the earliest days in the 1950s, in areas such as secretarial and bookkeeping skills. But there was a time when the very notion of part-time education was almost frowned upon.

This shift happened in 1963, based on the 1962 *Commission of Enquiry into Vocational and Technical Education*, or the “Chan Chieu Kiat Report” (headed by the principal of Queenstown Secondary Technical School). This Report recommended that Singapore Polytechnic reduce the number of part-time professional courses. It was felt that only full-time study could lead to a satisfactory standard, reflecting the old mindset of questioning the value and validity of part-time training, and seeing a clear line between formal education and working life.

By the 1970s, however, in tandem with the advancement of industrialisation, part-time training expanded once again, and has not looked back since. To meet the growing skills demand, skills upgrading was significantly stepped up for those already working, especially in growth sectors such as electronics, and electrical, mechanical and production engineering.




Signing of a Memorandum of Understanding (MOU) in 2022 for a competency-based stackable micro-credential pathway through a programme offering qualifications that can be stacked up to a degree conferred by Singapore Institute of Technology.

Source: Singapore Institute of Technology, Keng Photography/Tan Eng Keng

Over the years, courses became more customised to suit adult learners from the workforce. In 1992, Singapore Polytechnic adopted a modular system that allowed students some flexibility to adapt their study programmes to their pace of learning. A credit transfer system was also introduced, to allow students to switch from full-time to part-time studies, or vice versa.

Today, the momentum of these developments has continued further, very much in the direction of expanding and enhancing part-time education even more. In many ways, this is the best option for skills development to keep pace with the rapid and unpredictable changes in industry, and the global economy and workplace.

Along these lines, the most recent game-changer is the introduction of “stackable” modular qualifications that can even add up to a full-fledged degree. The year 2022 saw the announcement of a partnership – between Singapore Polytechnic, Nanyang Polytechnic, Temasek Polytechnic, NCS, Singtel and Singapore Computer Society – on a micro-credentials programme offering qualifications that can stack up to a degree conferred by Singapore Institute of Technology (SIT).



With this new pathway to skills accreditation, working adults can upgrade their skills in the information and communications technology (ICT) sector with qualifications in specific topics, in areas such as cyber security, software engineering and network systems.

Offering, and recognising, such micro-credentials will go some way towards helping to meet the talent shortage in emerging fields. For example, in the ICT sector, Singapore – which hosts some 80 of the world’s top 100 tech companies and over 3,800 tech-enabled startups – has a “talent gap” of some 19,000 jobs as at 2022.

Overall, the main benefit of giving more recognition to micro-credentials is to accord accreditation to skills in a more granular fashion, and in ways that are useful and recognised by industry. For example, Singapore Polytechnic has collaborated with Singapore Pools to build capabilities for their frontline service staff, through micro-credentials and skills assessment.

Approximately 1,000 frontliners from Singapore Pools will gain emerging retail skills through bite-size skills-based courses. The courses include digital fluency, service excellence, product advisory and product demonstration conducted by the Polytechnic and Singapore Pools, with certification to follow.

The Polytechnic also developed structured lesson plans and train-the-trainers sessions for Singapore Pools, to augment its in-house capabilities and ensure effective transfer of learning from the classroom to their workplace.

Another example is Singapore Polytechnic’s collaboration with the Institute for Human Resource Professionals to upskill HR professionals and managers in Singapore. This collaboration will

“

The main benefit of giving more recognition to micro-credentials is to accord accreditation to skills in a more granular fashion, and in ways that are useful and recognised by industry.

”

develop a micro-credentialing pathway for HR professionals and people managers, which will help promote HR skills and technology adoption in areas such as HR visualisation, analytics, automation and innovation.

Indeed, the SkillsFuture system still has some way to develop further, and must evolve some more to embrace an even wider view of credentials, says Mr Tharman Shanmugaratnam, former Senior Minister and Coordinating Minister for Social Policies. In a speech at the inaugural Global Lifelong Learning Summit in 2022, he said: “Credentials are... a very important motivator... we have to evolve so that you don’t just have one credential in life.”

This means that people should move towards thinking of a portfolio of credentials, with some that are from formal education in youth, and some skills-based, gained during their working life, and even well into retirement.

A future of continuous learning will surely open up many more such opportunities and possibilities.



At the CCA Carnival, freshmen get to explore over 100 CCA clubs during the three-day recruitment drive and find one that matches their interests.

SECTION TWO

NEW WAYS TO LEARN

EVEN AS SINGAPORE'S polytechnics are being called upon to evolve to become institutes of continuous learning, the very manner of education itself is undergoing fundamental transformation, bringing new modes of teaching and learning. In some ways, these changes are more radical now than at any other time in the 70-year span of polytechnic education thus far.

Singapore Polytechnic is among those in the world leading the way by introducing institution-wide “flipped learning” – in effect, turning some aspects of education right on the head.

Fully implemented in the academic year starting in 2022, flipped learning completely transforms the conventional lecture-tutorial format. The lecture theatre – hitherto the central arena of pedagogical authority – has been emptied, literally.

Instead, lectures are taken off campus, and have morphed into interactive learning packages that include videos placed online,





Student accessing video lectures from home.

as well as other materials. These materials are to be accessed and viewed ahead of tutorials by students by themselves at home or elsewhere off-campus. This is now happening asynchronously: at anytime, anywhere, and – most importantly – for any number of times.

Previously, attending a conventional lecture was a bit like watching a stage show. Students, if they chose to, could just sit back and be passive. Some could “multitask”, with their laptops or smartphones on at the same time. Some might even skip lectures sometimes, and borrow lecture notes later.

But with flipped learning, learning has now become more interactive and self-directed. Before students gather physically together in class as a tutorial, they must all engage themselves at their own time with the lecture material, which can be in the form of interactive learning packages.

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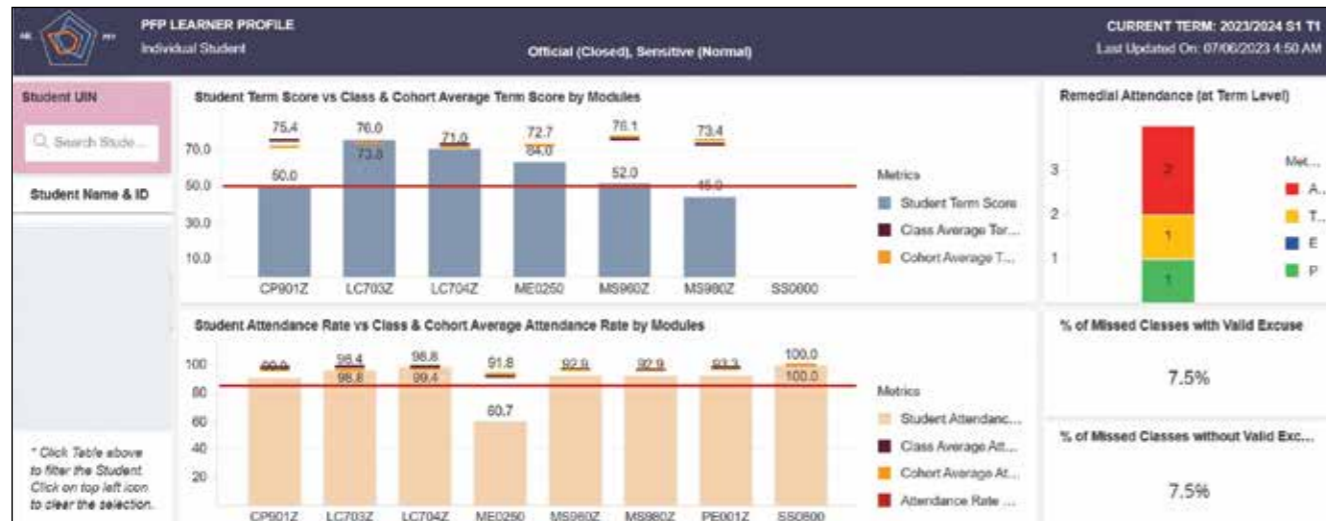
Singapore Polytechnic is leading the way by introducing institution-wide “flipped learning” — in effect, turning some aspects of education right on the head.

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While doing so, students have to answer quizzes about the lecture content through digital devices. This helps focus their learning more than before. It gives them time and space to gather questions for the tutorial that, within the limited duration and format of a conventional “live lecture”, they might previously not have got a chance to raise. Hence, they are required to become more independent and self-directed.

As Singapore Polytechnic Principal and Chief Executive Officer Soh Wai Wah observes: “This is a key outcome of flipped learning – more of a sense of self-directedness. The responsibility for learning now falls on the student. The message is not to passively come to the lecture hall to be “fed”. You have to decide yourself when to watch the lecture videos – say, 9am or 9pm; where to watch them – say, on a train or at home; and how many times you want to rewind for a certain difficult part.”

For staff, flipped learning enables them to become even more digitally oriented. The students’ responses to the quizzes on lecture content allow for data to be gathered on the topics that need further elaboration – for example, which quiz questions most students get wrong. Staff can then use such data, as well as other



Ms Diana Leyau (standing, centre), Senior Lecturer from the Media, Arts and Design School, focusing her attention on a few students at a tutorial.

learner feedback, to devise tutorials that go into the lecture subject in more depth and breadth than would be possible previously. From the data, staff will also be able to know before a tutorial which students understand the material well and which students need more help. They can decide, say, to seat one with the other, and make use of peer tutoring, or to seat them in separate groups so that they can pay more attention to the group requiring more help.

Flipped learning is being appreciated instinctively even by Singapore Polytechnic alumni who graduated long before, like Mr Eric Lai, a graduate in chemical process technology from 1994, who has been an active alumnus ever since, including as Country Director for Singapore and Industry Division Regional Managing Director (Asia Pacific) of Danish pump and water solution company Grundfos, which now collaborates with the Polytechnic on sustainability initiatives. As he observes, the ability given by flipped learning to rewind a video and look again at lecture

Learner profile dashboard showing use of data for flipped learning.

content makes a huge difference. “In the past, we would have to ask the lecturer to repeat an important point, or miss it,” he says. “Then, we would have to catch up through friends later on.”

So, conventional in-person lectures might have “disappeared”, but tutorials still happen, albeit in a different mode. Flipped learning revamps tutorial class-time, by allowing for much more clarification, discussion, and group work. As Mr Christian James, a lecturer from the Media, Arts and Design School, says, “Previously, during tutorials, students would often ask for certain parts of the lecture content to be repeated. Now, it is expected that students should review the online materials, and in some instances repeatedly, if they do not understand at the first instance. Thus, there is less need to repeat the lecture content during a tutorial, and class-time is better used. In that process, students also have been empowered to take charge of their own learning journeys.”

SINGAPORE POLYTECHNIC'S BUSINESS MODEL “OVERHAUL”

FLIPPED LEARNING is a development from ideas originally revolving around what was called the “flipped classroom” – essentially moving lectures onto interactive learning packages and then reconfiguring classes to elaborate on these materials. This experimental teaching method was tried out by educationists including in the United States in the 1990s and 2000s.

What Singapore Polytechnic has now implemented is a game-changing shift from an experimental method to full institution-wide implementation of flipped learning. This is part of a response to developments since around 2014, when the Polytechnic embarked on a journey of transformation, adjusting to larger national challenges, including the following:

1. The Report of the Committee on the Future Economy in 2016 gave guidance towards the need to equip students beyond skills just for the first job, to also



cover much more capabilities for longer-term future-readiness. This panel, chaired by then-Finance Minister Heng Swee Keat, was set up to develop economic strategies for the next decade, and consulted over 9,000 stakeholders including unions and companies. A key recommendation relevant to polytechnic education was to promote deep skills, to be an inspiration for lifelong learning, and to strengthen the nexus between the acquisition and utilisation of skills.

2. Digitalisation in recent years had gathered even more pace, for example, with the push for the whole public service to become “Digital to the Core”, to automate processes where possible for more seamless, yet also more inclusive, services for the public. Such intensive advancements of Singapore as a Smart Nation mean that the entire workforce and society will have to keep on upgrading digital skills, to keep pace with changes

Ms Janet Ang, Chairman of Singapore Polytechnic's Board of Governors, engaging with students, together with Mr Joseph Teo, Registrar.

in technology and automation, and to adjust to more disruptions in industry and the workplace.

3. With a declining birth rate, the size of each student cohort has been falling, triggering headcount reduction – which means that staff will have to work even smarter.
4. The Covid-19 pandemic's challenges placed tremendous stress on staff and students, especially with staying at home during the “circuit breaker” periods of isolation and safe distancing, and the resulting switch to pervasive online interaction.
5. After the pandemic, the pivot towards sustaining new norms of transformed work, workforce and workplace means that educating future generations will have to include adapting to new norms and expectations. One critical development is the move towards a more energy-efficient and sustainable way of operations, requiring less use of space and electricity in lecture theatres and other facilities, and reducing commuting to campus for students and staff.

Singapore Polytechnic responded to all these challenges with one decisive “overhaul” of its business model. The pandemic challenges were turned into opportunities for organisational transformation, centred on implementing flipped learning pedagogy throughout the whole curriculum. This made Singapore Polytechnic among the first to implement flipped learning on a systemic, institution-wide basis.



THE ADAPTIVE CHALLENGES OF BRINGING EVERYONE ON BOARD

WHEN MR SOH joined the Polytechnic in 2016, he knew instinctively that there must be more data to be injected as feedback into the lecture-tutorial system so as to enhance teaching and learning. There were already pockets of flipped learning – he saw the potential of the model and acknowledged the courage and inventiveness of the staff who piloted it. Then, at an inter-polytechnic event showcasing pedagogical innovations of different lecturers, he chanced upon an innovation from another polytechnic, where a lecturer issued quizzes to his students as homework after attending a conventional lecture, and collated the responses via digital devices as data which he used to plan the follow-up tutorial. Marrying the two innovations gave rise to the concept of “data-enabled flipped learning”.

Like any other organisational transformation that alters basic modes of behaviour, the success of implementing institution-wide flipped learning needed collective buy-in from all important



participants. Making the shift to flipped learning involved adaptive challenges in exercising leadership. The most critical factor in the success and sustainability of this change was staff acceptance.

Staff concerns included how to upskill themselves to meet the new job requirements; whether the job of a lecturer would become less valuable, if not partially obsolete; and also, whether student learning outcomes might be undermined.

To bring everyone on board took an extensive engagement strategy, with highlights including the following:

1. A pilot of the flipped pedagogy method was first conducted in Academic Year* (AY) 2015. In AY 2017, a survey of students was conducted, which affirmed its impact to engender self-directedness in students, while maintaining examination performance. Staff involved also shared positively about their experience.

Pioneering staff from the School of Business and School of Maths and Science who piloted flipped learning: (from left) Ms Lee Hwee Theng, Mr Neo Chip Chuan, Ms Sharon Quek, and Mr Alvin Ng.

* The Academic Year in SP begins in mid-April of every calendar year.

2. Based on the confidence generated from this study, flipped learning was cautiously expanded to all the Polytechnic's schools in AY 2019, at first with one flipped module per course per semester. Training was provided to all staff involved. More staff shared positive experience.
3. Staff were engaged to revisit the Polytechnic's mission and vision statements in 2020, refreshing their commitment to the motto "A polytechnic for all ages", and also to their responsibility to look after about 10 per cent of each birth cohort of Singaporeans to prepare them for the world of work.
4. An SP Education Model was developed to galvanise all staff towards the need and direction for transformation, in particular, towards an innovative pedagogy with greater digitalisation. Other aspects of transformation included developing a Common Core Curriculum and embracing Continuing Education and Training (CET) for adult learners as an expanded mission. (This Educational Model is elaborated on later in this Section.)
5. In AY 2020, during the Covid-19 pandemic, those modules not yet flipped were conducted online synchronously. Confidence was built up, and the momentum was exploited to flip all of them to asynchronous mode by AY 2022.
6. As part of the pandemic's temporary measures, the government had started a traineeship scheme for recent graduates. Some of these trainees were hired by the Polytechnic to help the staff to convert lecture materials into interactive learning packages and quizzes during the



preparatory phase in 2020 and 2021. This lessened the load and fears of the staff significantly and went a long way towards their acceptance.

Ms Sharmila Kanagalingam, a lecturer from the School of Architecture and the Built Environment, says, “It was a very challenging period for us, having to manage the rapid changes compelled by Covid, yet at the same time creating online content for the new flipped learning pedagogy. But my colleagues and I persevered to meet these challenges. The availability of the SGUnited Traineeships support hired to help in this translation made a significant difference.”

7. From the outset, and consistently since, staff are assured that there will be no impact on headcount even though there are no more conventional lectures.

Over time, with flipped learning, the realisation became clearer that face-to-face lectures might, in fact, not be an indispensable

Mr Hia Chuen Ling from the Department of Estates and Development returned to campus every few days for maintenance checks during the Covid-19 pandemic circuit breaker period in 2020.



The support provided by Mr Chua Kee Koon, Director of Information and Digital Technology (left, with Ms Ng Meng Siew, Deputy Director) and his team was critical to the successful implementation of flipped learning pedagogy.

part of acquiring new knowledge. As Ms Helene Leong, former Director of the Department of Educational Development, asks, “Even though we still hold the title of lecturers, what is this new role? Who are we now as we move forward? How do we redefine ourselves?”

Although still holding the designation of “lecturers”, staff are now not lecturers in person, and there is no lecture theatre as a stage. With the old lecture time freed up, staff can have time to also play other roles as, say, a mentor, or coach, or even counsellor, and give extra attention to students who need it. Intriguingly, staff can be thought of as having become more like digitally savvy learning facilitators, curating teaching materials to help students learn.

In 2023, from the brainstorming among Mr Soh and his staff, one reformulation of the concept of a lecturer was captured using the first letters of the word “lecturer”, that, with flipped learning, he or she is now a new kind of LECTURER: a Learning, Educational Change-agent, who is Technological, Unwavering, Relational, Empowered and Resourced.

PLUSES AND MINUSES

FLIPPED LEARNING fares well on an assessment of the pluses and minuses. To begin with, the conventional lecture-tutorial system had a few minus points:

1. Students had to be physically on campus, and at the lectures, which sometimes created issues for absentees.
2. Lectures naturally tended to be more lecturer-oriented, with the possibility of uneven lecture quality, even for the same lecturer over time.
3. For younger generations of digital natives, there was the challenge of maintaining attention during lectures. Should a student miss even one important sentence, they could lose track of, say, an important idea, for the rest of the lecture. Previously, there were few options for convenient, time-efficient ways to remedy this.
4. Student behaviour tended to be relatively passive during lectures, and thus, learning absorption and retention might be compromised.
5. While staff might issue homework to be done between lectures and tutorials, there was a lack of systematic collation of data before and after tutorials.

On the other hand, flipped learning brings several plus points:

1. With flipped learning pedagogy, “service delivery” of lecture content has improved, not merely through greater convenience for recipients. The online lecture material usually comprises voice recordings with supporting visuals. Staff also deploy available Internet material such as videoclips of other lectures on the same topic, including by expert speakers from anywhere around the world – essentially, using anything that will help students learn better.
2. Most importantly, students can access online lectures repeatedly, rewinding at any point where needed. This nurtures positive learning habits and allows deeper understanding of the material.
3. Students have to exercise self-directedness in deciding when to catch the lectures, and how much time to invest doing so, thus requiring initiative and fostering independence.
4. Staff are required to issue quizzes on the lecture content, and then to analyse data from the answers. They can then design the conduct of follow-up tutorials



depending on the data gleaned. For example, for questions that are not answered well by the class, more attention can be paid to these points during tutorials. Also, staff can identify students who need more help and seat them together to provide more attention to this group. Or staff can seat stronger students next to weaker ones, to facilitate peer tutoring.

5. Overall, staff become even more digitally savvy. For example, the interactive learning packages they now curate for each class include videos with materials from more sources than before, as well as more types of content, such as computer graphics and podcasts.

Ms Adeline Koh and Mr Tan Tiong Wei from the School of Chemical and Life Sciences are two of the pioneering lecturers in the use of data to plan the conducting of tutorials.

6. In lieu of the hours timetabled for face-to-face lectures, staff can deploy the released capacity for activities such as upgrading of lecture content, preparing for tutorials, conducting extra classes for weaker students, providing pastoral care to students, and personal and professional development.

Notwithstanding the above, flipped learning brings with it new concerns which the Polytechnic is working on addressing:

1. Not all students will go through their online lectures before class, especially when they are new to flipped learning. These students will, as a result, not benefit fully from the in-class activities and discussions. As lecturers are not expected to re-teach concepts covered in the online lectures, they could set this group of students aside for them to complete their pre-class activities in class, or put them to work in groups with students who have done the work. These students will then soon realise that, by coming to class unprepared, they are not taking full advantage of the learning opportunities.
2. Students who have not been exposed to flipped learning before coming to the Polytechnic may take some time to adjust to the more independent self-directed learning approach, where they must take greater ownership of their learning. Thus, lecturers have to provide them with support, including alerts and timely reminders for homework and other preparations before class, study strategies such as highlighting important concepts and key points, as well as learning-to-learn strategies

such as time-management and knowing where to find appropriate help and resources.

3. Some students, especially those with weak foundational knowledge, may have problems understanding and completing the required pre-class assignments. Statistics from quizzes embedded into the pre-class assignments allow lecturers to identify students who have difficulties, as well as topics that most students find difficult, which then need to be addressed in class.
4. Not all lecturers are familiar with flipped learning and may continue to teach as before. There was also some anxiety about the new approach – especially over the new skills that would need to be acquired, and possible increased workload. Good training in the flipped learning pedagogy, as well as support from module team members, mentors and specialists, was important to facilitate the adoption of flipped learning. Critical to lecturers' adoption of flipped learning were module team members' sharing of experiences and challenges they had encountered, or anticipate they would encounter, and then collaboratively working out possible solutions and strategies the team can adopt.
5. Producing well-designed materials that engage students can be challenging and time-consuming for some lecturers. Schools were provided with media developers trained to assist lecturers with the production of the flipped learning packages with interactivity and quizzes.



Licences for authoring tools and applications were acquired and distributed to the schools to support the development of these packages.

Since the pilot implementation of flipped learning in 2015 with 100 students, through its expansion until its full implementation in 2022, Singapore Polytechnic has been carefully monitoring the impact on student performance and learning behaviour, ensuring students benefit fully from the change.

It will continue to do so going forward, addressing the various concerns, evolving whenever needed, in seeking continuous improvement in how to better help students learn.

Mr Mark Nivan Singh (front, second from left), Deputy Director at the Department of Educational Development, and lecturers from various schools who are experimenting with different tutorial pedagogies using data gleaned from video lectures.

BEYOND SP

LOOKING AT THE longer term, learning outcomes of self-directed learning and teamwork will be developing instincts and competencies that will be required more and more in the workplaces of the future. Flipped learning seems best-placed to equip students to enter a world of work in which any knowledge today can easily become outdated in no time, and when the jobs of the future do not even exist yet.

From a big-picture perspective, flipped learning might also bring about benefits into working life. This is mainly because flipped learning engenders greater self-directedness, a key trait for life-long learning habits and the instincts of future-readiness.

In the broader context, flipped learning offers significantly more than the conventional lecture-tutorial method in preparing students for a future workplace in which the default mode will be working independently with more initiative. The instincts honed by flipped learning will also come in useful in collaborative teams, which could be required more and more in many, if not most, jobs of the future.

One phenomenon observed after implementing flipped learning is students forming groups among themselves to watch the lecture



videos together. This positive behaviour was not anticipated but delightfully noted and even encouraged, as it fosters teamwork and peer tutoring. Ms Helene Leong thinks it is perfectly fine for students to watch lecture videos as a group. “The years at the Polytechnic are when you find friends, and bond with them for life,” she says. “So, if you have a group where you are comfortable to learn together, I think that’s great.”

In the future, the impact of flipped learning will likely reach more beyond the Polytechnic’s walls. For example, Ms Leong shares that academics she knows at universities in Singapore have told her that Singapore Polytechnic graduates joining them have been asking: “Where are the flipped lessons?”

Students going through their online lectures together.

Following page: Although students do not have to come to campus for lectures, the campus is still full of vibrancy, with students engaged in various activities.





FLIPPED LEARNING: A BENEFICIARY'S VIEW

Mr Lee Yi Terng, a graduate in Infocomm Security Management from Singapore Polytechnic's Class of 2022, is all for flipped learning. Two of his three years at the Polytechnic were with the flipped learning method.

"Flipped learning is definitely better, it really fits my style very well; I took to it like a fish to water," he says. "It gives us the flexibility to study at home, and allows more discussion, debate, and learning from outside the classroom."

Since enlisting in national service in 2022, he has been expanding his interest in info-communications technology into a new area: cloud computing. He has been doing online courses, including some hosted by the National Library, as well as gaining certification in cloud computing from online providers.

He is one of the few Polytechnic graduates who have secured a Public Service Commission (Engineering) scholarship, which will later give him a career path in the civil service to work in a body like the Government Technology Agency, or GovTech.

Yi Terng recalls how flipped learning transformed the way of learning at Singapore Polytechnic. For some, if not most, courses, all lectures are made available at the start of the semester, which means that exceptionally diligent students could, if they wanted to, watch all the videos at one go – or "binge-watch", to borrow a term from the world of online video streaming.

“

Flipped learning is definitely better, it really fits my style very well; I took to it like a fish to water. It... allows more discussion, debate, and learning from outside the classroom.”

”

SP graduate Lee Yi Terng



Photo source: Lee Yi Terng/YouthHarmony

Of course, the flip side of this is that less hardworking students who tend to do "last-minute cramming" of their studies also have the option of watching the videos less attentively. However, if they were to be less prepared during tutorials, they would lose out in not getting more value out of class-time, through discussions and asking questions that could otherwise clarify doubts and increase their comprehension.

Students who are behind in their grasp of the subject might also lack some background understanding, and so, could miss out, for example, when lecturers during tutorials give practical tips that build on a basic grasp of the topic. "For flipped learning to benefit you as a student, you need to be self-disciplined, and have a certain attitude to studying," Yi Terng says. "You need to take it upon yourself to ask questions and learn."

Another, less apparent, effect of flipped learning is that it allows students to prepare for tutorials in self-organised study groups, for example, watching lecture videos together on, say, a group

video-chat on an online platform. In such a setting, positive peer pressure would then encourage weaker students to step up, to keep in touch with each class. Meanwhile, stronger students might indirectly also get practice in teamwork and leadership, helping their teammates to keep pace with the rest of the group.

Another pedagogical change happened during Yi Terng's time at the Polytechnic. In his second year, the electives system was put in place, which allows students to pick electives from any of the Polytechnic's 10 schools. This was how he was able to take electives outside his main curriculum, including in finance and accounting, and entrepreneurship.

In the process of putting the electives into place, the whole system also became even more geared to the students' interests, and to areas of growth potential for them. For example, based on student requests and feedback, one elective on entrepreneurship was modified to become more focused on an incubator approach, with a reduced component of theory.

Looking back, Yi Terng is grateful that the Polytechnic is always committed to offering holistic education, including nurturing skills such as public speaking and writing papers. He also had the chance to hone his leadership skills, for example, when he set up an interest group teaching others about cloud security through a series of weekly workshops.

On top of his coursework, he volunteered some 150 hours running these cloud security workshops. This won him a gold award at the Cybersecurity Student Volunteer and Recognition Programme awards, organised by the Association of Information Security Professionals and the Cyber Security Agency of Singapore.

INTERNATIONAL RECOGNITION

FLIPPED LEARNING is just the latest phase in Singapore Polytechnic's history of continuous adaptation and reinvention in the ways of teaching and learning.

In the past, adjustments had also been made whenever it made sense to change the mode of learning as student needs, technology and the environment changed. Examples include the following:

1. In 1978, the Polytechnic started offering CET programmes (then known as extra-mural/short courses) to alumni, to give them opportunities to upgrade their skills.
2. In the 1980s, a correspondence course was introduced, initially for 70 students taking up nautical and marine engineering, who were away at sea for extended periods of time.
3. In 2000, the Polytechnic became the first institution in Singapore to adopt the online learning management system, Blackboard, to allow rapid deployment of e-learning content via the Internet.

Of all the ways in which Singapore Polytechnic is exercising leadership in enhancing how to teach and learn, the one with the most international impact must be the CDIO (Conceive-Design-Implement-Operate) method.

Among educationists worldwide, there has always been a perception that engineering education should not be too theoretical, and that it would be good to add more hands-on experience. This spurred the development in early 2000 of the CDIO approach, conceived by the Massachusetts Institute of Technology (MIT) in the United States and three Swedish universities — Chalmers University of Technology, Linköping University and KTH Royal Institute of Technology. This expanded to become an international movement.

The CDIO approach, in short, seeks to make engineering solutions more hands-on and people-friendly. It uses active learning tools, such as group projects and problem-based learning, to better equip engineering students with technical knowledge as well as communication and professional skills.

In 2004, Singapore Polytechnic was the first educational institution in Singapore to join the CDIO Worldwide Initiative, a network of some 160 universities and other institutions. The then-Director of the Polytechnic's Department of Educational Development, Ms Helene Leong, served as Regional Co-Leader of CDIO in Asia (with some 55 institutions) from 2011 to 2022. In this role, she shared the CDIO approach to redesigning curricula with faculty in Asia, and helped organise the first CDIO International Conference in Asia (2009), CDIO Asia regional meetings (2013, 2022) and the CDIO International Working Meeting (2019).




Ms Leong went on to be elected as Co-Director of the CDIO Council (2018 to date). The CDIO Council oversees the CDIO Worldwide Initiative, including the CDIO Syllabus and Standards. In her role as Co-Director, she co-chairs the CDIO Council meetings.

Being a CDIO collaborator allowed the Polytechnic to continuously benchmark courses and approaches with internationally renowned institutions around the world. Ms Leong recalls that it was in 2004–05, when the Polytechnic was looking for a new model of education to fit a more 21st-century approach to education, that CDIO looked particularly attractive with its “design-build-experiment” offering.

CDIO provided a framework for reforming courses to be more practice-oriented, with multidisciplinary, hands-on curricula that

Ms Helene Leong, Co-Director of the CDIO Council (2018 to date), and past Regional Co-Leader of CDIO in Asia (2011–2022).



emphasise real-world applications. The aim was to develop in students the technical knowledge and engineering skills required of engineering graduates and valued by industry. These include personal and professional skills and attributes; interpersonal skills such as teamwork and communication; and engineering design and product-building skills.

At Singapore Polytechnic, the CDIO framework is applied in all engineering courses. CDIO is also adopted in non-engineering diploma programmes – in fields including perfumery and cosmetic science, food science and technology, and architecture – and in business final-year project modules. Hands-on learning experiences in different modules are integrated, and the CDIO skills made explicit. For example, the “Introduction to Engineering” module is aimed at stimulating students’ interest in, and strengthening their motivation for, engineering. This provides the foundational experience for engineering students to put into practice simple CDIO skills. Assessment schemes, particularly for final-year projects, reflect the application of CDIO.

From the start, students perceived the importance of the CDIO skills as a valuable part of their learning. The specific real-world tasks in the curriculum linked theory to practice, and made the learning experience more meaningful and interesting. Lecturers saw the relevance of the CDIO framework, and reported the positive impact of the changes made to the curriculum on student attention and interest.

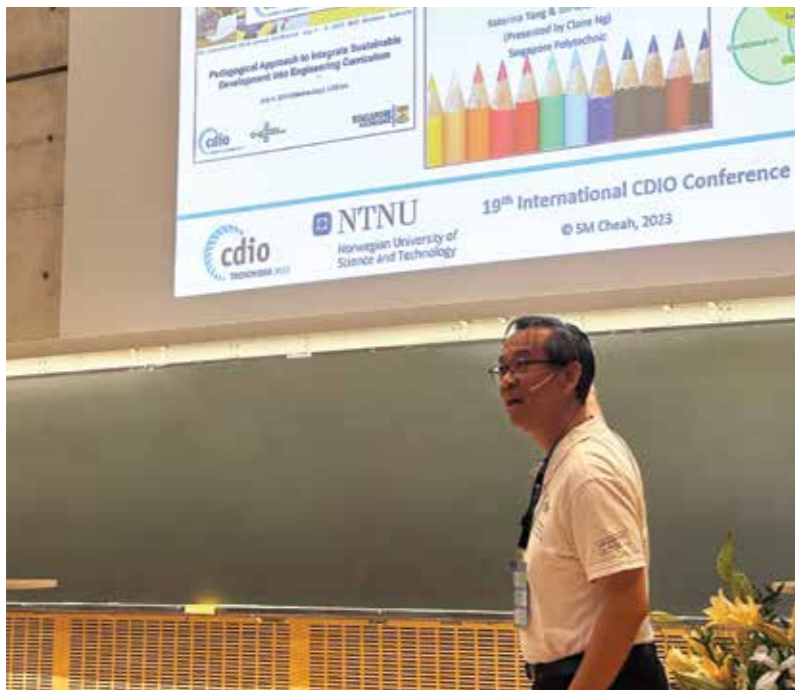
Since June 2011, Singapore Polytechnic has been the designated CDIO Regional Centre for Asia and the co-leader for the region.

With support from Temasek Foundation International and Singapore Polytechnic International, the Polytechnic has shared the CDIO framework and its implementation in engineering programmes with partner educational institutions in Malaysia, Thailand, Philippines, Indonesia, Vietnam, Mongolia, and India.

In this way, other institutions around the world have also come to adopt the CDIO model, with the help of Singapore Polytechnic. For example, in one of the earliest overseas partnerships in 2012, the Polytechnic conducted training for faculty members of universities in the region. The focus? Applying CDIO and design thinking to address social issues such as ageing, and generating innovative ideas and prototypes. One example is helping to prevent backache in old people who have to bend over to reach a refrigerator’s bottom shelves, by coming up with engineering solutions like using a horizontal fridge on a kitchen countertop that can be accessed at waist level.

Students’ abilities to conceive and design solutions to real-world problems were strengthened by incorporating design thinking, with its human-centred approach to innovations, into the Polytechnic’s CDIO model. Design thinking is an approach used for practical and creative problem-solving that focuses on collaboration between designers and users, based on how real users think, feel and behave. Singapore Polytechnic’s design thinking approach has four stages: Sense and Sensibility, Empathy, Ideation, and Prototype.

Across Asia, Singapore Polytechnic has also shared CDIO with institutions in Japan, Taiwan and South Korea, and some



Mr Cheah Sin Moh, Centre Director, SP-CDIO Centre for Innovative Teaching and Learning, and Regional Co-Leader of CDIO in Asia (2022–present).

eventually signed on as CDIO Collaborators. Under the Polytechnic's leadership, the institutions adopting CDIO in Asia grew from nine to around 50 in 2022.

The SP-CDIO Centre for Innovative Teaching and Learning was set up in 2019 to spearhead further development of CDIO in Asia. Presently, the centre is embarking on using the CDIO Framework as the basis for redesigning the engineering curriculum to integrate sustainable development. The centre is also leading a Peer-to-Peer Support Initiative with selected European and Australian partners to help other members in the CDIO community integrate sustainable development into their programmes.

These and other initiatives led by Singapore Polytechnic have won international recognition, with the Polytechnic being one of 15 institutions worldwide ranked as leaders in engineering education in a report[†] in 2018 by the Massachusetts Institute of Technology (MIT) in the USA.

[†] Graham, R., 2018. *The global state of the art in engineering education*. Cambridge, MA: Massachusetts Institute of Technology.

CDIO IN PRACTICE: LEARNING EXPRESS IN ASIA

The CDIO+Design Thinking model was the genesis of a programme called Learning Express (LeX), a cultural immersion experience in which students work as a multidisciplinary group in local communities in Asia, such as in vegetable farms run as social enterprises. There, they need to understand the authentic problems and issues faced on the ground, feel empathy by shadowing

LeX project, Batu, East Java, 2016.



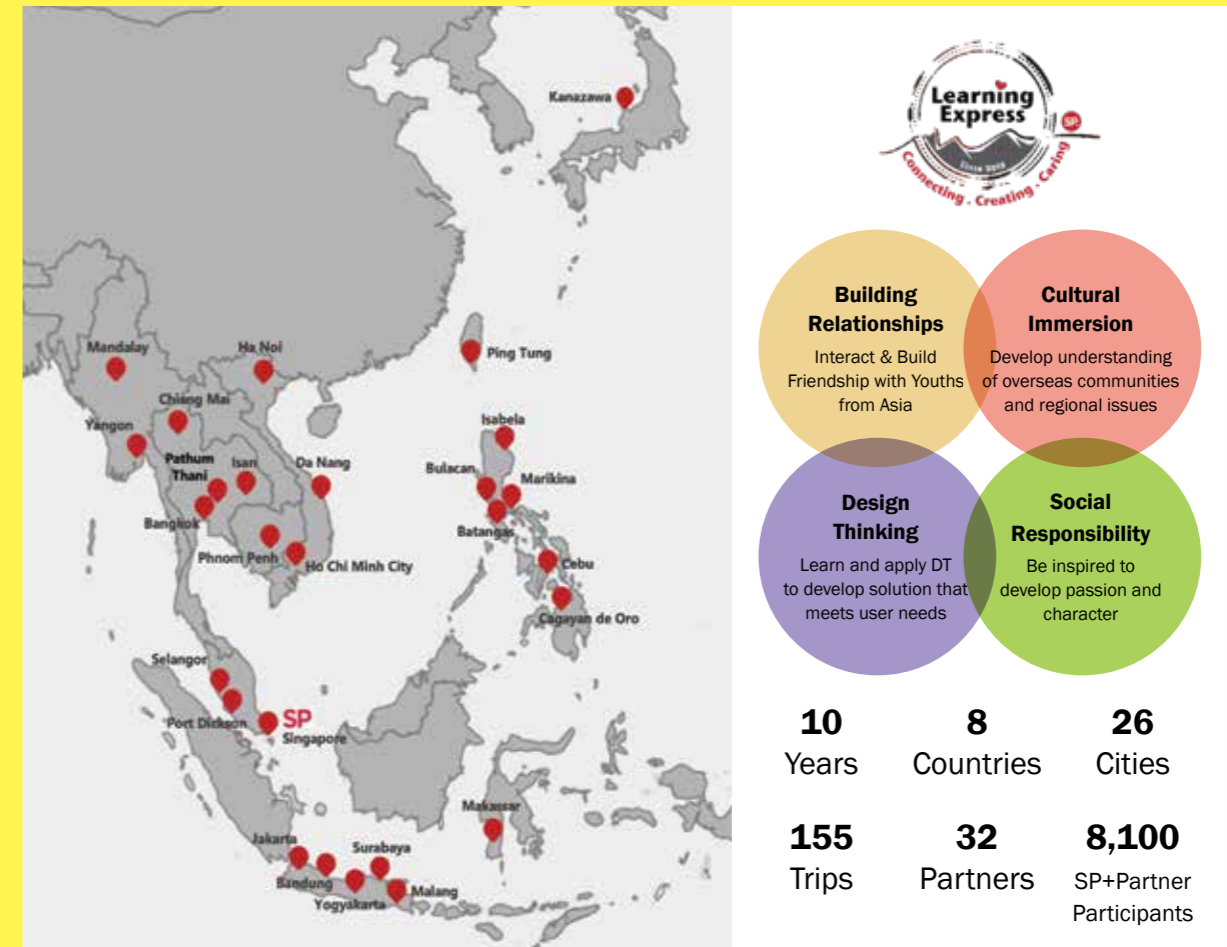
stakeholders, and propose innovative and sustainable solutions after testing out prototype approaches.

LeX is the overseas version of the Polytechnic’s Sustainable Innovation Project, one of the 10 modules of the Common Core Curriculum. It is open to a select number of students (up to 1,000 per year). The idea for LeX originated from a discussion in AY 2012 about taking students on a train (hence, express) ride through ASEAN countries. Started eight years before then-Education Minister Ong Ye Kung announced in 2020 that his Ministry would review the school curriculum to expand young people’s knowledge and experience in the region, LeX has evolved into a 12-day multidisciplinary, multinational and multicultural learning experience that follows the design thinking process.

Singapore Polytechnic has partnered numerous institutes across Southeast Asia, Japan and China for all LeX trips. During each trip, the Polytechnic’s students and students from the partner institute are grouped together to address societal issues in the host country or specific community that are mapped to the United Nations’ Sustainable Development Goals.

Before the trip, both groups receive training in design thinking, which emphasises empathy and user-centric prototyping. Then, the students from the two countries work together in a rural community in the host country for two weeks on a sustainability challenge. The team uses design thinking methodology to identify user needs and offer solutions that the rural community can then implement with their own resources.

The LeX experience challenges Singapore Polytechnic students to step out of their comfort zone, listen and communicate with people



Singapore Polytechnic’s LeX network across Asia.

who may not speak English, and collaborate with young people from diverse backgrounds, cultures, and nationalities. Through experiential learning, they develop resilience, learn to value diversity and cultural sensitivity, and become more resourceful and innovative. This out-of-classroom, out-of-country experience also gives them a deeper appreciation of the ASEAN region.

Since its inception in 2013, LeX has expanded its reach to 26 cities in Asia, forged partnerships with 32 overseas institutes, and impacted over 8,000 young people and some 300 communities in Asia. One particularly remarkable achievement of LeX is the anthology of life-changing stories of friendship and camaraderie among students, broadened perspectives of ASEAN, and meaningful LeX projects co-created with local communities.

For example, on a LeX project in 2017 at Roxas municipality in Isabela province, Philippines, a Singapore Polytechnic team applied design thinking to help tomato farmers avoid letting the large quantity of crops that can be harvested during the high season go to waste. In partnership with students from Isabela State University, they came up with the idea of using the surplus produce to make tomato jam and developed the recipes.

Other than picking up design thinking as an innovation methodology to solve challenges faced by communities in the region, the Polytechnic's students are also exposed to an authentic experience of working with peers from different social and cultural backgrounds in a project work setting. This enriches their learning experience at the Polytechnic, and further prepares them to be life-ready, work-ready and world-ready.

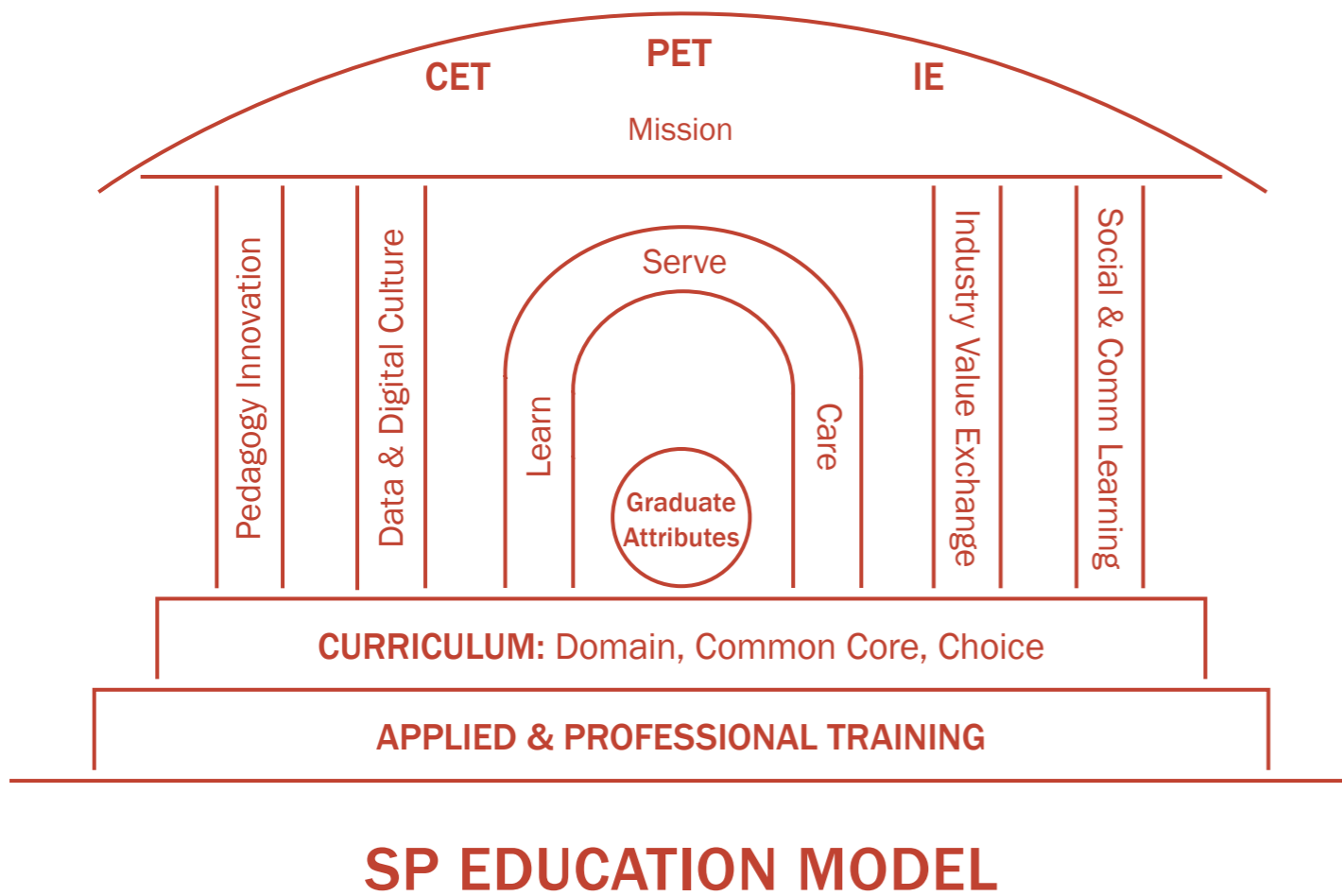
Ms Lee Yoke Ling from the School of Life Skills and Communication, a veteran of nine LeX trips, says: "I continue to do LeX because of the impact on students, both from SP and the partner institutions. The friendships they forge, as ASEAN youths, build bridges for future collaboration."

A WHOLE NEW EDUCATION MODEL

TO HELP learners and staff grow, serve and thrive at the new economic frontiers, Singapore Polytechnic saw that a refreshed education model was needed. This new tertiary education model would need to incorporate the key aspects of life-long learning, and address the demands of deep skills, versatility, entrepreneurial vigour and a global mindset.

A new aspirational statement, together with a co-created visual of the new education model, was unveiled in 2020. This new educational model then became the "North Star" that guided the transformation of students' learning. It also spurred the Polytechnic's staff to break new ground in curriculum design and pedagogical experimentation and guided all aspects of the Polytechnic's transformative journey.

This journey was marked by new institutional milestones. Two significant initiatives are the introduction of the Elective Framework and the Common Core Curriculum.



Singapore Polytechnic's new Education Model, launched in 2020.

A NEW ELECTIVE FRAMEWORK

INTRODUCED IN Academic Year 2019, the SP Elective Framework is designed to provide all students with educational experiences aligned with the Polytechnic's aspiration of developing self-directed, versatile, lifelong learners.

One of the subjects offered under the new Elective Framework by FabLab SP is Digital Fabrication and Prototyping Fundamentals.





Students can pick three to five out of about 140 possible electives organised into categories including the following: Computing, Applied Sciences, Design and Innovation, Manufacturing and Automation, Psychology, Data Science, Digital Media, Internationalisation, Music and Audio, Smart City and Mobility, and Sustainability. The intent is to give students the option to broaden their learning and even develop a minor to complement their principal domain skill. Students also have the option to deepen their knowledge by choosing electives within their principal domain.

Dr Pee Suat Hoon, then-Principal Specialist (Teaching and Learning), who was instrumental in designing the elective framework, says: “It is so gratifying to see students exercising their choices in a self-directed manner, whether to deepen in their principal domain, develop other skillsets, or pursue their interests.”

The Singapore Polytechnic Library is a dynamic learning hub that enables discovery, connection, creation and innovation within the SP community.

A NEW COMMON CORE CURRICULUM

SINGAPORE POLYTECHNIC’S Common Core Curriculum (CCC) was conceived in early 2020, when Singapore and the world were in a period of disruption caused not just by the pandemic, but also the long-term impact of rapid technological advancement. Innovations in automation and digitalisation, which are happening at an unprecedented pace, would render many current jobs redundant, if the focus of skills training is just to front-load learners with specialised skills when they are in school.

Instead, the first challenge of a common curriculum for all the Polytechnic’s students would be to help students develop foundational core skills to serve them well, regardless of the industry sectors they will join, or switch to, in future. These core skills should also be building blocks upon which students can develop strong technical or domain competencies.

These core skills were formalised after a national Review on Opportunities and Pathways in Applied Education was conducted in 2020, led by Second Minister for Education, Dr Maliki Osman. Among the six recommendations in the review was an initiative to strengthen life skills competencies for all students from

polytechnics. Termed the Ministry of Education LifeSkills framework, these 10 are categorised into three groups:

A. Cognition

1. Innovation
2. Curiosity and Independent Learning
3. Critical Thinking

B. Character

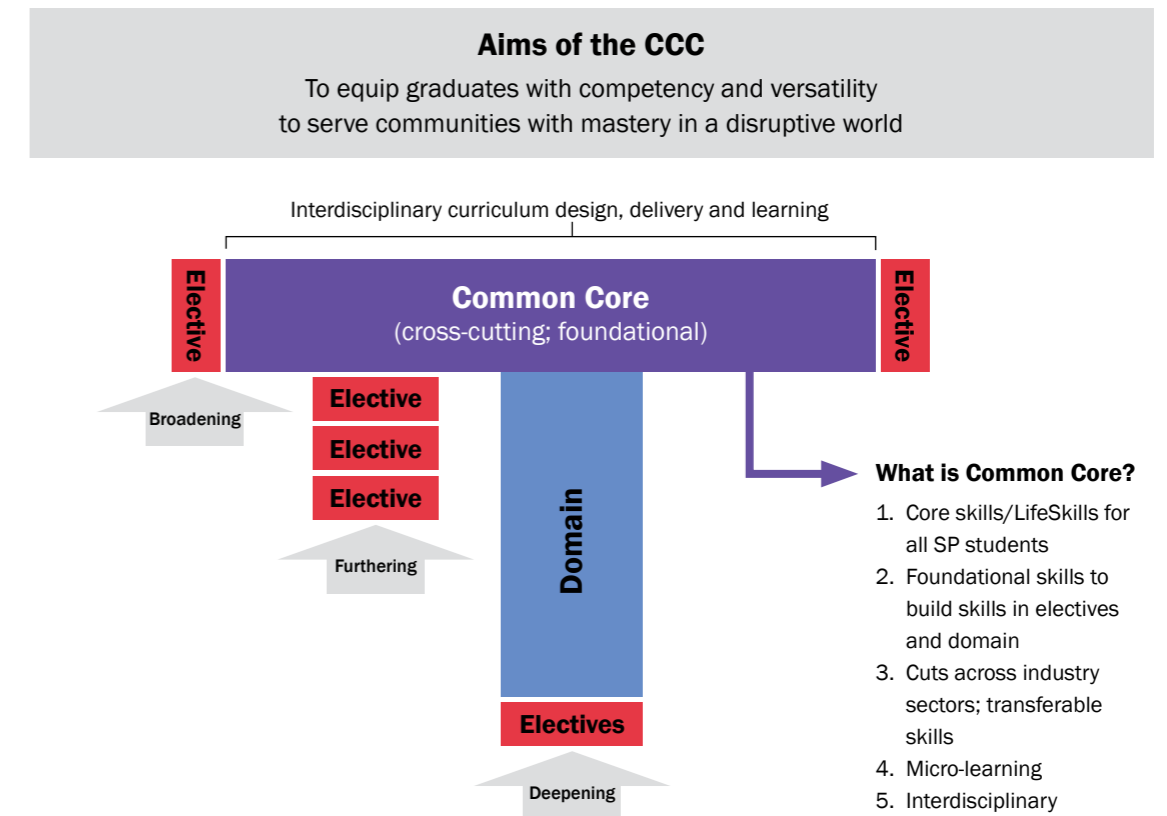
4. Personal Values and Professional Ethics
5. Self-Awareness and Mental Resilience
6. Personal Effectiveness

C. Citizenship and Community

7. Interpersonal and Collaboration Skills
8. Communication and Engagement Skills
9. Global Perspectives
10. Responsibility to the Community, Nation and the World, and Appreciation of Role as a Global Citizen

The aims and key features of the Polytechnic’s Common Core Curriculum were established at the end of 2020. This is the first time that the Polytechnic has experimented with such a format of 15-hour micro-modules, which convey the right amount of information to help learners achieve specific, actionable objectives or outcomes. For the Curriculum’s planners, this allows for greater agility in curriculum design, and the ability to quickly update module content based on industry needs.

Singapore Polytechnic initiated the coming together of an interdisciplinary team (of lecturers from the School of Mathematics and Science, and the School of Life Skills and Communication) to

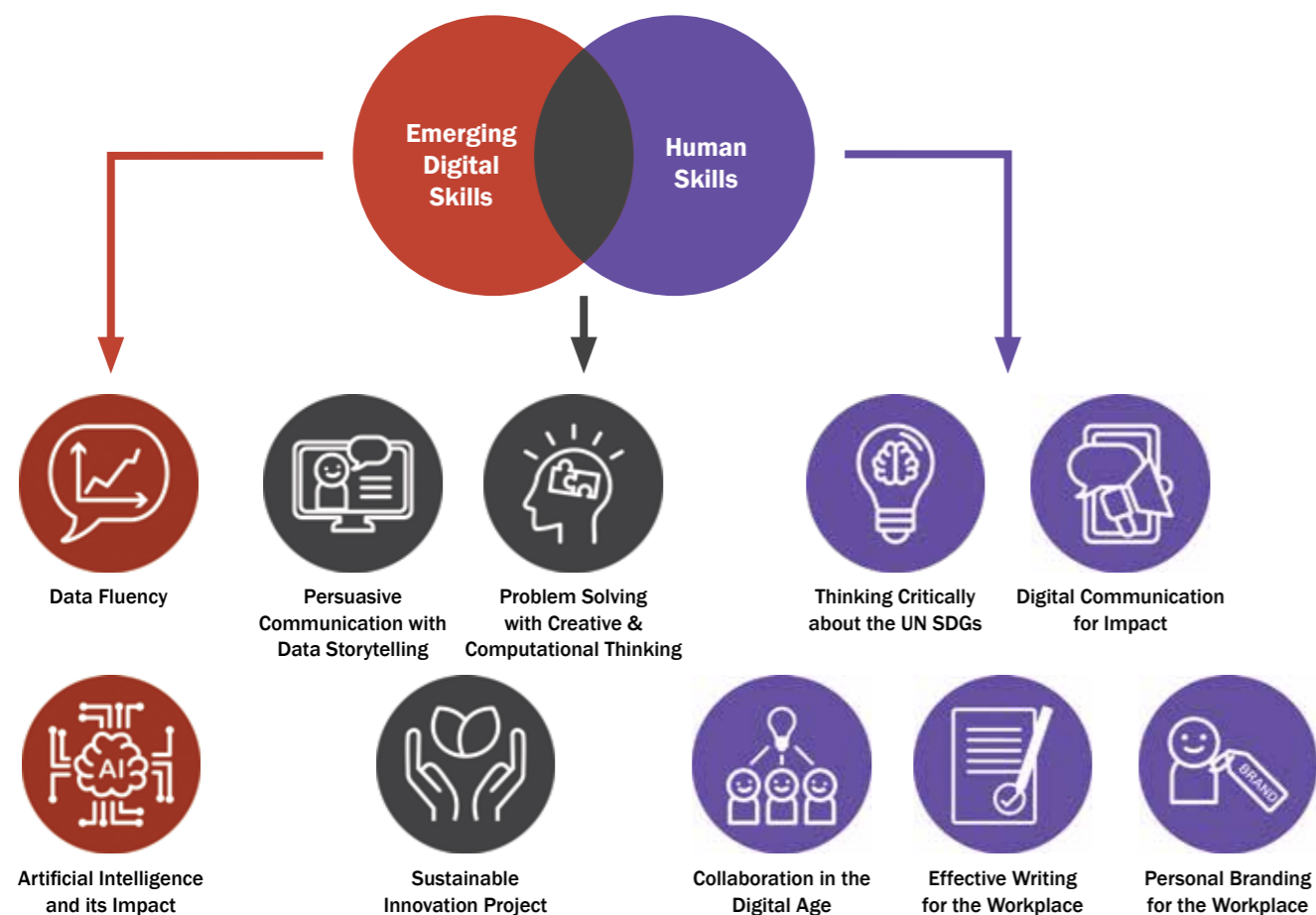


Aims and construct of SP's Common Core Curriculum

co-develop and co-teach an institution-wide common core curriculum to all students. This cross-pollination of skills resulted in a suite of core modules on human skills, emerging digital skills and hybrid skills.

To ensure coherence in the learning experience, all 10 common core modules expose students to the world’s “wicked problems” – those social or cultural problems that are very difficult to solve because of their complex and interconnected nature.

The curriculum content is also focused on addressing national and global issues. The global concerns are framed by the United Nations’ Sustainable Development Goals (the SDGs were adopted by the UN in 2015 as a universal call to action to end poverty, protect the planet, and to ensure that, by 2030, everyone on Earth will enjoy peace and prosperity). They are also aligned with the



Singapore Green Plan 2030, a whole-of-nation movement to advance Singapore’s national agenda on sustainable development.

The national and global contexts set the stage for the Polytechnic’s domain schools to further develop mindsets, technical skillsets and behaviour, for a collective effort towards the sustainability of Singapore and the world.

When rolled out in its entirety, this curriculum will be taught to almost 10,000 students across 30 diploma programmes each year. To ensure consistency, the team has had to invest tremendous effort in standardising the format of module materials, creating them in the Learning Management System for online access to teaching materials, and training a team of almost 200 lecturers.

Common Core Modules

Using games to teach about national, economic, social and political trade-offs as part of the Common Core Curriculum.

The CCC team undertook the challenging task of working with each course chair to identify suitable CCC modules that could feature the application of domain skills. An example of this successful collaboration was the integration of an engineering project into the written submission required by the CCC module, Effective Writing Skills.

Mr Danny Lee, then in the School of Electrical and Electronic Engineering, who was among the first two course chairs to implement CCC modules in his diploma, says: “It is so important that my students acquire skills beyond their principal domain areas. After all, more than being engineers in the future, they are also part of society and they need to be developed to be responsible citizens.”

NEW CAREER PATHWAYS

For Singapore Polytechnic to stay relevant to Singapore for all ages, its staff must also continually transform through the ages. One major revamp of the scheme of service for the Polytechnic's staff, as part of the overall revamp by the Ministry of Education of all Polytechnic and Institute of Technical Education (ITE) staff, took place in 2017.

Co-ordinated by the Human Resource Department, Singapore Polytechnic's staff moved from a range of former schemes to a new scheme called the ITE and Polytechnic Scheme of Service. The Polytechnic was first to peg the various grades under this new system to specific job scopes, operationalising the tracks for specialists and management. With this change, options in developmental pathways became available to the Polytechnic's staff. Since then, they have been able to grow to become specialists in their respective domains or as academic mentors, or along the management track.

Mr Soh Wai Wah emphasised: "The various transformations of the last decade would not have taken place without the sacrifices, courage and inventiveness of the staff of SP. The new scheme of service allows all their efforts to be better recognised."

Clockwise from top left: Dr Pee Suat Hoon, Principal Specialist (Teaching & Learning), 2012–2023; Mr Fann Zhi Jie, President's Award for Teachers Recipient 2023; Ms Kwa Lay Ping, President's Award for Teachers Recipient 2017; Mr George Teo, President's Award for Teachers Recipient 2018; Dr Chia Hui Teng, President's Award for Teachers Recipient 2020.





Mr Jimmy Lim, President of the Singapore Polytechnic Graduates' Guild (SPGG) (fourth from left), and Mr Clarence Chua, Director of Student Services (third from left), together raised close to \$28 million for the Singapore Polytechnic Endowment Fund over the past 10 years. Helping them were these gentlemen from the SPGG Education Fund & Giving Back Committee: (from left) Mr Tay Choon Mong, Mr Jeffrey Liew, Mr Lim Yong Wah (former Chairman of the Singapore Polytechnic Board of Governors), Mr Yeo Keng Joon and Mr Low Wong Fook (former Principal of Singapore Polytechnic).

SECTION THREE

READY FOR NEW FUTURES

BECOMING “FUTURE-READY” is at the core of Singapore Polytechnic’s DNA, expressed in its mission of being life-ready, work-ready and world-ready. “Future”, however – unlike “work” and “life” – can be thought of in the plural as “futures”, because the future is never monolithic, but always multidimensional.

Indeed, nurturing a future-ready global outlook can be said to encompass three main areas of what lies ahead, three dimensions of the future:

1. Personal / work life
2. Industry disruptions
3. Global shifts



1. PERSONAL / WORK LIFE

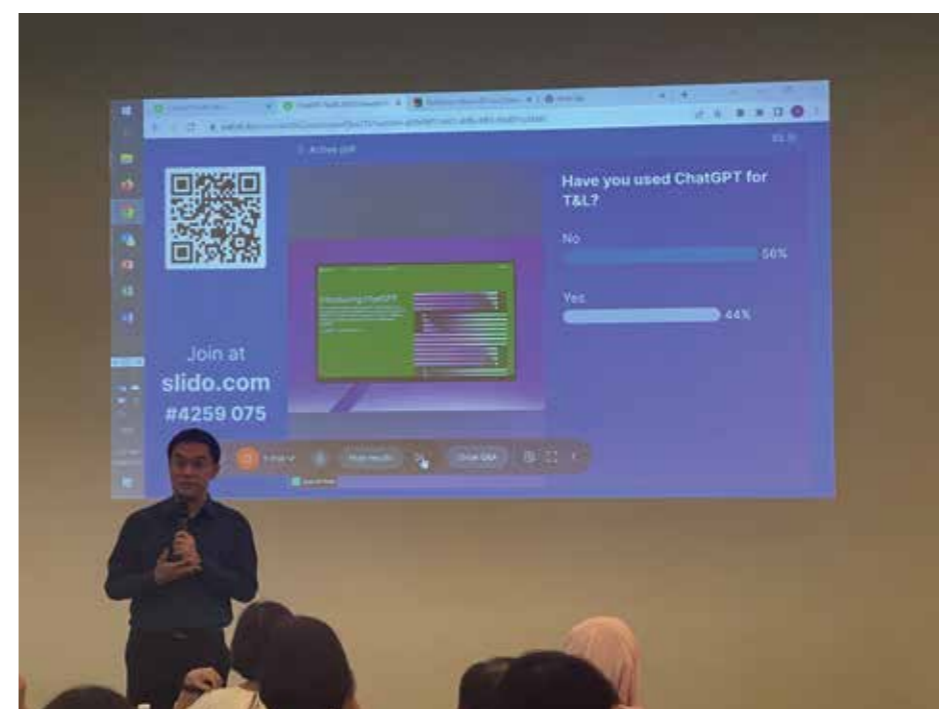
First, personal and work life are undergoing fundamental change. For the first time in living memory, going to the office is no longer the default. Doing just one job for life has already become unusual. Work in general has become more multi-functional. In some jobs, some employees may be required to move from team to team, and role to role.

Ever since the idea of “telecommuting” was first voiced in the previous century, a paradigm shift had been underway in the evolution of hybrid workplaces, across locations in the same city, or spanning different geographies. Today, globalisation has a new face – it used to be that goods could come from anywhere in the world; but now, services – and scarily, also jobs – can move anywhere across the globe. This calls for a different, more agile global mindset.

With the Covid-19 pandemic experience of enforced working from home from 2020 to 2022, these workplace transformations have been accelerated, and some aspects of it are now probably quite entrenched, and will surely evolve further in the hybrid direction.

2. INDUSTRY DISRUPTIONS

Second, the whole universe of industry has become much more disruptive, with game-changing developments in areas such as artificial intelligence (AI), machine learning, the Internet of Things (IoT), and robotics.



Further iterations of new technologies such as ChatGPT and other forms of generative AI threaten to transform life as it has been known thus far.

Presentation by Mr Yanto Jakop, lecturer from the School of Maths and Science, on leveraging ChatGPT for teaching and learning at the monthly Pedagogy Committee Exchange session.

3. GLOBAL SHIFTS

Third, the entire planet is evolving, with major developments such as climate change, along with related threats including flooding, deforestation, resource scarcity and food insecurity that are looming, that could potentially alter life on Earth altogether.

All these three spheres of change call for an urgent need to unlearn some old habits of the old world order, and to learn, and relearn, how to work well independently, with a greater capability for initiative and independent enquiry.

To become more future-ready, one of the most important big-picture shifts includes becoming more globally connected, which, in turn, nurtures the capacity to be more adaptable in all facets of personal and work life.

PERSONAL / WORK LIFE

CONNECTING GLOBALLY: THE MONGOLIA CONNECTION

ONE KEY “cultural DNA strand” of Singapore Polytechnic is always to seek to be globally connected. This includes fostering curiosity about the rest of the world, in all its diversity. Such an international outlook also builds empathy with people of other cultures, which is a vital ingredient in most fields of work, along with the capacity to understand the needs of users and consumers, markets and audiences.

One of the earliest, and best, examples of nurturing such a global mindset is the Polytechnic’s connection forged with Mongolia.

The year was 1993, when Singapore was launching a national effort to extend a “second wing” for the economy. To overcome Singapore’s constraints of small land size, this was a development strategy to boost internationalisation – to make the region, and the whole world, the country’s economic hinterland.

In yet another example of adapting and aligning to national shifts, this became an occasion for Singapore Polytechnic to also stretch

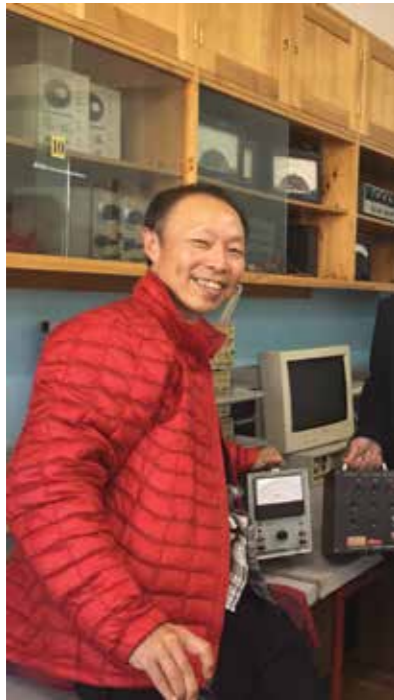


Former Deputy Principal Lim Peng Hun (centre) in Ulan Bator, Mongolia in 1993, at the official opening of the Industrial Electronics and Automation Laboratory at the Mongolian Technical University, set up by staff and students from Singapore Polytechnic.

its own “second wing”, to build relations with people and institutions in other countries. An opportunity arose from the fresh links with the Mongolian Technical University that had been established the year before in 1992, with a visit to Singapore by the university’s President.

Singapore Polytechnic’s reciprocal return visit in 1993 was a chance to offer assistance to Mongolia at a time of need, in those early years of development, in the aftermath of the fall in 1989 of the Soviet Union, under which Mongolia had previously been a satellite state.

A team of three Polytechnic staff, including former Deputy Principal Lim Peng Hun, and eight final-year students spent more than two weeks in and around Ulan Bator, the capital of Mongolia.



Mr Lim Peng Hun revisiting the same laboratory in Ulan Bator in 2015 and seeing the training equipment donated by Singapore Polytechnic still there, even after 22 years.

They brought along digital and analogue electronics equipment, including a solar-powered lighting system which was installed in a *ger* (a Mongolian felt tent) in the countryside. This was certainly a memorable trip, inspiring many of the Polytechnic's other international connections since.

Then, as fate would have it, 22 years later in 2015, under a Temasek Foundation programme to promote the CDIO (Conceive-Design-Implement-Organise) educational framework, Mr Lim got a chance to revisit Mongolia for a Memorandum of Understanding (MOU) signing.

There, memories came flooding back for him, when he recognised some of the university buildings that he had visited in 1993. He met a university staff member who turned out to have been one of the youngest there during that first visit by Singapore Polytechnic, who then organised a reunion of retired Mongolian Technical University faculty staff who had met Mr Lim all those years ago.

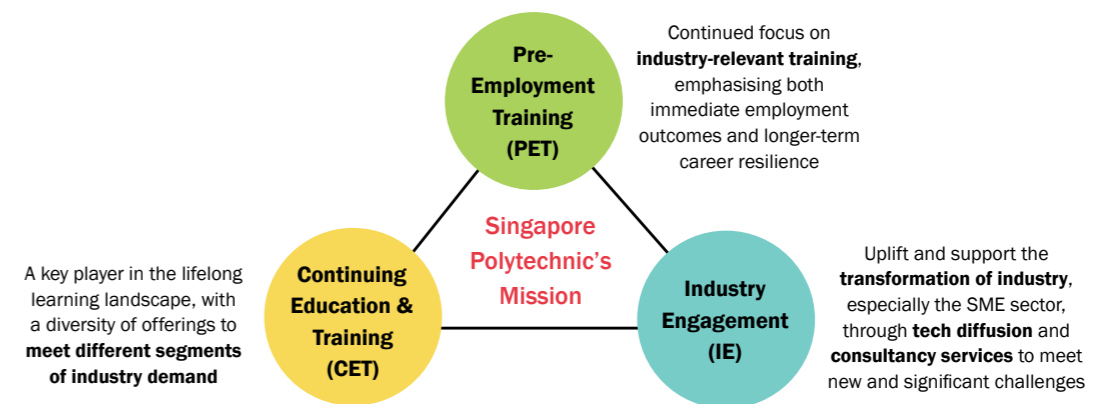
“For me, this was one of the most touching times,” Mr Lim recalls. “When I saw that the old equipment donated by Singapore Polytechnic was still there, and the polytechnic’s inventory tabs, though faded, were still on the equipment, I had tears in my eyes.”

INDUSTRY DISRUPTIONS

PARTNERING WITH ENTERPRISES

TO BE FUTURE-READY, there is no escape from the need to embrace, and adapt to, change in industry – whether from technological advances or other shifts in the workplace. Anticipating the future is the only safeguard against the worst of disruption and displacement.

To stay abreast of such developments, alongside Pre-Employment Training (PET) to prepare fresh graduates entering the workforce, and Continuing Education and Training (CET) to reskill and upskill them throughout their careers, Industry Engagement is an important part of the mission of Singapore Polytechnic. Specifically, the Polytechnic aims to transform enterprises and uplift



their capabilities in tandem with technological and economic development. It does so through its overarching SP Company and Workforce Transformation initiative that provides solutions in three key areas: (1) Strategy; (2) Enablers powered by technology, innovation, and catalysts driven by productivity and sustainability; and (3) Agility in learning and performance. The overall aim is to be a polytechnic that is always relevant to industry, by being proactive and responsive to the needs of companies.

In 2017, one of the Economic Review Committee's recommendations was introducing new modalities of education and training in the polytechnics. It was suggested that "industry partners should play a more active role in shaping the curriculum and participating in the selection of students/trainees".

With a quickening pace of change in industry, and the recognition that an enterprise's workforce is at the heart of any successful transformation, Singapore Polytechnic embraces a synergistic approach in meeting both business and workforce needs.

It starts with transforming the mindset of an enterprise's leaders and its people. This is followed by a deepening of skillsets of its workforce through application-based training. Finally, the end result is a behavioural transformation, by institutionalising new ways of work through business strategy transformation, process redesign, job redesign, technology, innovation, culture change, and change management.

The example of Tai Sin Electric Pte Ltd is one of the Polytechnic's success stories in helping a small and medium enterprise (SME) uplift its capabilities, and transform its capacity with end-to-end solutions.

TAI SIN ELECTRIC: TRANSFORMATION IN PROCESS

Tai Sin Electric operates manufacturing plants in Singapore, Malaysia and Vietnam, making electric cables used in telecommunications, manufacturing and construction. Their cables have been used, for example, in powering Singapore's Mass Rapid Transit subway lines, the Jewel mall at Changi Airport, and Gardens by the Bay.

A few years ago, the company was looking at enterprise transformation infused with workforce capability development. The company's management was intrigued by Singapore Polytechnic's project-based training methodology, which teaches critical skills to achieve business transformation outcomes.

Singapore Polytechnic's Company and Workforce Transformation (CWT) initiative – an integrated playbook for enterprise transformation offering end-to-end solutions provided by the consultancy and technology centres – supports SMEs in their drive to start, scale and sustain their digital transformation journey. Leveraging Industry 4.0 technology and solutions, this initiative helps businesses adapt to emerging ways of work through project-based training.

A clinic session was first held to understand and clarify the company's needs.

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The Polytechnic’s project-based training methodology enabled Tai Sin staff to develop essential core skills by working on transformation projects solving Tai Sin’s actual problem statements.

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Polytechnic staff and students were involved in the solutioning and training, towards achieving the three-pronged objectives:

1. Impacting enterprises through their eventual adoption of the solutioning;
2. Contributing to the Polytechnic’s CET mission (with project-based training); and
3. Giving students the opportunity to be exposed to real-life industry projects.

Two Tai Sin Electric senior executives responsible for Industry 4.0 (i4.0) transformation participated in Advanced Manufacturing Lead, the Polytechnic’s flagship one-week overseas immersion programme for senior leaders of local manufacturing companies, which included a visit to Germany. There, they saw i4.0 in action in several plants of the company Bosch Rexroth, in terms of the applications and benefits of advanced manufacturing technologies.

After this trip, the Polytechnic performed a training needs analysis exercise for Tai Sin, and developed competency roadmaps for various job roles in the company, contextualised to Tai Sin’s technological growth plans. This included a micro-learning suite on the benefits and applications of i4.0 to transform the mindsets of employees at all levels.



Mr Leong Mun Kin, from the Singapore Maritime Academy (extreme right), conducting a CWT session with Tai Sin employees.

The Polytechnic’s project-based training methodology enabled Tai Sin staff to develop essential core skills by working on transformation projects solving Tai Sin’s actual problem statements. The areas covered included transformation roadmapping, robotic process automation, manufacturing and logistics process redesign, and talent analytics for business sustainability.

A few of the Polytechnic’s centres and schools worked on various parts of the company’s needs, including the Advanced Manufacturing Centre, Business Innovation Centre, and Data Science and Analytics Centre. Students from the School of Mechanical & Aeronautical Engineering, School of Electrical & Electronic Engineering, and School of Computing were actively involved in the Lean Six Sigma Productivity Improvement on logistics, customer creditworthiness analysis, and customer segmentation projects.

As Mr Bernard Lim, Tai Sin Electric’s CEO, said, “The programme helped my team in aligning critical job roles and skills to our organisational strategy, goals and objectives. We are also now better-informed and more knowledgeable about various talent development solutions such as talent roadmapping, and coaching skills to enhance talent performance.”

According to Ms Georgina Phua, SP's Deputy Principal (Development), "Singapore Polytechnic also benefits greatly from the collaboration with Tai Sin. Our staff are able to uplift their skills and prove themselves relevant to industry while students have real-world settings to learn and acquire skills."

Singapore Polytechnic's approach to industry engagement is well-aligned to the country's overall approach to helping companies to thrive, through such conceptual models as Singapore's "enterprise ecosystem", a concept that came into current use around the late 1990s and early 2000s. Developed by the Singapore Economic Development Board, the idea of an enterprise ecosystem is that the total environment in Singapore for business and investment is like a whole natural habitat. This is closely connected with the larger global ecosystem that is self-renewing and self-sustaining, where new businesses constantly move into Singapore's habitat, while some venture out.

As in the Darwinian world of nature, competition is often keen, and the fittest survive. But, with state agencies acting as catalysts, budding ideas can develop into viable enterprises, taking over from obsolete notions and entities. Diverse industries co-exist, and leverage each other's strengths, to form industry clusters that will grow further, and internationalise. Meanwhile, workers constantly renew their skills, and can move from company to company.

Helping to transform and enhance the skills of SMEs like Tai Sin Electric is Singapore Polytechnic's ongoing contribution to Singapore's enterprise ecosystem.

LIKE A PHOENIX: RISE OF THE SOLAR CAR

SINGAPORE POLYTECHNIC'S sustained focus on future-readiness, always gearing up to embrace advances in technology and industry, is characterised by attributes such as far-sightedness and resilience – keeping an eye on the prize, and persevering on the long game.

These attributes of future-readiness are best exemplified by the achievements with the solar car – working on how to create vehicles that do not depend on fossil fuels that have harmful side-effects on the environment, which was a development that was typically ahead of its time.

The Polytechnic's involvement in renewable energy and electric vehicles began in the 1990s, long before it became fashionable to do so. The then-Department of Electrical Engineering was already exploring solar and wind energy sources, converting conventional combustion engine vehicles to run on electricity, and even building the Polytechnic's very own solar car.

Those were the days when sceptics used to say that solar energy was not viable in Singapore because, despite the island's sunny location on the Equator, the skies were just too cloudy on most



days. On this, the Polytechnic proved the doubters wrong, time and again.

In 1997, the Polytechnic collaborated with Trans Island Bus Services and Green Fuel Resources to successfully convert a 19-seater diesel bus into an electric bus. The Polytechnic's electric car, electric bus and solar car made headlines in the media on several occasions. These futuristic vehicles were shown to the public in a Solar/Electric Vehicles Parade along Orchard Road in early 1999, attracting press attention not only in Singapore, but also from neighbouring countries.

Building on the capabilities gained in solar technology and electric vehicles, staff and students from the then-Department of Electrical Engineering set themselves a challenge to design and build a solar car to participate in the World Solar Challenge, a gruelling 3,010 km race in Australia from the city of Darwin in the north to Adelaide in the south.

In 1999, the team entered their solar car, SUNSPEED, in the competition for the first time, completing a third of the race. After

returning from the competition, the department entered into a collaboration with the University of New South Wales, a world leader in photo-voltaic technology. As part of the collaboration, the department obtained the Sunswift solar car, which had taken part in the 1996 World Solar Challenge, for testing and research.

Then in 2011, a multidisciplinary team comprising students and staff from the Schools of Electrical and Electronic Engineering, and Mechanical and Aeronautical Engineering, resurrected the solar car dream. This time round, the team aimed to design and build solar cars, and to compete in major competitions, to promote green and clean energy.

The challenge for the team was to design and build a solar car to participate in the 2013 World Solar Challenge. The team started by building SunSPEC 2, which went on to win in the Solar category of the Shell Eco Marathon Asia 2012 in Malaysia. Following this success, they went on to build SunSPEC 3, which participated in the Challenger category of the 2013 World Solar Challenge, completing over 2,000 km of the journey. After seeing the team's tenacity, Singapore Power (SP Group) provided funding support

Solar/Electric Vehicles Parade in 1999.

of \$1 million for SunSPEC to participate in the 2015, 2017 and 2019 World Solar Challenges.

One particular episode in the Polytechnic's solar car journey shines bright among the rest. In 2015, SunSPEC 4's battery caught fire during maintenance work, causing severe damage just before it was due to be shipped to Australia for the World Solar Challenge. The team was devastated, and the students were emotionally affected.

The then-Group CEO of SP Group, Mr Wong Kim Yin, who was also a member of Singapore Polytechnic's Board of Governors, asked the team: "Can you rebuild the car and join the race?" The team discussed and replied with an emphatic "Yes!", even though they had less than a month to rebuild the car. With SP Group's support, and encouragement from the Polytechnic's senior management, the students and staff worked round the clock to put in all the sourcing components, fabricating the solar car body, and assembling and testing the car in a race against time, often staying overnight at the Polytechnic during those intense few weeks.

Showing remarkable resilience, the team rebuilt SunSPEC 4 in just three weeks. The solar car was flown to Darwin, sponsored by SP Group, and arrived in time for the race. SunSPEC 4's rise from the ashes was like that of a phoenix. Beyond the technical skills, the "fire" incident developed and highlighted the tenacious and never-say-die attitude of the staff and students.

Mr Steven Chew, then at the School of Electrical and Electronic Engineering and responsible for the project, says, "I will never forget the spirit and resilience displayed by the students, as they rebuilt SunSPEC 4 from scratch."



SunSPEC 4, after the fire.



Mr Steven Chew, then at the School of Electrical and Electronic Engineering (front, left) and students with the solar car that took part in the World Solar Challenge in Australia in 2015. Source: The Straits Times © SPH Media Limited. Permission required for reproduction.

The Polytechnic's journey in electric vehicle technology continues to the present day, with the School of Electrical and Electronic Engineering focusing on autonomous electric vehicle technology development and electric vehicle education. Over the last few years, the school has developed various autonomous electric vehicle prototypes by retrofitting e-scooters, go-karts, and electric buggies to become drive-by-wire and ready for autonomous driving.

The Polytechnic's electric vehicle courses are now co-developed with automotive industry partners such as Inchcape, and government agencies including the Land Transport Authority. These courses are available as electives to full-time students and as short courses to the industry and public. The Polytechnic is also one of the approved institutions offering the National Electric Vehicle Specialist Safety Certification course.

A FUTURE WITH EVEN MORE INDUSTRY CO-LOCATION

IN ITS ONGOING EFFORTS to foster future-readiness to meet industry disruptions, Singapore Polytechnic closes the “last mile” by bringing industry right onto campus. The latest equipment and expertise are made available at Dover Road, to engage first-hand with staff and students.

Industry co-location is a strategic initiative that seamlessly links up all three aspects of the Polytechnic’s work in PET, CET and industry engagement. In 2017, further augmenting real-world learning was identified as a key thrust of the Polytechnic’s mission. Vital to this is to have deep industry involvement in curriculum design and delivery, with strong industry presence on campus, and learners’ participation in industry. More industry co-location partnerships would further increase collaborative learning together with industry.

The Polytechnic now has a conscious strategy to expand the footprint of industry on campus. The industry partners co-locating facilities on campus rose from six in 2018 to 28 today. These companies are from various industry sectors such as food

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The Polytechnic now has a conscious strategy to expand the footprint of industry on campus.

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manufacturing, advanced manufacturing, electronics, artificial intelligence of things (AIoT), built environment, consumer chemicals, info-communications technology, artificial intelligence and analytics, human capital and optometry.

With these partnerships, Singapore Polytechnic students and staff get to work on real-life industry projects. Staff also have access to the latest industry equipment with which to train their students, as well as opportunities to go on staff industry attachments and industry training, to stay in touch with the latest changes in industry.

The following are two examples of co-location initiatives:

1. ADVANCED MANUFACTURING CENTRE

This centre at the Polytechnic hosts the Advanced Manufacturing Learning Journey with SiTA (Smart i4.0 Transformation Alliance) and Onn Wah Tech. Besides using co-located companies’ equipment and knowhow to benefit PET, some co-labs can also grow

their partnership for CET, learning journeys, projects and staff capability development.

SiTA is a consortium of more than 20 Singapore-based and overseas enterprises that promotes adoption of Industry 4.0 to optimise manufacturing processes and increase productivity, to facilitate the transformation of a conventional factory into a Smart Factory.

The Polytechnic's Advanced Manufacturing Learning Journey has hosted more than 400 local enterprises. This learning journey programme takes SME business owners and their employees through hands-on interactive learning activities, with various technologies contributed by co-located companies. This enables them to envision the possible steps ahead in adding Industry 4.0 aspects to their own companies.

On a typical day at the Advanced Manufacturing Centre (AMC), while the Polytechnic's staff host industry partners for their learning journey sessions, it is not uncommon to see Polytechnic students undergoing training at the same joint facility. Over time, this co-location facility has become a vibrant learning space for industry partners, academia and students, at a nexus for learning and transformation.

AMC's Centre Director Dr Lee Kim Kheng says: "Business owners come to AMC and discover how they can embark on the i4.0 transformation in a progressive and systematic way. We also show them how they can make upgrades to their existing machines without replacing them altogether."



2. CONSUMER CHEMICALS TECHNOLOGY CENTRE

The Consumer Chemicals Technology Centre (CCTC) is a Centre of Innovation for the beauty and personal care sector, which focuses on establishing a consumer business ecosystem to build and transfer technical capabilities for industry.

Central to this is bringing together novel yet complementary expertise and extended business networks. For example, Singapore biotechnology company Denova Sciences offers product safety tests for other companies that have developed product formulations at the Centre, while PT Megasurya Mas, a palm oil

Mr Tan Ming Jie, Co-founder and Chief Scientific Officer of co-location partner Denova Sciences, with a student working on real-world projects in the lab on campus.

derivatives manufacturer from Indonesia, brings their expertise in developing halal cosmetics.

The presence of these companies on campus is important, as they offer invaluable support to nurture talent. These partners guide and mentor students by sponsoring real-world projects in these labs, thus extending and enhancing the Polytechnic's mission in growing new generations of talent to be work-ready, world-ready and future-ready.

This is evident with the Industry Now Curriculum, an alternative pathway created specially by the Polytechnic for Diploma in Perfumery and Cosmetic Science students from the School of Chemical and Life Sciences. These students work on real-world problem statements from industry, and propose formulation solutions to industry sponsors. This method of learning focuses on competency-based training, helping students to become better able to hit the ground running when they are later employed upon graduation.

Polytechnic staff also benefit from this ecosystem through industry attachments, enabling them to sharpen their technical expertise through exposure to cutting-edge technology and innovation. This, in turn, updates the Polytechnic's academic knowledge base, and invigorates the curriculum development for even more dynamic and effective learning.

S'pore Poly ramps up industry training for students



Under the Industry Now Curriculum scheme, second-year perfumery and cosmetic science student Naomi Choa has been working with healthcare company Johnson & Johnson since last October to create a hair-care product from scratch. PHOTO: SINGAPORE POLYTECHNIC

Work, real-world projects to become bigger part of school life under pilot learning format

Diploma in Perfumery and Cosmetic Science student Naomi Choa working with Johnson & Johnson. Source: The Straits Times © SPH Media Limited. Permission required for reproduction.

Certainly, there is nothing like having industry partners onsite, for Singapore Polytechnic to provide continuous learning that is best-equipped to nurture future-ready members of Singapore's workforce.

Dr Tan Tuan Lin, Director of the School of Chemical and Life Sciences, says: "Through the partners in CCTC, students from the Diploma in Perfumery and Cosmetic Science get to learn through hands-on industry projects. They typically spend only three semesters out of six learning in classrooms. For the remaining three semesters, they learn through working on projects from the industry."

FUTURE-READINESS FOR ALL SCHOOLS: A POLY FOR ALL AGES

Singapore Polytechnic's influence on helping to prepare for the technological advancements and industry disruptions of the future also extends far beyond the Polytechnic's walls.

Since 2009, in collaboration with the Science Centre Singapore, the Polytechnic has been organising the RoboCup competition, involving students from primary schools up to polytechnics, including some foreign schools. Through this competition, the Polytechnic has been developing interest in robotics among students from across Singapore.

Dr Zhou Changjiu, Centre Director of the Advanced Robotics and Intelligent Control Centre, who has been organising the competition since its inception, says: "An inspiring example of the impact of RoboCup is Kenneth Chow. He first participated in RoboCup 2008 in Suzhou, China, as a Primary 6 student. The following year, he participated in the inaugural RoboCup Singapore Open held at SP and has consistently taken part ever since, initially as a competitor and then as a mentor and organising committee member from 2015 onwards. He is now the Founder & CEO of the Centre of Robotics Excellence, offering robotics services for both education and consultancy."



Students participating in a RoboCup activity.

In this way, through RoboCup, Singapore Polytechnic has been able to extend its educational reach beyond Dover Road, to help shape young minds from schools across the country and beyond, in the field of robotics, for almost 15 years now. This is an external, more holistic expression of the Polytechnic's vision of nurturing lifelong learning by being "a polytechnic for all ages".



Singapore Polytechnic students are given opportunities to take part in a diverse range of in-class and out-of-classroom learning activities.

NURTURING TEAMWORK

A key aspect of Singapore Polytechnic's instinct to always be future-ready is to keep seeking out new frontiers of knowledge and practice. One example of this is in the beginnings of what is now simply called the "teamwork project".

Teamwork is, of course, spoken of and promoted in many ways in many other organisations and settings. But, as former Deputy Principal Lim Peng Hun explains, what makes the way the Polytechnic is nurturing teamwork special is the institutionalised, systemic way it is being done. This makes it outstanding among educational institutions.

Singapore Polytechnic's approach is different because of what he calls the robust and rigorous way in which teamwork is learned and measured. There will be at least half a dozen occasions during the three years of a diploma programme on which each student will be given feedback from peers in project teams, on various aspects of being a team player. Peer rating is done on this set of criteria of the various ways to be a team player.

In the past, lecturers had given marks for teamwork, but this was under a disparate system. The difference now is standardised teamwork assessment, using a consistent peer-rating methodology, including randomised team formation to derive more accurate, unbiased data.

Such data also allows for self-evaluation, for students to grow in their own teamwork behaviour journey over their three years at the Polytechnic. The rigorous methodology allows the Polytechnic

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Singapore Polytechnic's teamwork project will also align with a larger trend in the workplace of moving further away from old-school models of command-and-control management, and towards flatter hierarchies and more collaborative work arrangements.

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to rank students according to their scores; those who score well can opt to publish their scores on their graduation testimonials and transcripts, to enhance their employability.

A related facet to this focus on developing teamwork is that this will also align with a larger trend in the workplace of moving further away from old-school models of command-and-control management, and towards flatter hierarchies, as well as more flexible and collaborative work arrangements, including working with colleagues in multinational teams across geographies.

As Mr Neo Chip Chuan from the School of Business, who contributed to the design of the methodology, says: "This system will help students to grow, and to see that studying at the Polytechnic is not only about getting good grades, but also about becoming good team players. It also answers a question that employers often ask: 'Don't just tell us they have a high GPA (grade point average); tell us also: are they good team players?'"



GLOBAL SHIFTS

ADDRESSING WORLDWIDE CONCERNS: SUSTAINABILITY

OF ALL THE GLOBAL issues facing the world, for most people, climate change tops the list. This subject is huge too, at Singapore Polytechnic, as efforts to help students become more “future-ready” focus on addressing sustainability, always from a holistic, big-picture perspective.

This commitment is most concrete in the Polytechnic’s Sustainable Innovation Project (SIP), one of the 10 modules of the Common Core Curriculum. This is a learning experience that culminates in a capstone project that students work on in their second year of study.

Students from different diploma programmes collaborate in multidisciplinary teams to tackle societal issues in Singapore that correspond to the United Nations’ Sustainable Development Goals, such as sustainable healthcare, minimising food wastage, and mental well-being. The problem-solving process is anchored in the design thinking methodology adopted by the Polytechnic.

Ms Lim Lee Yee, Director of the School of Life Skills and Communication, says: “The primary goal of SIP is to develop a

Singapore Polytechnic’s Dover Road campus, full of green initiatives aiming to realise its Green Pledge.

Mr Idris Bidin, Senior Lecturer from the School of Architecture and the Built Environment, who helped to create an SP Tree Heritage database, in front of a Brown Woolly Fig.





user-centric mindset among students and encourage them to create innovative prototypes that address their chosen sustainability challenge in Singapore and Asia.”

To enhance the authenticity of the learning experience and deepen students’ understanding of the challenges faced by Singapore, problem statements in SIP are devised with the help of industry partners. At the end of the process, the prototypes are presented in a gallery walk to industry partners and relevant users for feedback, emphasising the importance of user-centricity.

Through SIP, students gain first-hand insights into the challenges faced by ordinary Singaporeans, such as elderly people living in rental flats or residents at void decks, by interacting with them during the user empathy stage. Often, these insights challenge students’ assumptions, and give them new perspectives on the problem statements.

The final stages of ideation and prototyping push students to work out solutions that meet the needs of fellow Singaporeans, thus broadening the students’ perspectives, and helping them see that

Mr Ong Ye Kung, Minister for Health (who was at the Ministry of Education from 2015 to 2020), being briefed by students on their SIP project, in collaboration with the Health District @ Queenstown initiative to support elderly residents to lead healthy and purposeful lives.

they too have a stake in building and sustaining a better Singapore. SIP enables students to develop a deeper sense of empathy and responsibility towards their community, while honing their problem-solving and collaboration skills in multidisciplinary teams.

As an advocate of the green agenda, Singapore Polytechnic itself walks the talk on campus, throughout the lush grounds of some 38 hectares.

The Polytechnic’s efforts go far beyond keeping the campus physically clean and green. The holistic aim is to nurture future corporate citizens who can contribute to the nation both economically and ecologically. This institutional emphasis started off in a small, humble way in 1997, with a Green Committee tasked to create environmental awareness, and to educate and strengthen participation in related programmes within the campus community.

The Polytechnic has come a long way since, for example, achieving ISO 14001 certification for its Environmental Management System in 2001.

In 2000, the Polytechnic embarked on the development of a new campus master plan, with a development policy established to build selectively on brownfield sites.

A conscious effort was made not to extend beyond the footprints of the current buildings. There may even be an increase in greenfield sites in future, if the current low-rise buildings are replaced with high-rise ones in future.

In 2002, the Land Transport Authority’s opening of the Dover MRT station adjacent to the campus gave students and staff an



even better, more environmentally friendly mode of travel. In 2003, the Biostream, conceptualised as an outdoor classroom for the newly launched Landscape Diploma course, was added along the northern perimeter of the campus.

To take stock of the Polytechnic's sustainability status, the *Singapore Polytechnic Environment & Sustainability Report 2005* was published, to give comprehensive coverage of the organisation's environmental performance and initiatives. It won the Best Environmental Report award from the Association of Chartered Certified Accountants that year.

Nurturing the Polytechnic's tradition of being green-oriented, the seed for the "Campus in a Garden" concept was sown with the rollout of the Campus Rejuvenation Project in 2009.

Ms Emily Goh, Director of Estates and Development, says: "Under this rejuvenation project, we were able to incorporate various

Former Singapore Polytechnic Principal Tan Hang Cheong receiving the President's Award for the Environment from late President S.R. Nathan. Source: Ministry of Information, Communications and the Arts Collection, courtesy of National Archives of Singapore

green features in the campus, such as EcoOasis, Sanctuary, InnoV Trail, Heritage Trail and Hilltop Gardens."

In October 2010, Singapore Polytechnic was recognised as the first polytechnic in Singapore to receive the President's Award for the Environment. This accolade recognises its green contributions, including mobilising staff and students to protect the campus environment, and conducting outreach programmes for the industry and the community.

Going green is such a big part of the Polytechnic's life that it celebrated its 60th anniversary in 2014 with the theme "Campus in a Garden". Green initiatives were showcased, including those promoting green spaces and biodiversity, environmental sustainability, and overall quality of life.

Staff and students were engaged through participation in activities such as eco-office challenges and community garden competitions. Infrastructural enhancements include an outdoor social space, the Tree House, and the InnoVillage, a development certified by the Building and Construction Authority that includes features for water and energy efficiency.

The "Campus in a Garden" theme reflected the then-national vision of nurturing Singapore as a "City in a Garden", a concept of developing the entire country as if it were one large garden, with more flora and biodiversity. This is a larger-scale, more holistic progression from the simpler plan of a "Garden City" (a city with many gardens) from the late 1960s. The third iteration of this national greening plan, since the 2010s, is of Singapore as a "City in Nature" – a city in harmony with nature, with even more flora and wildlife thriving throughout.





On 13 May 2023, Singapore Polytechnic students showed their commitment to keeping Singapore clean by joining the Public Hygiene Council for SG Clean Day.



GRUNDFOS: A PARTNERSHIP FOR SUSTAINABILITY

Preparing for a more sustainable future with industry comes together with great synergy in the case of the collaboration between Singapore Polytechnic and Danish company Grundfos.

Partnering with technology champions from industry draws from the Polytechnic's strong aspiration to advance the drive towards sustainability, and to contribute to the global fight against climate change. A key aim is to be a thought leader in sustainability in three areas:

1. To drive green technology innovation and adoption for industry;
2. To move the campus towards the net-zero emissions target and build a culture of active practice towards sustainability on-campus; and
3. To develop green PET/CET talents through quality education.

A case study of public-private partnership in sustainability, the Singapore Polytechnic-Grundfos partnership was sealed with a Memorandum of Understanding signed in 2021 to co-develop energy- and water-efficient smart solutions aimed at supporting industries in Singapore in their efforts to be more sustainable.

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Singapore Polytechnic is recognised as an enabler for businesses' decarbonisation journey through key partners like Grundfos.

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The three-year partnership focuses on sustainability, innovation, education, and talent development.

Grundfos' Country Director for Singapore and its Industry Division Regional Managing Director (Asia Pacific) is Mr Eric Lai, an alumnus of Singapore Polytechnic, who graduated in 1994 from the School of Chemical Process Technology (now the School of Chemical and Life Sciences). For him, his time as a student at the Polytechnic prepared him to be future-ready through the focus on core values, including self-discipline, integrity, care and concern, and responsibility.

In a similar way, sustainability – the focus of the Singapore Polytechnic-Grundfos collaboration – is also about giving back to the next generation. As Eric says, “As a working professional, I'm always looking to be sure that I am giving back to my alma mater, the community and the environment, and to try to be a role model for my juniors at the Polytechnic.”

As a Danish pump and water solution company, Grundfos focuses on intelligent, sustainable and energy-efficient solutions for industries, commercial and residential buildings, as well as water



SP alumnus Mr Eric Lai, Grundfos' Country Director for Singapore, and Industry Division Regional Managing Director (Asia Pacific).

utilities. Denmark is well-known as a front-runner in sustainability, and a key element that Eric thinks puts Denmark at the leading edge of environmentally friendly practices is the workplace culture, such as always being conscious of new and better ways to reduce the carbon and water footprint.

“Sustainability is also about changing human behaviour, to be more responsible for the environment,” he says, making the connection to the importance of core values from his student days at Singapore Polytechnic and his work now, which involves getting facets of sustainability into the habits of people, and of organisational “DNA”.

As part of this partnership, Singapore Polytechnic worked on a feasibility study to identify gaps and opportunities in Grundfos' Asia-Pacific headquarters in Singapore to further reduce energy consumption.

The Polytechnic also applied its extensive knowledge in Green Mark accreditation for rating buildings on environmental impact and performance. Staff and students established existing energy consumption baseline levels, and leveraged the Polytechnic's network and industry connections to curate learning journeys to places such as the Building and Construction Authority's Zero Energy Building, a live demonstration of an energy-efficient building, to help Grundfos with its goal of moving from a Gold to a Platinum energy standard.

The Polytechnic's research on achieving greater efficiencies in resource use centres on re-imagining the green buildings of the future. At Grundfos, the strategic approaches being studied led to practical solutions brought concretely to life. Examples include energy creation from solar power, energy savings through optimised cooling systems and lighting, as well as water conservation through a rainwater harvesting system.

Grundfos showcased its solutions at the Polytechnic's “Values-Based Green Transition – For Singapore Businesses” sustainability event in 2022 through a mobile truck. The truck featured sustainable water technologies showing how industry can reduce the carbon footprint, from energy optimisation to improving product sustainability with eco-design principles.

Such showcases highlight how Grundfos provides end-to-end solutions which enable digital transformation for the built environment and industry, while Singapore Polytechnic is recognised as an enabler for businesses' decarbonisation journey through key partners like Grundfos.

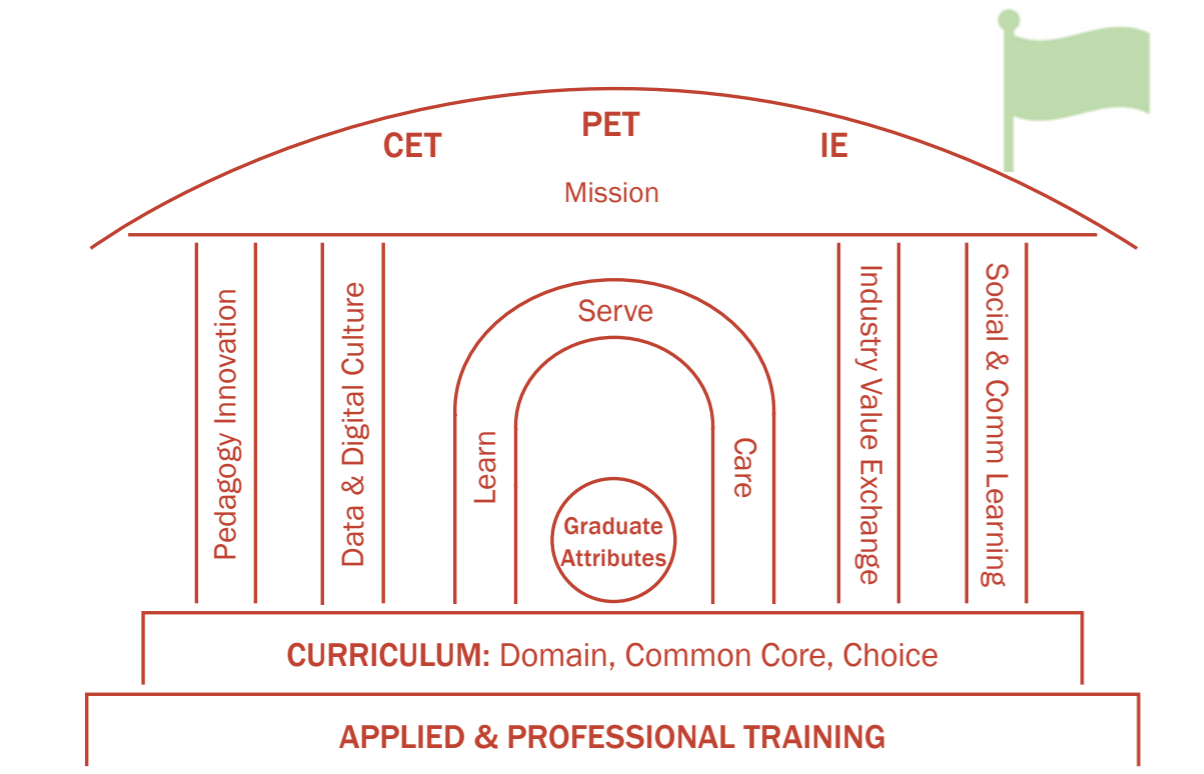
SUSTAINABILITY AND MANAGING FOR THE FUTURE

IN RECENT YEARS, the matter of sustainability and climate change has become more urgent. At the 2019 National Day Rally, Prime Minister Lee Hsien Loong described it as an existential matter, and said that everyone must make the effort to deal with the challenges or “otherwise one day, our children and grandchildren will be ashamed of what our generation did not do”.

Thus, the government has announced that government agencies should aim to reach net zero carbon emission by about 2045. However, as an educational institution, Singapore Polytechnic must aspire to do more. With sustainability being “infused” into the curriculum, students will challenge the institution on whether the staff walk the talk. Hence, seeking to act as a role model of what is in the curriculum, the Polytechnic now aspires to reach the net zero target before 2045. To this end, Singapore Polytechnic is among the first organisations in Singapore to have commenced a consultancy project to identify the goals and measures to be undertaken to realise this net zero aspiration.



The entire Senior Management Team pledging Singapore Polytechnic to be a Champion for Sustainability, witnessed by Dr Amy Khor, Senior Minister of State for Sustainability and the Environment, and Transport, in the presence of about 1,000 staff and students, at the Go Green SP Forum held on 5 July 2023.



SP EDUCATION MODEL

The Polytechnic’s staff have committed to take a further step, to voluntarily change their personal behaviour towards a more sustainable lifestyle. This makes for two parallel journeys of transformation towards sustainability: one by the Polytechnic as an institution, the other by staff members in their own lifestyles.

As Mr Soh Wai Wah noted, with the responsibility of educating more than 10 per cent of each birth cohort, and also having the role of adult retraining, Singapore Polytechnic has extensive reach to the Singapore population. It is thus a privilege, but also a responsibility, to promote commitment to a cause as important as sustainability.

A green flag added to the Education Model in 2023 signals a new significant dimension that Singapore Polytechnic pledges to address.

ALWAYS READY, FOR ALL AGES

IN THE BOOK *Learning for Life*, published by the then-Workforce Development Agency in 2014, then-Deputy Prime Minister Tharman Shanmugaratnam envisaged a future culture of learning in Singapore: “When everyone is learning, it creates a culture of learning in the family... likewise, when you see people in extra-mural courses who come from all walks of life, it creates a tone of learning in society. There’s a shift to the intrinsic value and satisfaction of learning. And, I think, to be a truly advanced society, we need that.”

As Singapore society advances in truly embracing a culture of learning, Singapore Polytechnic’s continued focus on future-readiness should sustain its own contributions, in vital ways, to nurturing continuous lifelong learning, as the country itself gears up to remain always future-ready.

The whole mode of learning might be further transformed in ways that cannot even be imagined today with the advent of technology tools, of which generative artificial intelligence such as ChatGPT is but the most recent example.

Nevertheless, Mr Soh is confident that Singapore Polytechnic will continue aiming to stay ahead of the game, as it has always done. As Singapore Polytechnic evolves as an institute of continuous learning in support of a new life of learning in Singapore, it must also learn continuously. This ongoing spirit of reinvention will enable Singapore Polytechnic to always be ready, for all ages to come.





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