

Advancing 21st Century Competencies in Singapore

By Jennifer Pei-Ling Tan, Elizabeth Koh, Melvin Chan, Pamela Costes-Onishi, and David Hung, National Institute of Education, Nanyang Technological University



Advancing 21st Century Competencies in Singapore

February 2017

Case Study Authors:

Jennifer Pei-Ling Tan, Elizabeth Koh, Melvin Chan, Pamela Costes-Onishi, and David Hung,
National Institute of Education, Nanyang Technological University

ASIA SOCIETY

Asia Society is the leading educational organization dedicated to promoting mutual understanding and strengthening partnerships among peoples, leaders, and institutions of Asia and the United States in a global context. Founded in 1956 by John D. Rockefeller 3rd, Asia Society today is a global institution—with offices throughout the United States and Asia—that fulfills its educational mandate through a wide range of cross-disciplinary programming. Across the fields of arts, business, culture, education, and policy, the Society provides insight, generates ideas, and promotes collaboration to address present challenges and create a shared future.

The Center for Global Education at Asia Society brings together leaders and institutions from around the world to tackle one of the most critical education challenges today: how to educate all students for employability and citizenship in a global era. Our mission is to develop global competence in students, young leaders, and educators as the foundation for understanding between people in the Asia Pacific region and throughout the world. We accomplish this by working with educators, school districts, parents, and communities to ensure that they have the tools and support they need to globalize learning and prepare young people for our global future.

ACKNOWLEDGMENTS

This paper is one of five case studies that accompany the Asia Society report entitled “Advancing 21st Century Competencies in East Asian Education Systems” by Professor Kai-ming Cheng from the University of Hong Kong. Professor Cheng assembled and led an international team of researchers who developed the case study reports on each country. We are grateful for the contributions of Kai-ming Cheng and Liz Jackson from the University of Hong Kong; Wing-on Lee from The Open University of Hong Kong; Daisuke Kimura and Madoka Tatsuno from Global Incubation x Fostering Talents (GiFT) in Japan; Jennifer Pei-Ling Tan, Elizabeth Koh, David Hung, Melvin Chan, and Pamela Onishi from the National Institute of Education at Nanyang Technological University in Singapore; Hyo-Jeong Kim and Jeongmin Eom from the Asia-Pacific Centre of Education for International Understanding (APCEIU) in South Korea; and Hsiao-Lan Sharon Chen and Hsuan-Yi Huang from the National Taiwan Normal University in Taiwan.

At Asia Society, Alexis Menten directed the conception, development, and publication of the paper, in collaboration with the authors. We wish to thank Asia Society Senior Advisor Vivien Stewart for her invaluable guidance throughout the development of this paper.

This paper was informed by teams participating in Asia Society’s Global Cities Education Network 21st century competencies working group, including Hiroshima, Japan; Seoul, South Korea; and Singapore. Several Asia Society staff contributed to the development and support of this paper and the 21st century competencies working group, including Tony Jackson, Alexis Menten, Jessica Kehayes, Heather Loewecke, Heather Singmaster, and Apoorvaa Joshi.

We thank the William and Flora Hewlett Foundation for its support of the development, publication, and dissemination of this paper.

TABLE OF CONTENTS

Chapter 1: Educating for 21st Century Competencies (21CC):

The Singapore Journey 1–16

Introduction 1–2

The “Little Red Dot” 1

Beating the Odds? 2

Two Decades of 21CC Education Initiatives and Policies (119–2016) 3–8

Thinking Schools, Learning Nation: A Pivotal 21CC Vision 3

Table 1: Key Highlights of 21CC-related Policies and Initiatives in
Singapore (1997–2015) 4

Teach Less, Learn More 6

Framework for 21CC and Student Outcomes 6

A Systemic Ecological Approach to Educational Change 8

**Strong Tripartite Relationship A Key Enabling Mechanism for
21CC Education in Singapore** 8–9

**NIE a Key Node in the Tripartite Network: Strategic Alignments
in Teacher Education and Research to Further the 21CC**

Educational Agenda 9–15

Teacher Education Model for the 21st Century (TE21) 10

ER3.0: A Responsive Education Research Agenda 10 Years on 11

Chapter Summary 15

Chapter 2: Educating for 21CC in Singapore: From Policy to Practice 17–24

Introduction 17

**Educating for 21CC in Singapore: Highlights of Policy to
Practice Enactments** 17–23

Structural Shifts 17

Programmatic Shifts 19

Programme of Active Learning, PE, Arts, and Music

Education (PALPAM) 19

Applied Learning and Learning for Life Programmes (ALP/LLP) 20

ALP and LLP in the Arts 20

Socio-Technological Infrastructural Shifts 21

Concluding Remarks 23–24

References 25–28

Chapter 1: Educating for 21st Century Competencies (21CC): The Singapore Journey

By Jennifer Pei-Ling Tan, Elizabeth Koh, and David Hung, National Institute of Education,
Nanyang Technological University

INTRODUCTION

In this chapter, we make an attempt to broadly chronicle the key educational aspirations, policy thrusts, and reform initiatives that we consider to be noteworthy in Singapore’s journey toward preparing our young people for the 21st century. These were collectively aimed at forging a resilient and active national citizenry characterized by strong shared values of social responsibility, respect, and harmony amid diversity, alongside high levels of 21st century workforce-relevant knowledge and competencies vital to our young nation-state’s sustained productivity and growth in the wider global economy. The aim here is to provide some insights into when and how “21st century competencies” (21CC) was conceived, articulated, and enacted in Singapore’s public education discourse, policy, and practice. We then highlight one particular “enabling mechanism”—that of a strong tripartite relationship among Singapore’s educational critical stakeholder groups in policy, research, and practice—held together by a common vision and mission that have underpinned, and we expect will continue to buttress, Singapore’s ongoing educational innovation and success in the years ahead.

We qualify at the outset that this chapter represents only one local narrative of the pivotal ways in which Singapore’s formal education sector has engaged with and responded to the global 21CC agenda over the past two decades. It is by no means intended as an official historical account that reflects the unanimous views and/or institutional stances of the National Institute of Education and the Ministry of Education (MOE) Singapore. While the authors draw from and make reference to a number of published sources, including government press releases, policy and curricular documents, as well as relevant academic publications, this chapter nevertheless constitutes a reflective and synthetic narrative of the key educational aspirations and efforts undertaken in Singapore, as seen through the lived experiences of three Singaporean educational researchers and teacher-educators—who once studied in and now work within the system—and who bear a shared professional dedication to Singapore’s ongoing commitment to providing high-quality and future-relevant educational experiences, outcomes, and social trajectories for its young people.

THE “LITTLE RED DOT”

Singapore is often referred to, mostly affectionately, in the media and in conversations as the “Little Red Dot.” This nickname is both a literal reference to the way it is visualized on many world maps, as well as a figurative reference to its physical size, especially when taken in contrast to its achievements. Singapore has been the subject of some level of “international fascination ... partly because [it] is so small and yet so well-known and influential and partly because of its extraordinary success,” both economically, as well as “in international comparative student achievement tests” (Connelly, 2013, pp. vii).

For a young postcolonial island city-state that was barely 582 square kilometers with neither hinterland nor natural resources when it gained independence in the mid-1960s, few would refute that it has achieved remarkable economic success and established a robust internationally recognized education system within

a generation. Today, Singapore's reported land area of 719 square kilometers is densely populated with an estimated population of 5.5 million comprising both local and foreign-born citizens (61%) and permanent residents or temporary migrants on study/work/dependent status (39%) of diverse ethnic, linguistic, and religious backgrounds (Department of Statistics Singapore, 2016). Its cataloged achievements and accolades are numerous, some more commonly known, while others can still invoke some element of surprise when brought to the fore. We highlight some notable examples here. Singapore:

- is a global leader in several economic sectors, including the world's top logistics hub and largest oil-rig producer, 3rd-largest oil-refining and trading center and major hub for ship repair services, 3rd-largest foreign exchange center, and 4th-leading financial center;
- ranks as 2nd-freest economy in the world per the 2015 Index of Economic Freedom, and consistently ranks as one of the least corrupt countries in the world per the Corruption Perception Index, being the only Asian country in the past decade to receive the top-tier AAA sovereign ratings from all major credit rating agencies worldwide;
- consistently reports one of the lowest unemployment rates among developed countries, while its highly developed market economy—historically founded on extended entrepôt trade—reports a remarkable GDP per capita of approximately SGD71,000 or USD49,000 (Department of Statistics Singapore, 2015);
- ranks as the most “Technology-Ready Nation” by the World Economic Forum in its 2015 Global Technology Report;
- ranks 1st in Asia and 11th worldwide in terms of its national social policies as indicated by the UN's Human Development Index that draws on key measures of education, health care, life expectancy, quality of life, personal safety, and housing;
- ranks as the 6th-best health care system in the world per the World Health Organization's World Health Report, with life expectancy rates ranked 4th in the world;
- ranks 4th worldwide in the 2014 Environmental Performance Index, which measures the effectiveness of state policies for environmental sustainability (Yale Center for Environmental Law & Policy, 2014);
- ranks as the 1st- and 6th-best world destination to visit in 2015 by Lonely Planet and the New York Times, respectively; and
- is a major education hub attracting more than 80,000 international students in 2006, a figure that has more or less remained steady despite slight fluctuations in the past decade (EU-Asia Higher Education Platform, 2011); while its two most established local universities continue to steadily climb the world university rankings in recent years, with the National University of Singapore ranked 26th worldwide, and Nanyang Technological University ranked 55th and 10th worldwide, overall and in the field of education, respectively (Quacquarelli Symonds Limited, 2015).

BEATING THE ODDS?

Against this background, “beating the odds” is a commonly heard idiom when Singapore is spoken of. This suggests that many view the Singapore story and trajectory as one that has defied “commonsensical,” even logical and calculated, probabilities of success.

In a similar vein, we argue that the Singapore education landscape defies simplistic stereotypes. On the one hand, many are quick to attribute its consistent strong performance in international benchmarking studies, such as the Programme for International Student Assessment (PISA) and the Trends in International Mathematics and Science Study (TIMSS), to a highly structured, teacher-centric, and content-focused system. Alongside these critiques are largely unsubstantiated claims that such an education system tends to produce students who may do well in memorizing and reproducing factual content, and be prolific at providing accurate answers to structured exam questions, but who are weak in exercising creative and critical faculties in a flexible manner to solve ill-defined, complex problems. Yet, results of the 2012 PISA assessment of students' creative problem-solving abilities served to confound clichéd understandings of Singapore's public education terrain, when its 15-year-olds again outperformed many of their international peers on tasks that required flexible and innovative thinking, and the transfer and application of learning to unfamiliar and complex problem contexts.

Our interest here is to push beyond simple binary formulations and broad generalizations of Singapore's education system. We do so by taking a closer look in the next section at the various educational initiatives over the past two decades that reflect a purposeful drive to nurture a resilient, agile, and productive social citizenry who can not only survive but thrive in the 21st century, characterized by rapid technological advancements and heightened global competitiveness and vulnerabilities.

TWO DECADES OF 21CC EDUCATION INITIATIVES AND POLICIES (1997–2016)

THINKING SCHOOLS, LEARNING NATION: A PIVOTAL 21CC VISION

Facing rapid globalization, the knowledge-based economy, and increasing global competition, the Ministry of Education undertook a major curriculum review in 1997 to rethink its goals and directions for the future (MOE, 2008; Poon et al., in press). This led to the inception of **Thinking Schools, Learning Nation (TSLN)** in the same year. TSLN was a pivotal policy shift toward 21CC education that aimed to prepare Singapore's students for the future. It represented a clear articulation that the future sustainability and economic growth of Singapore depended on the ability of its people to learn (Goh & Gopinathan, 2008), and consequently, that transformation of pedagogy and practice in schools and classrooms was needed to broaden learning experiences and better address students' diverse learning needs (Poon et al., in press). While there had been several curricular programs introduced prior to 1997 that focused on enhancing students' thinking skills (Deng, Gopinathan, & Lee, 2013), the 1997 launch of TSLN is widely recognized as a defining moment that formalized Singapore's systemic efforts in educating for 21CC that concentrated resources on teachers, infrastructure, and technology, with the aim of developing in students the necessary knowledge and competencies to respond to challenges ahead. In this way, TSLN firmly cemented Singapore's move into educating for 21CC (Poon et al., in press). The policy focused on enabling students to develop creative and critical thinking skills, and its strategies included the explicit teaching of creative and critical thinking skills, reduction of curriculum content, revision of assessment modes, and greater emphasis on process instead of outcomes in learning and teaching (MOE, 1997b; Tan, 2013).

Following the TSLN vision, a suite of 21CC curriculum initiatives were systematically introduced and refined to strengthen the preparation of Singapore's young people for the future. Table 1 provides a list of some of the key initiatives that were implemented over the past two decades. These included changes to curriculum and pedagogies, infrastructure and technology support, and programs and structures, which are briefly explained in the following section. Poon et al. (in press) conceptualized this as a systems approach to realizing the TSLN, which required a

common vision and belief, a culture of continuous improvement, an open and collaborative school environment, and Ministry support.

Table 1: Key Highlights of 21CC-related Policies and Initiatives in Singapore (1997–2015)

Year	Policy/Initiative	Brief Description
1997	Thinking Schools, Learning Nation (TSLN)	Launched by then-Prime Minister Goh Chok Tong, TSLN was a vision to prepare students to meet the challenges of the future (MOE, 1997b).
1997	First Masterplan for ICT in Education (Masterplan 1)	Masterplan 1 was launched by Teo Chee Hean, then-Minister for Education. It aimed to equip each school with hardware, software, and network connectivity for students and teachers to access resources. It also targeted that 30% of students' curriculum time would use computers (MOE, 1997c).
1997	National Education Curriculum	Launched by then-Deputy Prime Minister Lee Hsien Loong to develop national cohesion by instilling shared core values, the will to prevail, and ensure Singapore's continued success and well-being (MOE, 1997a).
1997	Desired Outcomes of Education	First formulated by MOE in 1997, it envisioned what the Singapore student should attain (MOE, 2009a).
2003	Second Masterplan for ICT in Education (Masterplan 2)	This built on Masterplan 1 and aimed for the effective and pervasive use of ICT in schools by integrating ICT into the curriculum, establishing baseline ICT standards, and seeding innovative use of ICT among schools (MOE, 2015a).
2004	Integrated Programme	Provided some students with broader learning experiences through a seamless six-year program starting in grade 7 (Secondary 1) that culminates in a grade 12 (Pre-Tertiary 2) examination, without having to sit for a grade 10 (Secondary 4) GCE "O" levels national examination.
2004	Direct School Admission scheme	Offered students the opportunity to gain admission to secondary schooling based on specialized strengths rather than solely on academic grades (Tan, Chow, & Goh, 2008).
2005	Teach Less, Learn More (TLLM)	Emphasized pedagogical change to encourage active and independent learning by trimming syllabus content and to enhance critical thinking and inquiry-based learning among students.
2006	Revised Junior College Curriculum	Offered greater breadth and depth of learning as students study at least one subject beyond their main specialization and have the choice of differing levels of study within each subject (MOE, 2002).
2009	Third Masterplan for ICT in Education (Masterplan 3)	Masterplan 3 built on previous masterplans and aimed to develop students' self-directed and collaborative learning using ICT (MOE, 2015b).
2009	Revised Desired Outcomes of Education	The first set of Desired Outcomes of Education in 1997 was re-articulated into four specific Desired Outcomes of Education—namely, Confident Person, Self-Directed Learner, Active Contributor, Concerned Citizen.
2010	21CC Framework	A "total curriculum" framework that articulated Singapore's education vision where the four Desired Outcomes of Education are underpinned by a suite of emerging 21CC, social-emotional competencies, and values (see Figure 1).

Year	Policy/Initiative	Brief Description
2010	Primary and Secondary Education Review and Implementation (PERI and SERI)	The PERI committee was formed to evaluate and improve the quality of primary education in Singapore, including social-emotional development, non-academic curriculum, and lifelong learning (MOE, 2009b). Key initiatives included Holistic Assessment; Programme for Active Learning; PE, Art, and Music Education; Engaging Pedagogies; Strategies to Ensure More Attention for Individual Pupil Development; and enhancing infrastructure and investing in a quality teaching force. The SERI committee was the equivalent of their PERI counterpart to enhance the quality of secondary education in Singapore.
2012	Teacher Growth Model	A professional development model to encourage teachers' lifelong learning and personal well-being (MOE, 2012).
2012	Values in Action (VIA)	Learning experiences that encourage students' involvement in the community and nurture them to become socially responsible citizens.
2013	Applied Learning Programme (ALP) and Learning for Life Programme (LLP)	To be started in all schools by 2017, the ALP focuses on interdisciplinary knowledge and the application of skills to professional real-world settings; the LLP aims to nurture students' character and values, and develop their interpersonal skill (MOE, n.d.).
2015	Fourth Masterplan for ICT in Education (Masterplan 4)	The goal of MP4 is to develop future-ready and responsible digital learners. It is aligned with student-centric and values-driven education and aims to help students develop mastery of subjects and enhance their 21CC (MOE, 2015c).

In the years closely following 1997, tied to the push for students in Singapore schools to learn more effectively in acquiring both content knowledge and 21CC, technology was (and continues to be) considered a powerful leverage. The **Masterplan 1 (MP1) for Information Communication Technology (ICT) in Education** was launched in 1997. It aimed to encourage students to acquire thinking, learning, and communicating skills through harnessing the use of IT. MP1 also helped equip schools with the necessary hardware and software (e.g., computers, printers, Internet, CD-ROM, word processor) to enable learning and teaching with these tools. MP1's target was to have all schools equipped with the necessary technological infrastructure for IT-based learning for up to 30% of the curriculum (MOE, 1997c).

The **National Education** initiative was also launched in 1997 to nurture national cohesion and inculcate a shared national identity among students. It aimed to help students recognize the vulnerabilities and challenges that Singapore faced, and its core values were meritocracy, multiracial harmony, and multireligious harmony.

Besides an awareness of Singapore's challenges, a key initiative rolled out during this same period was the **Desired Outcomes of Education**. This aimed to develop the Singapore student in the moral, cognitive, physical, social, and aesthetic aspects. Intermediate and final outcomes for primary, secondary, junior college, and postsecondary and tertiary education were set. These included goals such as being morally upright, believing in principles of multiracialism and meritocracy, being gracious, willing to strive, think, and reason, seeking knowledge, and being innovative (Tan, 2013). These would later be refined and re-articulated in 2009.

The driving premise behind these 21CC-related initiatives implemented in the early years following 1997 was aptly summarized by the then-Minister of Education Teo Chee Hean (MOE, 1999):

The Desired Outcomes define our goals in education. We aim to achieve these outcomes through various initiatives—the ICT Masterplan, National Education, the Curriculum Review. All these aim to develop our

young for life, not just for their schooling days; and to develop their potential to the full, not just in academic studies. This requires our Education system to shift from an efficiency-driven to an ability-driven paradigm.

Teach Less, Learn More

The emphasis of pedagogical change was a key thrust from TSLN. In 2004, the “**Teach Less, Learn More**” (**TLLM**) movement further enabled the realization of pedagogical change set out in the TSLN vision. TLLM was first introduced by Prime Minister Lee Hsien Loong in 2004 and subsequently launched in 2005 by then-Minister of Education Tharman Shanmugaratnam with the aim of enhancing the quality of education through reducing syllabuses so that students have more space to learn and explore (Koh, 2013; MOE, 2005). This development was premised on the recognition that 21CC education required new innovative pedagogies such as inquiry-based learning, which requires more curriculum time. The operationalization of TLLM in practice was supported by a suite of curriculum frameworks and resources with practical principles that aimed to help teachers put the TLLM ideas into practice more easily. These included the TLLM framework, the TLLM *Ignite!* package, and the PETALSTM framework, among others (Teo, Deng, Lee, & Lim-Ratnam, 2013).

The technology aspect was also refined in that there was a push for greater integration between 21CC learning and technology. The aim of the **Third Masterplan for ICT (MP3)** launched in 2009 was to “enrich and transform the learning environments” and equip students “with the critical competencies and dispositions to succeed in a knowledge economy” (MOE, 2015b). Two key 21CCs were emphasized: self-directed learning and collaborative learning competencies. Many ICT innovations in learning and teaching were spearheaded by schools and curriculum planners in the Ministry to do so.

In the same year of MP3, the desired outcomes of education were revised. Based on the continuing feedback and reviews from various stakeholders, MOE synthesized the earlier articulations into **four desired outcomes of the student** (MOE, 2009a):

- a **confident person** who has a strong sense of right and wrong, is adaptable and resilient, knows himself, is discerning in judgment, thinks independently and critically, and communicates effectively;
- a **self-directed learner** who takes responsibility for his own learning, who questions, reflects, and perseveres in the pursuit of learning;
- an **active contributor** who can work effectively in teams, exercises initiative, takes calculated risks, is innovative, and strives for excellence; and
- a **concerned citizen** who is rooted to Singapore, has a strong civic consciousness, is informed, and takes an active role in bettering the lives of others around him.

These revised desired outcomes also emphasized students’ development of self-awareness, and interpersonal relationships, and served as a vision that continues to guide the Ministry in all its educational and curricular policies and initiatives.

Framework for 21CC and Student Outcomes

Closely following the revised desired outcomes in 2009, the **Framework for 21CC and Student Outcomes** (Figure 1) formalized in 2010 represented one of the most significant developments in Singapore’s 21CC education efforts

in recent years (MOE, 2016a; Tan, 2013). Broadening the earlier focus on thinking skills, the framework expanded 21CC to include values, emotions, interpersonal skills, and emerging forms of 21CC (Poon et al., in press).

Affectionately called the “swiss-roll,” the framework is depicted as three concentric layers. The outer layer consists of three broad areas of **emerging 21CC**: Civic Literacy, Global Awareness, and Cross-Cultural Skills (CGC), Critical and Inventive Thinking (CIT), and Communication, Collaboration, and Information Skills (CCI). The term “emerging 21CC” was used, as these competencies were recognized as becoming increasingly vital to helping Singapore’s young people thrive in the 21st century. The inner layer represents the **social and emotional competencies**—Self-Awareness, Self-Management, Social Awareness, Relationship Management, and Responsible Decision-Making—that are viewed as enablers to the acquisition of the emerging 21CC. At the heart of the framework sit the **core values** of Respect, Responsibility, Integrity, Care, Resilience, and Harmony, which together anchor the development of competencies.

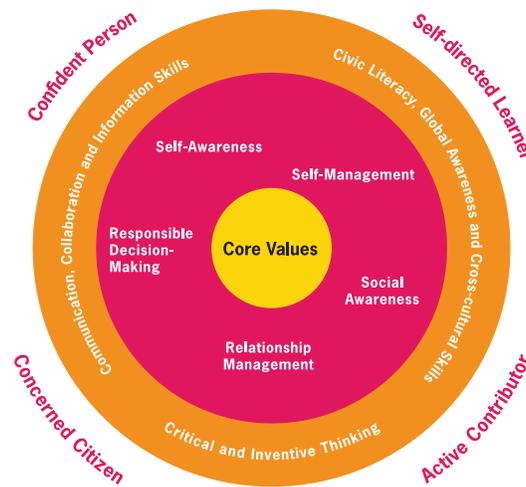


Figure 1: Framework for 21CC and Student Outcomes

Since its inception, the 21CC framework has been infused into the academic curriculum, co-curricular activities, character and citizenship education, as well as applied learning programs (for secondary schools). Toh, Hung, Chua, He, and Jamaludin (in press) highlighted that this integration avoids the trap of compartmentalization and affords the sustainability of these competencies in the Singapore education system.

In 2011, value-centric and need-based strategies and policies were emphasized. This was signaled by the then-Minister of Education Heng Swee Kiat in 2011. Heng (MOE, 2011) launched the **Character and Citizenship Education (CCE) framework**, which brought together National Education (NE), Values Education, Education and Career Guidance, as well as Cyberwellness and Sexuality Education. This was based on ground-up feedback from numerous stakeholders in the education system. Heng (MOE, 2011, p. 5) posited:

We want to make our education system even more student-centric, and sharpen our focus in holistic education—centred on values and character development. We could call this Student-Centric, Values-Driven education. Another way of putting it, value in our learners and learning values.

As a case in point, the Community Involvement Programme, which builds 21CC and character, was repositioned as Values in Action in 2012. This emphasized the character-building aspect of the program. In 2013, the initiative of having two distinctive student-centric and holistic programs for secondary schools was launched. These two programs, **Applied Learning Programme and Learning for Life Programme**, are to be rolled out

in all secondary schools by 2017. These again illustrate the extent to which the Singapore education system has embraced 21CC firmly in its vision and plans, with the view to expand the breadth (i.e., broad and inclusive approach, broad and holistic education), depth (i.e., deep values, deep foundation for learning), and length (i.e., lifelong learning, learning for life) of students' educational experiences.

A SYSTEMIC ECOLOGICAL APPROACH TO EDUCATIONAL CHANGE

In the preceding section, we have attempted to trace the development of when and how the notion of 21CC formally entered Singapore's educational and policy discourse and practice over the past two decades, through a series of strategic ministerial speeches and state-driven policy formulations and initiatives. These ranged from aspirational vision and mission statements that communicated a shared philosophy of education and desired student outcomes toward nurturing and sustaining a vibrant pluralistic social fabric and robust economy for the nation, to a series of curricular, structural, and infrastructural reforms that collectively defined a holistic approach to education innovation for 21CC teaching and learning.

It is important to note, however, that just as systemwide educational change—for Singapore, as for many other nation-states—is by no means an overnight affair, “the Singapore journey” of innovating education to prepare its students for the 21st century is characterized by an ecological approach that encompasses much more than highly centralized “top-down” directives (Lee, Hung, & Teh, 2013; Toh, Jamaludin, He, Chua, & Hung, 2015).

Rather, there is a shared understanding among the professional education community—MOE officers, school practitioners, teacher-educators, and researchers alike—that an education system is a complex ecology wherein any given change process is necessarily evolutionary, adaptive, and nonlinear in nature. And so, for such a change process to have any fair chance of success, ongoing strategic alignments, synergistic partnerships, and iterative calibrations, fostered and forged through continual reciprocal dialogues among key change agents and stakeholders, are paramount.

In many ways, this shared understanding is encapsulated in what has been referred to as Singapore's “unique model ... [of] concomitant emphasis on the tripartite partnership between schools, universities and the government” (Toh et al., in press, p. 16). We argue that this strong tripartite relationship constitutes a key enabling mechanism for successful education innovation toward 21CC teaching and learning in Singapore, and elaborate on this in the section that follows.

STRONG TRIPARTITE RELATIONSHIP A KEY ENABLING MECHANISM FOR 21CC EDUCATION IN SINGAPORE

In 2011, a high-level roundtable discussion was hosted by the National Institute of Education (NIE) entitled “Paving the Fourth Way: The Singapore Story” that focused on leading and enacting educational change for successful and sustainable educational futures. This roundtable featured a distinguished international scholar, Professor Andy Hargreaves, and involved several invited panelists comprising senior leaders from Singapore's formal education community. At this roundtable, an incisive comment was made by Dr. Poon Chew Leng, Director of Research and Evaluation at the Planning Division of the Ministry of Education Singapore:

If you ask why the Singapore system works for ourselves, in our context, I would suggest that it is the unity of vision and mission among our teachers, school leaders, union leaders, NIE educators and researchers and policymakers at MOE ... All of us, despite our different views and leanings work towards a shared vision of moulding the future of our nation (Poon, 2011: cited in Low et al., 2011, p. 18).

At the roundtable and in a subsequent article, Dr. Poon pointed to the dynamic tripartite relationship between research, policy, and practice (Figure 2) as a key attribute of the Singapore education landscape. This serves as a critical enabling mechanism for successful educational innovation and improvement processes and outcomes (Poon, 2012).

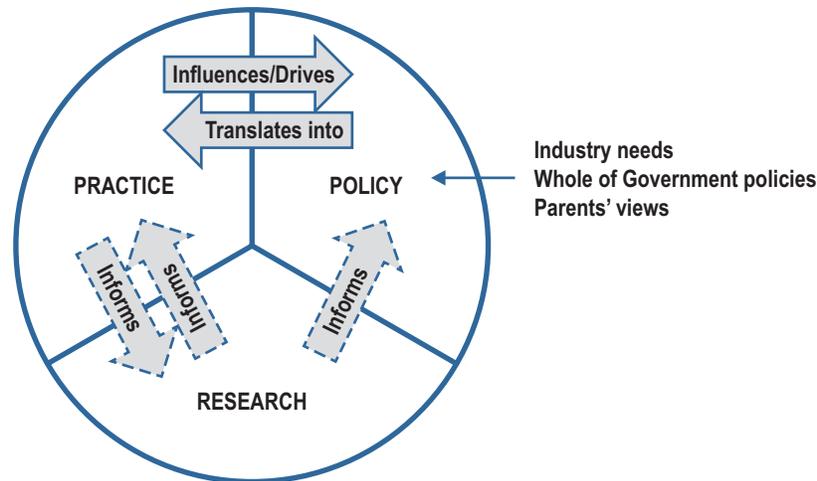


Figure 2: Relationship between research, policy and practice in Singapore's educational context (adapted from Poon, 2011, p.19)

She exemplified the outworking of this strong tripartite relationship with a number of recent policy development efforts in Singapore, such as the mother tongue languages policy review in 2011 in a bid to remain closely relevant to the shifting multi-ethnic and multilingual needs and environments of Singaporean students, families, and societies at large, as well as the introduction of two policies—the Integrated Programme (IP) and Direct School Admission (DSA) scheme in 2004 (see Table 1), both aimed at mitigating the less desirable effects of high-stakes standardized testing, while introducing greater flexibility and autonomy to the education system (Poon, 2012).

The formulation and formalization of these policies, as with many others described in the preceding sections, invariably resulted from extensive engagements and consultations among political leaders, MOE officers, and school stakeholders on the ground—involving not only school leaders and teachers, but also often students, parents, and community leaders. It is common for MOE to continue providing strong support via open communicative loops and relevant resources to schools and teachers as they engage with and enact these policies on the front lines of teaching and learning in classrooms subsequent to the “official launch” of policy initiatives. Furthermore, this policy/practice “mutual-grounding” loop is continually buttressed by targeted research efforts to gather empirically based, contextually relevant insights alongside international evidence. This is in turn complemented by ongoing dialogic interactions with leading experts and specialists in the field, local and global.

NIE A KEY NODE IN THE TRIPARTITE NETWORK: STRATEGIC ALIGNMENTS IN TEACHER EDUCATION AND RESEARCH TO FURTHER THE 21CC EDUCATIONAL AGENDA

As Singapore's national institute of teacher education and educational research, NIE inexorably constitutes a key node in the tripartite network described above. It plays an integral role in servicing the nation's educational

community, with its approximately 450-strong faculty across 12 academic programs,¹ four program offices,² and four departments³ collectively committed to working alongside the MOE and the 33,000-strong teaching force to continually improve the quality, relevance, and impact of Singapore’s formal education sector in preparing young people for productive 21st century futures. In the section that follows, we elaborate on two key institutional thrusts that directly address and engage with the 21CC educational movement in Singapore.

TEACHER EDUCATION MODEL FOR THE 21ST CENTURY (TE21)

In 2009, NIE conducted a systematic review of its teacher education programs in partnership with MOE and schools. This process was informed by Singapore’s national “21CC Framework and Total Curriculum,” and underpinned by rigorous and robust research. The review resulted in the Teacher Education Model for the 21st Century (TE21), with an articulation of a clear set of Graduated Teacher Competencies for preservice teachers, and the new V3SK framework that explicitly outlined three key attributes constitutive of the 21st century teaching professional—Values, Skills, and Knowledge (Figure 3). This framework was and is intended to serve as a compass for developing 21st century teachers who in turn are adequately equipped to nurture 21st century learners (NIE, n.d.).

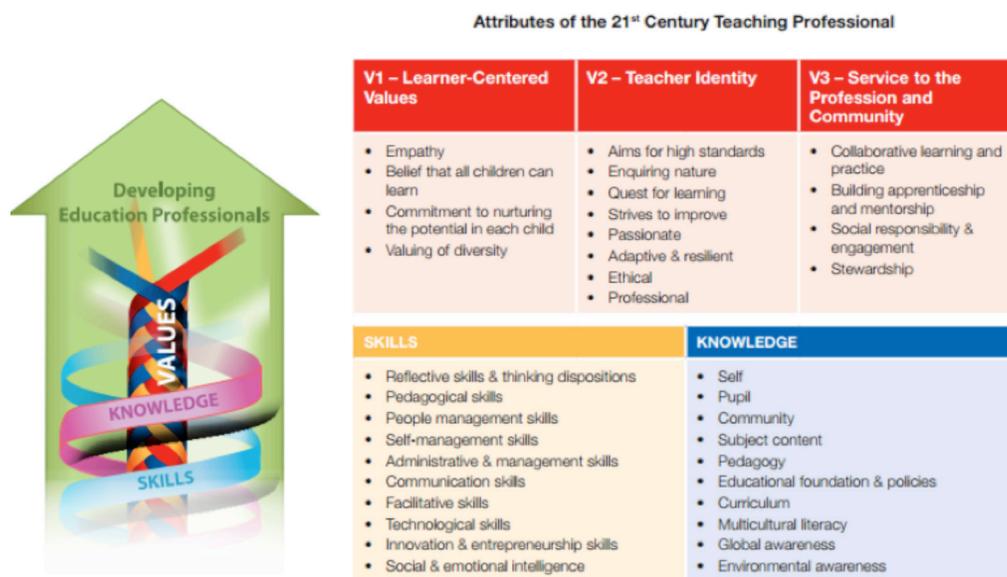


Figure 3: New Values, Skills, and Knowledge (V3SK) Model

The genesis, process, and outcome of TE21 is comprehensively laid out in a recent chapter by Lee and Low (2013) on Singapore’s approach to preparing teachers for 21st century educational innovation. In broad terms, TE21 is underpinned by a values-driven philosophy emphasizing the critical importance of (i) *learner-centeredness*

¹ Asian Languages and Culture (ALC); Curriculum, Teaching and Learning (CTL); Early Childhood and Special Needs Education (ECSE); English Language and Literature (ELL); Humanities and Social Studies Education (HSSE); Learning Sciences and Technologies (LST); Mathematics and Mathematics Education (MME); Natural Sciences and Science Education (NSSE); Physical Education and Sports Science (PESS); Policy and Leadership Studies (PLS); Psychological Studies (PS); and Visual and Performing Arts (VPA).

² Office of Teacher Education (OTE); Office of Graduate Studies and Professional Learning (GPL); Office of Education Research (OER); and Office of Strategic Planning and Academic Quality (SPAQ).

³ Office for Faculty Affairs (OFA); Academic Computing and Information Services (ACIS); and Administrative Departments.

premised on the belief that all students can learn and learn well with strong teacher empathy and commitment to nurturing the diverse and unique strengths of learners; (ii) developing a strong *teacher identity* characterized by passion, curiosity, excellence, integrity, adaptivity, resilience, and professionalism; and (iii) *service* to the profession and community. The TE21 model was operationalized in the following key ways:

- *curricular changes* resulting from a coherent mapping of the V³SK components across a comprehensive suite of preservice programs and courses, with mandatory core programs focusing on values development, and with individual teachers being afforded the agency to map out their personal learning journey and goals;
- *pedagogical and assessment innovation*, foregrounding inquiry-based, problem-based, and experiential learning, understanding the social context of learning and learners, engaging with and leveraging on contemporary technologies to enrich learning designs, processes, and outcomes, as well as fostering assessment literacy with an emphasis on assessment for and as learning; and
- *structural and infrastructural affordances*, including (i) the introduction of a Teaching and Learning e-Portfolio to nurture purposeful individual and collaborative reflection; (ii) strengthening theory/practice ties and mentorship through enhancements to the existing practicum model (e.g., a Focused Conversations component was introduced where student teachers had the opportunity to dialogue with their School Coordinating Mentors regularly over a sustained period of time); as well as (iii) transforming the physical infrastructure to reflect the new pedagogical underpinnings (e.g., all tutorial classrooms were redesigned to become technology-rich “collaborative classrooms” that structurally optimize support for group-based interactive learning).

As indicated earlier, TE21 was far from a siloistic institutional effort to offer a world-class teacher training program. Rather, it was an endeavor purposefully aligned with and responsive to the broader 21CC educational policy reforms and needs of the Singapore eduscape. Like its MOE counterpart, NIE undertook this teacher education innovation effort in a manner that exemplified and reinforced the strong tripartite linkages between policy, practice, and research in Singapore. We now turn the lens toward NIE’s corresponding educational research enterprise that serves as a parallel enabling mechanism in Singapore’s 21CC education journey.

ER3.0: A RESPONSIVE EDUCATION RESEARCH AGENDA 10 YEARS ON

Prior to 1999, while there may have been education and pedagogical research undertaken in Singapore for some decades (Koay, 2010), there was no dedicated and recurrent funding for education research in Singapore. This began in 1999, with MOE committing an annual budget of S\$1M to the undertaking of education research in NIE, in part a responsive move strategically aligned to the 1997 Thinking Schools, Learning Nation initiative (Gopinathan & Hung, 2010).

The next momentous episode occurred in 2003, when the Ministry awarded a five-year tranche funding of approximately SGD50M (approximately USD35M) that saw the establishment of first the Centre for Research in Pedagogy and Practice (CRPP) in 2003, followed by a second research center—the Learning Sciences Lab (LSL) in 2005. Girded by a three-pronged mission to (i) advance knowledge that promotes the improvement of teaching and learning in Singapore and the wider educational community; (ii) provide relevant and practical responses to persistent educational issues; and (iii) inform and spread innovations in pedagogy and practice, CRPP set out to achieve the following objectives:

- describe and measure patterns of classroom pedagogy in Singaporean schools;
- evaluate the impact of pedagogical beliefs and practices on student outcomes;
- design and support the implementation of technology-enriched learning in classrooms;
- identify opportunities for pedagogical improvement through carefully designed and evidence-based intervention studies; and
- support evidence-based policy formulation and practice to meet the challenges of 21st century environments.

CRPP’s system-level focus was complemented by LSL, which at the time largely served as an “incubation space” for smaller-scale, more proximal and context-specific design-based research projects with a distinctive ICT focus to iteratively develop, implement, and refine pedagogical innovations premised on student-centered, inquiry-based learning, including knowledge building, seamless learning, new media and literacies, and science inquiry, among others.

In 2008, a second tranche of MOE funding approximating SGD100M (approximately USD69M) was awarded after a rigorous process of evaluation and review of the contributions and impact of education research on policy and practice that ensued from the first tranche. This period saw the strengthening of existing research capacity, studies, and outcomes within CRPP and LSL, as well as the establishment of the Office of Education Research (OER) to set strategic directions for NIE, and to promote and foster strong partnerships and interactions—internally among NIE faculty with varied research interests and strengths, and externally between NIE researchers and MOE policymakers, school practitioners, as well as with other universities in Singapore and internationally.

Following this, a third tranche of funding to the quantum of SGD130M (approximately USD90M) was awarded in 2013, to support an institution-wide research agenda, known as Education Research 3.0 (ER3.0). ER3.0 was strategically aligned with and focused on addressing corresponding educational needs and issues in Singapore alongside the formalization and active infusions at the policy and practice levels of education reforms and innovations for 21st century teaching and learning. This responsive education research agenda was focused along four main thrusts, with their target funding allocation indicated in parentheses:

- ***Blue-Sky Research Development and Innovation*** aimed at pre-empting future needs 10 years ahead (9%);
- ***Strategic Research Development and Innovation*** aimed at anticipating future needs five years ahead (44%);
- ***Priority Innovation and Intervention*** to address current educational realities and more immediate needs, including the ongoing evaluations of key policy initiatives (38%); and
- ***Scaling Translation and Knowledge Management*** aimed at refining, adapting, and diffusing proven learning interventions that are implementable in the near term (9%).

ER3.0 was further operationalized into five broad research programs and 28 research niche areas. This is shown in Figure 5, following a visual representation of NIE’s research journey in Figure 4.



Figure 4: NIE's ER3.0 Journey 2003–2017

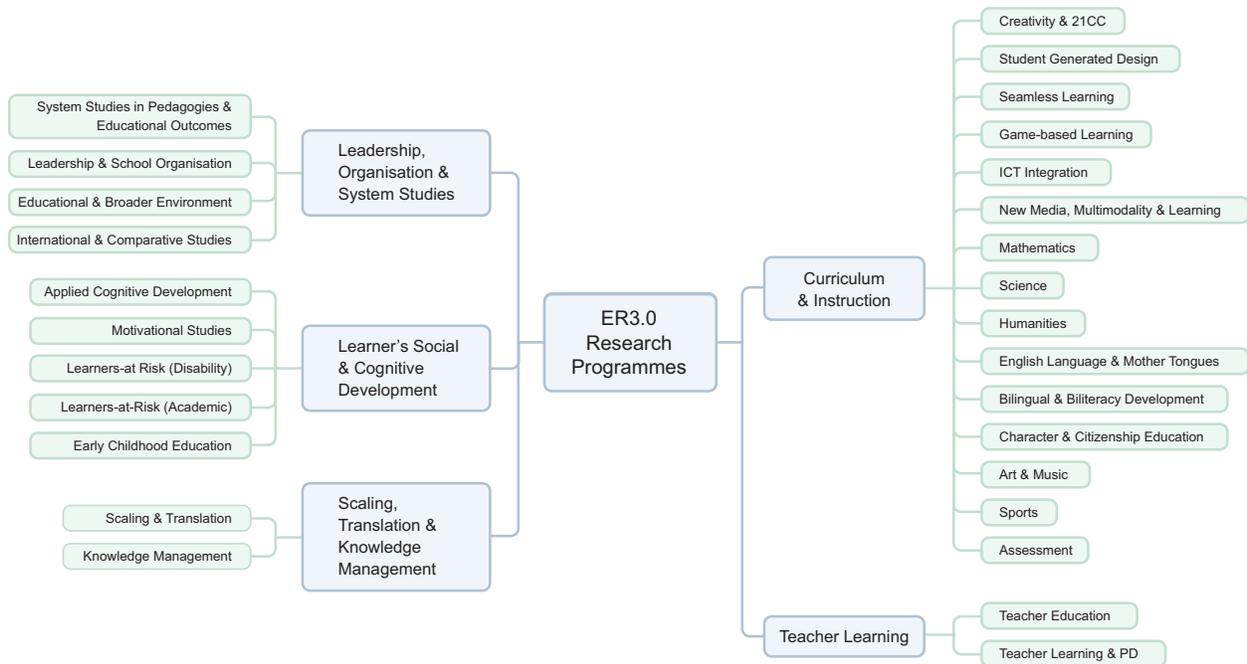


Figure 5: NIE's ER3.0 Research Programs and Niche Areas

In addition to a specific niche area dedicated to Creativity and 21CC research within the Curriculum and Instruction Research Programme, many competitively funded research projects across the 28 niche areas (Figure 5) also focused on innovating teaching and learning to address 21st century needs. A network analysis of the interactions and linkages across research projects further substantiated the centrality of Creativity and 21CC as a major focal point of all research undertaken between 2008 and 2015 (Figure 6).

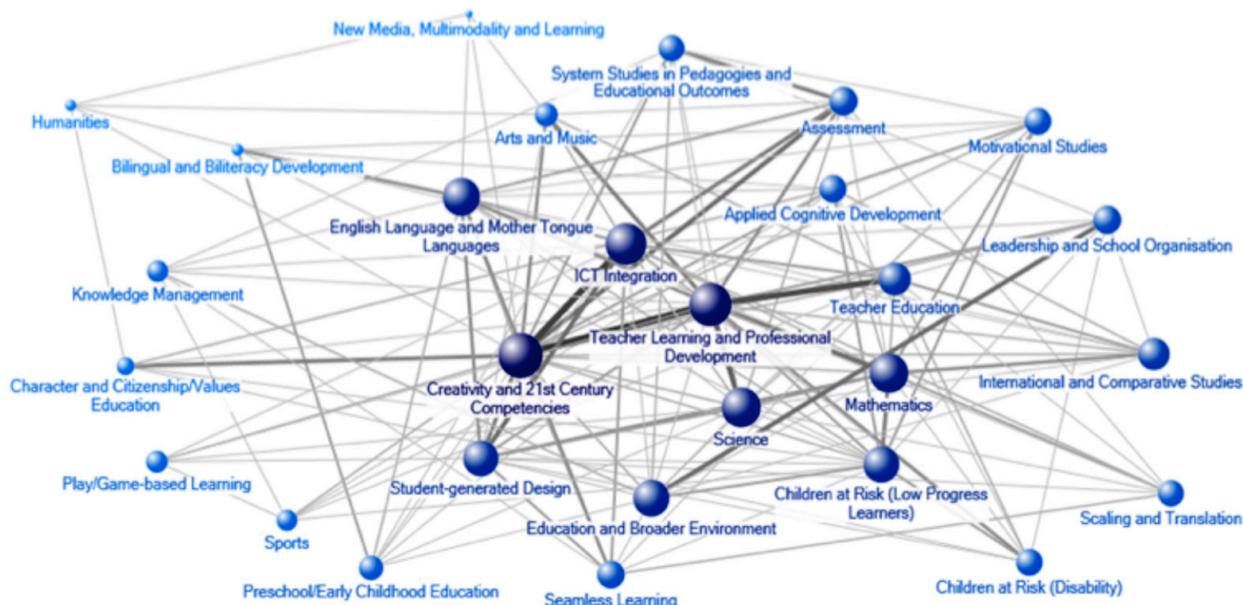


Figure 6: Creativity and 21CC a Highly Interconnected and Focal Research Niche Area within NIE

Node size: bigger nodes represent higher centrality (i.e., more connections with other niche areas)
Tie width: thicker lines represent a greater number of projects

A further synthesis of all research projects funded and conducted between 2008 and 2015 (completed and ongoing) along 11 broader categories similarly foregrounded **Innovations for 21st Century Learning and Teaching** as the most active research domain, in terms of both quantum of projects and funding awarded (Figure 7).

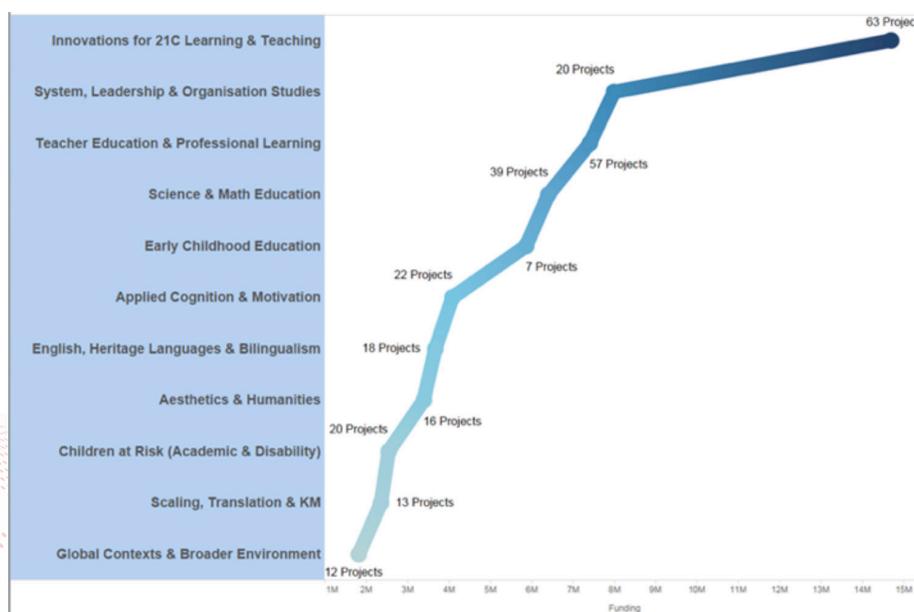


Figure 7: Innovations for 21st Century Learning and Teaching a Highly Active Research Domain within NIE

The intention here is not to downplay other critical areas of research undertakings in NIE, but rather, to highlight the responsiveness of NIE educational research, especially over the past decade, to a larger systemwide call and move toward a 21st century relevant education model. This is shared collectively by the formal education professional community—policymakers and school practitioners alike.

In exemplification of this shared vision and mission, as well as the ways in which the strong tripartite relationship between MOE, NIE, and schools works together as a key enabling mechanism of ecological change, we provide a snapshot of some research projects (Figure 8), all of which aimed to develop important 21st century capacities and dispositions in learners, alongside deep content learning and mastery across a range of curricular domain areas. These projects were undertaken as collaborative engagements involving schools and MOE—an approach that is strongly encouraged by and fostered through NIE’s ER3.0 research agenda (OER, 2016).

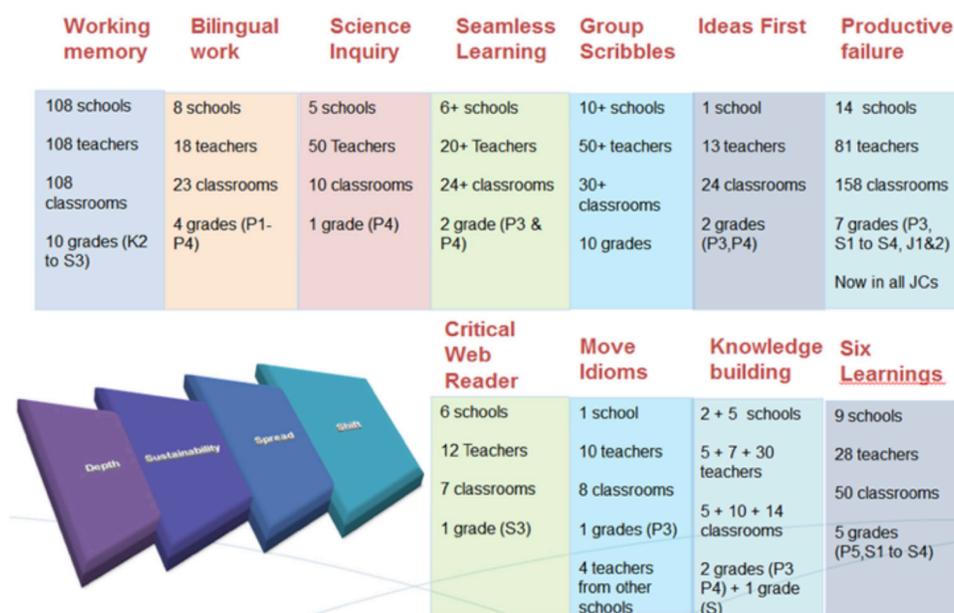


Figure 8: Snapshot of Some 21CC-related Research Projects from 2008 to 2015

Note: More information on these projects is available at [www.http://www.nie.edu.sg/research/projects/](http://www.nie.edu.sg/research/projects/).

CHAPTER SUMMARY

This chapter provides one account of Singapore’s journey to recalibrate its education system in a bid to better prepare its students for positive social and professional trajectories in a globalized 21st century world, as seen through the lens of a group of teacher-educators and educational social scientists indigenous to the system. We have attempted to trace the key 21CC-related policies and initiatives over the past two decades. This was followed by the foregrounding of what we consider to be one key enabling mechanism—a strong tripartite relationship between policy (MOE), research (NIE), and practice (schools and NIE). We further exemplified the outworking of this enabling mechanism by shedding light on NIE’s innovation efforts in teacher education (i.e., TE21 model) and educational research (i.e., ER3.0) over the past ten years, which together reflect a clear intentionality to be strategically aligned and responsive to the needs of the wider education system and its stakeholders. In doing so, we underscored the ecological view and approach to 21CC education innovation shared by the Singapore educational community as a whole—policymakers, practitioners, teacher-educators, and researchers alike.

We conclude by noting some pertinent challenges ahead. It has been observed by some that while other more decentralized education systems, such as the United States, are moving toward standardized curriculum, assessments, and examinations (Hargreaves & Shirley, 2009), Singapore started on the other end of the continuum epitomizing a highly centralized and structured system bolstered by standardized high-stakes national assessments at the end of grades 6, 10, and 12 (Tan & Gopinathan, 2000). Drawing from recent literature, it appears that the Singapore education system can be somewhat uniquely characterized by two key aspirational attributes.

First, while some East Asian systems such as Hong Kong and South Korea appear to be moving toward decentralization (Kim & Cho, 2014; Lee & Manzon, 2014), Singapore’s policymakers have espoused the belief that degrees of centralization are essential to the small city-state’s agility in responding to external circumstances and challenges (Lee et al., 2013). This has led some to describe the Singapore education system as a hybridized centralization/decentralization model (Ng, 2013)—high quality is maintained by centralizing controls on strategic directions, curriculum, resources, and infrastructure. Concomitantly, more operational and tactical ventures are decentralized by enabling schools to value and respond to diversity, as well as exercise flexibility and innovativeness in curricular enactments.

Second, while educating for 21CC is at the forefront of Singapore’s contemporary educational reforms, there is an equally powerful “collective consciousness” (Durkheim, 2014; Tsoukalas, 2007) that this should not come at the expense of, but rather reinforce, deep content mastery, high performance, and academic achievement.

In this regard, rather than subscribing to binary formulations of *centralization versus decentralization*, and *21CC versus academic achievement*, pursuing a hybridized “Third Space” that holds two seemingly incommensurate constructs appears to mark the distinctive “Singapore Way.” Such a path is no doubt fraught with many paradoxical tensions, pedagogical complexities, even frustrating encounters, that require deep and recurrent negotiations and fine recalibrations across all levels and by multiple stakeholders.

Borrowing the words of Gramsci (1971, pp. 34–35), “... a historical, dialectical conception of the world ... understands movement and change, and appreciates the sum of effort and sacrifice which the present has cost the past, and which the future is costing the present, and ... conceives the contemporary world as a synthesis of the past, of all past generations, which projects itself into the future.” To this end, the Singapore journey of engaging with the global 21CC educational agenda has by no means been a straightforward or linear one. It is yet too preliminary to speak of any conclusive success at this historical point in time, though few could purport that it is for a lack of effort or even sacrifice. It is this necessarily problematic educational challenge that makes the formal schooling venture in Singapore an inexorably compelling and fascinating one. We may yet beat the odds.

Chapter 2: Educating for 21CC in Singapore: From Policy to Practice

By Jennifer Pei-Ling Tan, Elizabeth Koh, Melvin Chan, and Pamela Costes-Onishi,
National Institute of Education, Nanyang Technological University

INTRODUCTION

This chapter follows on from our first chapter, in which we provided a brief overview and discussion of Singapore’s unique developmental trajectory as a nation-state and its educational landscape as generally understood. We concluded the first chapter by foregrounding a key enabling mechanism relatively unique to Singapore’s “tight-loose” education system—that of a strong tripartite relationship among Singapore’s critical stakeholder groups in educational policy, research, and practice. This tripartite partnership enables policy, research, and practice to inform one another in a reciprocal co-constructive loop that reflects an ecological approach toward curricular and pedagogical innovation in classrooms, schools, and teacher learning contexts across the whole system.

In this chapter, we further exemplify Singapore’s efforts to prepare students for the 21st century by foregrounding some concrete examples of policy enactments in practice that reflect shifts in three key areas: (a) structural shifts, (b) programmatic shifts, and (c) socio-technological infrastructural shifts. The following sections discuss these in turn.

EDUCATING FOR 21CC IN SINGAPORE: HIGHLIGHTS OF POLICY TO PRACTICE ENACTMENTS

STRUCTURAL SHIFTS

Singapore’s education system is commonly perceived as one that is excessively focused on the coverage and mastery of disciplinary content, with progression through schooling trajectories being largely determined by academic grades in school-based tests and national standardized assessments at the end of primary school (year 6), high school (year 10), and junior college (year 12).

However, the structural landscape of formal education is slowly but surely shifting. Targeted efforts have been undertaken and are still underway to strategically “loosen” educational structures across the different phases of formal schooling since the launch of the TSLN initiative in 1997. **These reflect Singapore’s current commitment to prepare its young people to thrive in complex and ambiguous 21st century lifeworlds, by cultivating a deeper love for learning and appreciation for one’s diverse talents and strengths that go beyond academic performance in high-stakes tests.** On the whole, these structural shifts follow the principles of decentralization and differentiation toward greater choice, flexibility, and diversity, with the aim of creating multiple developmental pathways and trajectories of educational success throughout the formal schooling phases, from primary to secondary and postsecondary.

Primary Schooling: Since 2004 and over the course of the next several years, refinements were made to the **structures and practice of “streaming”** in Singapore’s primary schools. By 2008, the widely debated primary

education “streaming” of nine-year-old students at the end of year 4 into EM1, EM2, and EM3 (English and Mother Tongue at 1st, 2nd, and 3rd language, respectively) largely based on their end-of-year 4 exam results was significantly redesigned. These three “streams” no longer exist, and were replaced by the “subject-banding” scheme instead. Students now take subjects at differentiated foundation, standard, and higher levels, depending on their aptitudes and proficiencies in those disciplinary domains. While some may argue that this only constitutes more a change in form, rather than substance, it nevertheless reflects a structural shift that was enacted in the organization of schooling, away from a more *functional* “ability-driven” view of learners toward a more *responsive* educational philosophy premised on differentiated and inclusive learning to meet diverse student needs.

This change in “streaming” practice was further buttressed by the introduction of the **Direct School Admission (DSA) scheme** in 2004. Essentially the DSA-Secondary scheme offered students the opportunity to gain admission to secondary schooling (and later, the DSA-JC scheme at the postsecondary level) based on their diverse achievements and strengths before the Primary School Leaving Examination (PSLE) results (and correspondingly, their GCE “O” level results for the DSA-JC scheme) are released (MOE, 2016b; 2016d). In this way, the DSA scheme reflects another deep structural shift in the organization of Singapore’s formal education landscape that seeks to promote a more holistic 21CC education that acknowledges and rewards achievements and talents, such as in arts or sports, rather than strong academic performance in the conventional 3Rs (i.e., reading, writing, and arithmetic) alone.

Secondary and Postsecondary Schooling: At the secondary schooling phase, the Integrated Programme (IP) and Specialised Independent Schools are particularly noteworthy initiatives reflecting such structural shifts to the practical organization of schooling to allow for more flexibility and diversity in curricular demands and therefore, students’ learning experiences. In 2004, the **Integrated Programme (IP)** was introduced to allow for more pedagogic and curricular freedom by combining secondary and JC education and in the process, removing the constraint of the high-stakes GCE “O” levels exam, which was otherwise mandatory at the end of secondary schooling (year 10 or 11). In this way, schools offering the IP are able to optimize the time freed up from GCE “O” levels exam preparations to further stretch the learning of students, and provide greater breadth in both the academic and non-academic domains (MOE, 2016c). IP schools may also apply to offer an alternative curriculum to the GCE “A” levels, such as the more broad-based and inquiry-oriented International Baccalaureate Diploma Programme (IBDP). In addition to the IP, four **Specialised Independent Schools** were founded in 2004, 2006, 2008, and 2010, respectively, to nurture talent in the sports, mathematics, science, the arts, and technology fields—namely, the *Singapore Sports School*, the *NUS High School of Mathematics and Science*, the *School of the Arts Singapore*, and the *School of Science and Technology*. The curriculum and pedagogical orientations in these Specialised Independent Schools are specifically designed to deliver niche programs that build on and cultivate students’ critical thinking and creative competencies, talents, and strengths in the relevant domains. To date, there are 18 schools that offer the IP and four Specialised Independent Schools (of approximately 125 secondary schools). While the IP and Specialised Independent Schools initiatives have been criticized, similar to the DSA scheme, for innately privileging students who are either already academically inclined a priori and/or socioeconomically advantaged as compared to their cohort of peers, and therefore, potentially further reinforcing gaps in educational achievement and longer-term socioeconomic trajectories, we argue here that at heart, these nonetheless represent efforts of policy enactments in the structural practices of schooling, following TSLN and TLLM, to allow for more pliancy in the education system, such that schools, teachers, and students alike may have more practical opportunities in formal schooling contexts to cultivate a suite of 21CC and dispositions that transcend academic domains and achievements.

PROGRAMMATIC SHIFTS

In a similar vein to the structural shifts discussed above, in recent years, a number of curricular and programmatic shifts directly influenced by the TSLN and TLLM policy movements to support more holistic, broad-based, and 21CC-oriented learning were enacted in Singapore schools and classrooms at the primary and secondary levels. Notable examples include the Programme of Active Learning (PAL) and increased emphasis on PE/Outdoor Education (specifically, Outdoor Experiential Learning), Arts, and Music (PAM) in the primary education level, and the Applied Learning Programme and Learning for Life Programme (ALP/LLP) at the secondary education level.

Programme of Active Learning, PE, Arts, and Music Education (PALPAM)

PALPAM constituted a key strategic thrust of the Primary Education Review and Implementation (PERI) policy initiative launched in 2010, that saw the comprehensive evaluation and improvement of the quality of primary education in Singapore to focus on enhancing social-emotional development, non-academic curriculum, and lifelong learning in young students (MOE, 2009b). We elaborate on PAL and PAM in the respective sections below.

PAL aims to facilitate the well-rounded development of pupils in the five learning domains (cognitive, moral, social, aesthetics, and physical) and help pupils to develop social-emotional competencies. To achieve this, PAL modules provide pupils with broad exposure in two areas: Sports and Outdoor Education, and Performing and Visual Arts. The modules are experiential in nature and incorporate learning in creative and enjoyable ways. Schools have the flexibility to select PAL activities to cater to the needs and interests of their pupils. Each PAL module will be conducted during curriculum time for at least 2 hours a week, with each module lasting between 7 and 10 weeks. At the end of Primary 2, all pupils would have been exposed to at least six different modules. If the pupils discover that they have a flair or interest in a specific area, they could choose to focus on one particular CCA at the upper primary level. All Primary 3 to 6 pupils should either continue with PAL and/or opt for a main CCA where they can specialize in an area of interest. To sustain PAL in schools, it is important to ensure that PAL schools are well supported to carry out the program. As such, PAL specialists need to have a robust understanding of PAL in order to provide quality consultancy to schools, lead training workshops, and develop quality PAL curriculum. PAL vendors also need to be well equipped to support teachers in delivering the program effectively.

To enhance **PAM** education since 2010, MOE has invested in providing quality infrastructure and facilities in Singapore schools, such as Indoor Sports Halls and synthetic turf fields. In line with PERI recommendations, the provision of infrastructure will continue to be further expanded upon (e.g., building of dance studios, outdoor running tracks, etc.). Furthermore, the establishment of the Physical Education and Sports Teacher Academy (PESTA) and the Singapore Teachers' Academy for the Arts (STAR) also supports the in-service training and professional development of our PAM teachers to strengthen PAM education. To enhance the delivery of the Art and Music curriculum, all new Art and Music teachers will be trained for single-subject specialization, i.e., only in Art or Music. They will focus on teaching either Art or Music, and handle Art- or Music-related CCAs and programs. Existing Art and Music teachers will also move toward single-subject specialization, via a four-month intensive specialist professional development program culminating in an Advanced Diploma co-initiated by the MOE and the NIE (Costes-Onishi, 2016). In this way, Primary Music and Art teachers in Singapore are gradually “transformed” from generalists to specialists, better equipped professionally and pedagogically to enact student-centered teaching strategies and practices in schools

and classrooms across Singapore schools. MOE will also increase PE curriculum time for all primary and secondary school students. For Primary 1 and 2, PE curriculum time will be extended from 1.5 hours to 2 hours (in addition to 2 hours of PAL); for Primary 3 to 6, it will be extended from 1.5 hours to 2.5 hours; and for Secondary 1 to 4, it will be extended from 1 hour to 2 hours.

Applied Learning and Learning for Life Programmes (ALP/LLP)

As part of the efforts to prioritize the cultivation of 21CC in schools alongside academic excellence, then-Minister of Education Mr. Heng Swee Kiat announced two new programs during the 2013 Ministry of Education's (MOE) Workplan Seminar. They are the Applied Learning Programme (ALP) and the Learning for Life Programme (LLP). The ALP/LLP serve two broad objectives: (1) to provide students with more opportunities to pursue learning in line with their interests; and (2) to deepen their 21CC. In brief terms, the ALP aims for authentic learning or the ability to connect knowledge and skills to real-world situations; LLP aims for experiential learning that would develop positive character and values (MOE, 2013). The programs have a goal of ensuring all secondary schools specialize in a niche domain that will be offered to all students under the ALP or LLP by 2017 (MOE, 2013).

In order for schools to not have to start from scratch in developing these two programs, these could be synergized with existing or emerging niche areas of the schools. These niche-area specialized programs, introduced in schools since 2000 onward, include distinctive programs in the domains of Sports and Outdoor Education (approximately 27% of secondary schools with niche programs), the Arts and Music (~21%), Science (~17%), Community and Youth Leadership (~12%), Uniformed Groups (10%), Business and Entrepreneurship (~5%), as well as a range of other areas (~8%) such as Problem-Solving, Humanities, Language, Journalism, Design, and Technology. We elaborate further on ALP/LLP in the Arts as an example of curricular/programmatic shifts in Singapore educational practice as an enactment of broader 21CC-specific policy initiatives.

ALP and LLP in the Arts

To date, there are five secondary schools under the ALP and 25 schools under the LLP in the Arts. According to the Arts Education Branch (AEB) of MOE, the ALP and LLP bear distinct programmatic objectives and characteristics:

Applied Learning Programme (ALP)

This program serves to connect academic knowledge and skills with the real world. The emphasis is on the application of thinking skills, connecting knowledge across subject disciplines, stretching the imagination, and applying these in authentic settings in society and industries. The intent is to help students appreciate the relevance and value of what they are learning in the academic curriculum and develop stronger motivation and purpose to acquire knowledge and skills. ALPs may be developed in areas such as business and entrepreneurship, design, engineering and robotics, environmental science and technology, health services, heritage, journalism and broadcasting, literary arts, simulation and modeling, and the arts.

Learning for Life Programme (LLP)

The LLP provides students with real-life experiential learning to develop their character and values, cultivate positive attitudes, self-expression, and strengthen their people skills. This is an integral aspect and

a distinctive signature approach of Character and Citizenship Education (CCE). The intent is to instill in our students a sense of rootedness and responsibility for their community and fellow Singaporeans. Areas can include, among others, outdoor adventure learning, sports, student leadership development, uniformed groups, and the arts.

ALP is therefore focused on authentic learning, while LLP emphasizes experiential learning based on this definition. Seen within the curricular lens proposed by Acedo and Hughes (2014), their guiding principles converge for learning in the 21st century, by integrating both the *knowledge component* (STEM learning, concepts-focused learning, information literacy) needed for authentic learning, and the *attitude component* (academic honesty, health and mindfulness, service learning) needed for experiential learning, with both these components in turn interconnected by the 21CC of creativity and critical thinking. Indeed, the balance between authentic and experiential learning is deemed important to prepare students for the complexity of the 21st century.

As a domain, the arts ALP and LLP has the following aims: (1) to nurture in students a keen sense of aesthetics and an appreciation for the arts; (2) to provide students with breadth and depth of experience in traditional and contemporary arts practices; (3) to develop students' social and emotional competencies through the practice of the arts; and (4) to equip students with knowledge, skills, and dispositions needed in their pursuit of educational and career pathways in the arts (applicable more to ALP). More specifically, over the past years since its launch, and going forward, MOE-AEB plans to achieve these aims through providing targeted support that helps schools to establish and continually build/enhance: (1) vibrant school arts culture comprising: strong art and music instructional programs and a range of arts co-curricular and enrichment programs; (2) opportunities for all to: continuously engage in the arts, and contribute to the community through the arts; (3) meaningful partnership(s) with the community and arts organizations; (4) meaningful partnership(s) within the arts industry and with Institutes of Higher Learning (IHLs); and (5) Enhanced Education and Career Guidance (ECG) in the arts, such that students may develop a growing sense of 21st century–relevant, real-world professional identities, dispositions, skills, and career trajectories in the field of the arts beyond secondary schooling.

SOCIO-TECHNOLOGICAL INFRASTRUCTURAL SHIFTS

While structural and programmatic shifts helped to cement education in Singapore toward 21CC, on the technological front, the ICT layer and the impetus to shift with socio-technological innovations added the icing to the cake.

In its systematic way, MOE has conceptualized and implemented three Masterplans for ICT in Education, with the fourth one currently in progress. Singapore has used a centralized approach when it comes to infrastructure adoption, with a shared vision of ICT and how it should enable education to achieve 21CC goals. Each ICT masterplan typically lasts five years and builds on the previous masterplan, reviewing the prior successes and challenges, and considering the needs of Singapore in the face of worldwide trends.

We highlight the recently enacted masterplan, the Third Masterplan for ICT in Education (MP3), implemented between 2009 and 2014. MP3 built on the previous two masterplans and aimed to “enrich and transform the learning environments” of students and “equip them with the critical competencies and dispositions to succeed in a knowledge economy” (MOE, 2015b). The competencies were distilled and concentrated primarily on self-directed learning (SDL) and integration of ICT in schools' curriculum.

During the launch of this policy masterplan, many meetings between stakeholders were carried out. This included meetings between the masterplan planners and school leaders, teachers, teacher-educators, researchers (NIE), ICT vendors, and other collaborating ministries (e.g., the Information Development Authority). While Singapore has a centralized vision of the ICT masterplan, the implementation approach is decentralized, allowing each stakeholder to appropriate the policy to their own contextual needs and constraints. For instance, in a school, school leaders are able to adapt the policy such that it suits the school and learners, and basically, change takes place according to the schools' readiness level.

We offer a successful case example of the enactment of MP3 in Singapore (Lee & Hung, 2016; Looi, Sun, Seow, & Chia, 2014; Toh, Jamaludin, Hung, & Chua, 2014). In Pebble Primary School (pseudonym), the enactment and spread of MP3 was spearheaded by the school leaders (Lee & Hung, 2016; Toh et al., 2014). Prior to MP3, the school had already experimented with several ICT-based innovations and was ready for further innovations. During the period of MP3, the school co-designed a seamless learning innovation with NIE researchers, an international university, and private vendors. This five-year project saw the development of the Mobilized 5E (Engagement, Exploration, Explanation, Elaboration, Evaluation) Science Curriculum, which is an integration of seamless mobile learning with the national Primary 3 and 4 Science Curriculum (Looi et al., 2014). The innovation aimed to help deepen students' scientific concepts, and enhance their modeling, reasoning, reflective thinking, and self-directed learning skills. According to Looi et al. (2014), the Mobilized 5E Science Curriculum was a viable and successful curriculum innovation, with evidence showing an improvement in students' conceptual understanding with this inquiry-based seamless learning pedagogy. The researchers also observed that participating students were able to be self-directed in their learning through the use of mobile phones in and out of the classroom, and also engage in collaborative learning with their peers when discussing learning artifacts on the mobile devices (Looi et al., 2014). Parents were also part of the picture, as some of the inquiry-based explorations involved students' dialoguing with their parents.

In the early stages of the project, this MP3 enactment had an internal focus, on changing pedagogical practices in the school via ICT. As evidence of 21CC goals was demonstrated, the project subsequently looked outward toward scaling the innovation in other schools. Five other schools from the same cluster joined the project and adopted the Mobilized 5E Science Curriculum (Toh et al., 2014). This was in line with the MP3 goals of enriching the learning environment by creating a more integrated curriculum and transforming it through a wave of innovative practices with a cluster of schools.

Lee and Hung (2016) pointed out that school leadership was very important in the launch and implementation of the pedagogical innovation. Their paper foregrounded the role of the school leader in providing (1) the socio-technological resources for the teachers to experiment in the classroom, (2) learning support and professional development that shifted the pedagogy, curriculum, and assessment, (3) a structure of teacher learning communities to sustain innovation efforts, and (4) feedback mechanisms and time for teachers to develop and refine the curriculum.

At the micro-level of the MP3 enactment, the school leader and teachers spurred and developed the seamless learning curriculum. However, macro and meso-exo forces were at play too (Toh et al., 2014). Macro forces referred mainly to the support from the cluster superintendent to identify and draw other schools who were willing to be part of this innovation. At the meso-exo level, platforms of dialogue were initiated between various schools' heads, Science and ICT heads, and allied educators. The schools had regular and frequent professional development sessions, and shared resources, such as lesson toolkits and standard operating procedures (Toh et al., 2014).

This case of MP3 enactment clearly highlights two key thrusts in Singapore’s 21st century education drive. The first is the tripartite relationship between research, practice, and policy. The seamless learning pedagogy innovation is a manifestation of the tight research, practice, and policy nexus in Singapore. The pedagogy advanced by NIE researchers was tightly aligned with the policy direction of MP3, and the practice in the school had close linkages with research and policy. In this way, the implementation of the Mobilized 5E Science Curriculum was co-constructed throughout. Second, this case also shows the involvement of multiple layers of stakeholders, in line with Singapore’s systemic ecological model of educational change. This enactment involved a host of stakeholders (akin to “It takes a village”), from the students, to teachers, school leaders, parents, ICT vendors, researchers, other schools, community partners, and cluster leaders. The implementation of this enactment of MP3 would not have been possible without these stakeholders of the various layers playing a supportive role. As Toh et al. (2014, p. 844) highlight, the “multi-tier interfacing of ecological constituents within the paradigm of centralized decentralization” tends to be overlooked. It is also a uniqueness of the Singapore system. While it may be a challenge to navigate the multiple layers, this case example demonstrates that the close linkages and partnerships between the different constituents (e.g., cluster superintendent and school, parents and school, school and ICT vendors, school and other schools) were important in establishing a successful policy enactment.

The next Masterplan for ICT in Education, the fourth, is underway. Launched in 2015, it builds on the transformative learning environments of MP3, and aims to enhance the quality of the learning environment and build “future-ready and responsible digital learners” (MOE, 2015c). MP4 hinges on two key enablers: empowering teachers to be designers of learning environments, and encouraging school leaders to be culture builders. This policy is very much an enhanced iteration of the previous masterplan and is tightly intertwined with Singapore’s overall focus on 21CC. It goes to imply that MP4 implementations will therefore be pivoted on enhancing 21CC development (“future-ready” competencies) among students. While actual implementation results are yet to be seen, it is within the scope to suggest that the socio-technological policy/practice link will be relatively aligned.

CONCLUDING REMARKS

At the height of the Asian financial crisis in 1997, then-Prime Minister Goh Chok Tong urged the Singaporean people to recognize that the world had changed dramatically since the government first established the basic architecture of the contemporary educational system in 1979. Therefore, he argued for the importance of both acknowledging the substantial accomplishments of the current system, and adjusting to the changed realities of a rapidly globalizing world. To ensure the relevance of schooling to the changing socioeconomic restructuring taking place in Singapore and globally, the Ministry of Education launched the Thinking Schools, Learning Nation initiative. This was an attempt to provide more pathways and opportunities that nurture creative talents, abilities, and lifelong learning. Since then, over the past two decades, the Singapore education system has evolved significantly.

One of the most visible shifts in the organization of schooling is the move away from a “one-size-fits-all” system to one of considerable diversity and flexibility. The underlying principle of the “multiple pathways” framework is to ensure that young people in Singapore have optimal opportunities to excel and succeed through diverse educational pathways that reflect different learning styles, interests, and life aspirations. To this end, the Ministry aimed to build interlinked “bridges and ladders” across multiple educational pathways such that success at one stage is connected to the next through the investment of effort. This approach is summarized in a 2007 ministerial speech:

[The Singapore education system] is one that opens up ladders all along the way, so that it is driven by each student's aspirations ... We must keep enough flexibility in the system, keep open the bridges and ladders and make sure there is always space for aspirations, so that every Singaporean feels encouraged to try hard and go further. Some will take a longer path to get to where they want, but they often end up stronger. (MOE, 2007)

Against this background, we have highlighted in this chapter a suite of distinct yet synergistic examples of 21CC-oriented policy enactments in practice. We classified these broadly into three categories: (a) structural shifts, (b) programmatic shifts, and (c) socio-technological infrastructural shifts. The highlighted examples include the (a) Integrated Programme, Specialised Independent Schools, and the Direct School Admission scheme (*structural shifts*); (b) the Programme of Active Learning, intensified emphasis on PE/Outdoor Education, Arts, and Music (PAM) education at the primary education level, and the Applied Learning Programme (ALP) and Learning for Life Programme (LLP) at the secondary education level (*programmatic shifts*); and (c) Masterplan 3 (MP3) and related schools- and classrooms-based enactments of technology-enhanced learning to foster collaboration and self-directed learning dispositions among students (*socio-technological infrastructural shifts*).

In conclusion, we underscore Singapore's unique ecological approach to education reform, which sees close collaborations and strong partnerships between policymakers, school practitioners, and very importantly, educational researchers. In Chapter 1, we posited this strong tripartite relationship as a key enabling mechanism that has buttressed Singapore's 21CC educational agenda and reform efforts over the past decades, and provided specific explications of how the policy formulation process and enactment process in Singapore take place alongside intensive and purposeful consultations and collaborations with practitioners and scholar-researchers alike. In this regard, we emphasize that all the examples of structural, programmatic, and socio-technological infrastructural policy-to-practice enactments provided in Chapter 2 are buttressed by corresponding applied research projects led by NIE researchers (in collaboration with policymaker colleagues and schools) that range from baseline/exploratory to intervention studies.

It is in this shared national commitment—by policymakers, practitioners, and scholar-researchers alike—to a cautious yet persistent transformation of the education system that makes the story of our nation-state's 21CC educational journey a compelling one. To revisit our earlier remark: we may yet beat the odds.

REFERENCES

- Acedo, C., & Hughes, C. (2014). Principles for learning and competences in the 21st-century curriculum. *Prospects*, 44(4), 503–525.
- Connelly, F. M. (2013). From images of controlled perfection to curricular plausibility: Singapore educational reform. In Z. Deng, S. Gopinathan, & C. K-E. Lee (Eds.), *Globalisation and the Singapore curriculum: From policy to classroom* (p. vii). Singapore: Springer Science+Business Media.
- Costes-Onishi, P. (2016). Generalists to specialists: Transformative evidences and impediments to student-centred practices of primary music and art teachers in Singapore. *International Journal of Education and the Arts*, 17(7). Retrieved from <http://www.ijea.org/v17n7>.
- Deng, Z., Gopinathan, S., & Lee, C. K-E (Eds.). (2013). *Globalisation and the Singapore curriculum: From policy to classroom*. Singapore: Springer Science+Business Media.
- Department of Statistics Singapore. (2015). *Singapore in Figures 2015*. Retrieved February 1, 2016, from http://www.singstat.gov.sg/docs/default-source/default-document-library/publications/publications_and_papers/reference/sif2015.pdf.
- Department of Statistics Singapore. (2016). *Latest Data*. Retrieved December 19, 2016, from <http://www.singstat.gov.sg/statistics/latest-data#16>.
- Durkheim, E. (2014). *The division of labor in society*. New York: Simon and Schuster.
- EU-Asia Higher Education Platform. (2011). Developing Asian education hubs. Retrieved February 1, 2016, from <http://www.eahep.org/asiahigher-education/asian-policy-drivers/127-developing-asian-education-hubs.html>.
- Goh, C. B., & Gopinathan, S. (2008). Education in Singapore: Development since 1965. In B. Fredriksen & J. P. Tan (Eds.), *An African Exploration of the East Asian Education* (pp. 80–108). Washington, DC: The World Bank.
- Gopinathan, S., & Hung, D. (2010). Research in the National Institute of Education since 1991. In A. Y. Chen & S. L. Koay (Eds.), *Transforming teaching, inspiring learning: 60 years of teacher education in Singapore 1950–2010*. Singapore: National Institute of Education.
- Gramsci, A. (1971). *Selections from the Prison Notebooks of Antonio Gramsci: Ed. and Transl. by Quintin Hoare and Geoffrey Nowell Smith*. G. New York: Nowell Smith & Q. Hoare (Eds.). International Publishers.
- Hargreaves, A., & Shirley, D. (2009). *The fourth way: The inspiring future for educational change*. Thousand Oaks, CA: Corwin.
- Kim, Y., & Cho, Y. H. (2014). The second leap toward “world class” education in Korea. *The Asia-Pacific Education Researcher*, 23(4), 783–794.
- Koay, S. L. (2010). Expansion and consolidation of postgraduate and research programmes. In A. Y. Chen & S. L. Koay (Eds.), *Transforming teaching, inspiring learning: 60 years of teacher education in Singapore 1950–2010*. Singapore: National Institute of Education.
- Koh, A. (2013). A vision of schooling for the twenty-first century: Thinking Schools and Learning Nation. In Z. Deng, S. Gopinathan, & C. K-E. Lee (Eds.), *Globalisation and the Singapore curriculum: From policy to classroom* (pp. 49–63). Singapore: Springer Science+Business Media.

- Lee, S. S., & Hung, D. (2016). A socio-cultural perspective to teacher adaptivity: The spreading of curricular innovations in Singapore schools. *Learning: Research and Practice*, 2(1), 1–21.
- Lee, S. S., Hung, D., & Teh, L. W. (2013). Moving Singapore from great to excellent: How educational research informs this shift. *KEDI Journal of Educational Policy*, 10(2), 267–291.
- Lee, S. S., & Low, E. L. (2013). Conceptualising teacher preparation for educational innovation: Singapore's approach. In S. K. Lee, W. O. Lee, & E. L. Low (Eds.), *Educational policy innovations: Levelling up and sustaining educational achievement* (pp. 49–70). Singapore: Springer Science+Business Media.
- Lee, W. O., & Manzon, M. (2014). The issue of equity and quality of education in Hong Kong. *The Asia-Pacific Education Researcher*, 23(4), 823–833.
- Looi, C.-K., Sun, D., Seow, P., & Chia, G. (2014). Enacting a technology-based science curriculum across a grade level: The journey of teachers' appropriation. *Computers and Education*, 71, 222–236.
- Low, E. L., Joseph, J., Atienza, J., Chng, S., Hui, C., & Lam, A. (2011). Paving the fourth way: The Singapore story. National Institute of Education (NIE) Roundtable Report. Retrieved March 14, 2016, from <http://www.nie.edu.sg/docs/default-source/nie-research/paving-the-fourth-way-pdf.pdf?sfvrsn=2>.
- Ministry of Education. (1997a). Speech by BG Lee Hsien Loong, Deputy Prime Minister at the launch of National Education on Saturday 17 May 1997 at TCS TV Theatre at 9.30 am. Retrieved from <https://www.moe.gov.sg/media/speeches/1997/170597.htm>.
- Ministry of Education. (1997b). Speech by Prime Minister Goh Chok Tong at the opening of the 7th International Conference on Thinking on Monday, 2 June 1997, at 9.00 am at the Suntec City Convention Centre Ballroom. Retrieved from <https://www.moe.gov.sg/media/speeches/1997/020697.htm>.
- Ministry of Education. (1997c). Speech by RAdm Teo Chee Hean, Minister for Education and 2nd Minister for Defence at the launch of the Masterplan for IT in education on Monday 28 April 97 at Suntec City at 10 am. Retrieved from <https://www.moe.gov.sg/media/speeches/1997/280497.htm>.
- Ministry of Education. (1999). Ministerial Statement by Minister for Education RAdm Teo Chee Hean at the Committee of Supply Debate, FY1999 in Parliament on 17 Mar 99. Retrieved from <https://www.moe.gov.sg/media/speeches/1999/sp170399.htm>.
- Ministry of Education. (2002). Government accepts recommendations for a broader and more flexible curriculum and a more diverse JC/Upper Secondary education landscape. Retrieved from <https://www.moe.gov.sg/media/press/2002/pr15102002.htm>.
- Ministry of Education. (2005). Greater support for teachers and school leaders. Retrieved from <https://www.moe.gov.sg/media/press/2005/pr20050922b.htm>.
- Ministry of Education. (2007). Having every child succeed. Speech by Mr. Tharman Shanmugaratnam, Minister for Education, at the MOE work plan seminar 2007. Retrieved from <https://www.moe.gov.sg/media/speeches/2007/sp20071002-short.htm>.
- Ministry of Education. (2008). Learning, creating, communicating: A curriculum review. Retrieved from <https://www.moe.gov.sg/media/speeches/1998/CurryRevueReport.htm>.

- Ministry of Education. (2009a). Desired outcomes of education. Retrieved from <https://www.moe.gov.sg/education/education-system/desired-outcomes-of-education>.
- Ministry of Education. (2009b). Preparing our students for the future. Retrieved from <https://www.moe.gov.sg/media/press/files/2009/01/peri-slides.pdf>.
- Ministry of Education. (2011). Opening address by Mr. Heng Swee Keat, Minister for Education, at the Ministry of Education (MOE) Work Plan Seminar, on Thursday, 22 September 2011 at 10.00 am at Ngee Ann Polytechnic Convention Centre. Retrieved from <http://www.moe.gov.sg/media/speeches/2011/09/22/work-planseminar-2011.php>.
- Ministry of Education. (2012). The teacher growth model. Retrieved from <https://www.moe.gov.sg/media/press/files/2012/05/fact-sheet-teacher-growth-model.pdf>.
- Ministry of Education. (2013). Student-centric, values-driven education: A broad and deep foundation for a lifelong journey. Keynote address by Mr. Heng Swee Keat, Minister for Education, at the Ministry of Education Work Plan Seminar 2013. Retrieved from <https://www.moe.gov.sg/news/speeches/keynote-address-by-mr-heng-swee-keat--minister-for-education--at-the-ministry-of-education-work-plan-seminar-2013--on-wednesday--25-september-2013-at-915am-at-ngee-ann-polytechnic-convention-centre>.
- Ministry of Education. (2015a). Masterplan 2. Retrieved from <http://ictconnection.moe.edu.sg/masterplan-4/our-ict-journey/masterplan-2>.
- Ministry of Education. (2015b). Masterplan 3. Retrieved from <http://ictconnection.moe.edu.sg/cos/o.x?c=/ictconnection/pagetree&func=view&rid=665>.
- Ministry of Education. (2015c). Masterplan 4. Retrieved from <http://ictconnection.moe.edu.sg/masterplan-4>.
- Ministry of Education. (2016a). 21st century competencies. Retrieved from <https://www.moe.gov.sg/education/education-system/21st-century-competencies>.
- Ministry of Education. (2016b). DSA-Secondary overview. Retrieved from <https://www.moe.gov.sg/admissions/direct-admissions/dsa-sec/overview>.
- Ministry of Education. (2016c). Integrated Programmes (IP). Retrieved from <https://www.moe.gov.sg/education/secondary/other/integrated-programme>.
- Ministry of Education. (2016d). Readyng our people for the future. MOE FY 2016 Committee of Supply Debate—Speech by Acting Minister for Education (Schools) Ng Chee Meng. Retrieved from <https://www.moe.gov.sg/news/speeches/moe-fy-2016-committee-of-supply-debate---speech-by-acting-minister-for-education-schools-ng-chee-meng>.
- Ministry of Education. (n.d.). Student-centric and values-driven. Retrieved from <https://www.moe.gov.sg/docs/default-source/document/education/files/student-centric-values-driven-flyer.pdf>.
- National Institute of Education Singapore. (n.d.). A teacher education model for the 21st century. Retrieved from https://www.nie.edu.sg/docs/default-source/te21_docs/te21-online-version---updated.pdf?sfvrsn=2.
- Ng, P. T. (2013). An examination of school accountability from the perspective of Singapore school leaders. *Educational Research for Policy and Practice*, 12(2), 1–11.

- Office of Education Research (OER), National Institute of Education. (2016). *About our research*. Retrieved February 1, 2016, from <http://www.nie.edu.sg/research/research-offices/office-of-education-research>.
- Poon, C.L. (2011). Translation of research into policy and practice. In E.L. Low (Ed.). CJ Koh Professorial Lecture Series No. 1. Paving the Fourth Way: The Singapore Story (pp.18-20). National Institute of Education. Available at: https://repository.nie.edu.sg/bitstream/10497/4628/1/CJKoh_Series_No1_Fourth_Way.pdf
- Poon, C. L. (2012). Fourth way in action: Translation of research into policy and practice. *Educational Research for Policy and Practice*, 11(1), 19–25.
- Poon, C. L., Lam, K. W. L., Chan, M., Chng, M., Kwek, D., Tan, S. (in press). Preparing students for the 21st century: A snapshot of Singapore's approach. In S. Choo, R. Vinz, D. Sawch, & A. Villanueva (Eds.), *Educating for 21st century global capacities: International perspectives and practices*. Singapore: Springer Science+Business Media.
- Quacquarelli Symonds Limited. (2015). *University rankings*. Retrieved March 18, 2016, from <http://www.topuniversities.com/qs-world-university-rankings>.
- Tan, J. (2013). Aims of schooling for the twenty-first century: The desired outcomes of education. In Z. Deng, S. Gopinathan, & C. K-E. Lee (Eds.), *Globalisation and the Singapore curriculum: From policy to classroom* (pp. 15–47). Singapore: Springer Science+Business Media.
- Tan, J., & Gopinathan, S. (2000). Education reform in Singapore: Towards greater creativity and innovation. *NIRA Review*, 7, 5–10.
- Tan, Y. K., Chow, H. K., & Goh, C. (2008). *Examinations in Singapore: Change and continuity (1891–2007)*. Singapore: World Scientific.
- Teo, J. E., Deng, Z., Lee, C. K-E., & Lim-Ratnam, C. (2013). Teach less, learn more: Lost in translation. In Z. Deng, S. Gopinathan, & C. K-E. Lee (Eds.), *Globalisation and the Singapore curriculum: From policy to classroom* (pp. 99–117). Singapore: Springer Science+Business Media.
- Toh, Y., Hung, D., Chua, P., He, S., & Jamaludin, A. (in press). Pedagogical reforms within a centralized-decentralized system: A Singapore's perspective to diffuse 21st century learning innovations. *International Journal of Educational Management*.
- Toh, Y., Jamaludin, A., He, S., Chua, P., & Hung, D. (2015). Leveraging autonomous pedagogical space for technology-transformed learning: A Singapore's perspective to sustaining educational reform with, across and beyond schools. *International Journal of Mobile Learning and Organisation*, 9(4), 334–353.
- Toh, Y., Jamaludin, A., Hung, W. L. D., & Chua, P. M. H. (2014). Ecological leadership: Going beyond system leadership for diffusing school-based innovations in the crucible of change for 21st century learning. *The Asia-Pacific Education Researcher*, 23(4), 835–850.
- Tsoukalas, I. (2007). Exploring the microfoundations of group consciousness. *Culture and Psychology*, 13(1), 39–81.
- Yale Center for Environmental Law & Policy (2014). *Environmental Performance Index: Full report and analysis*. Yale University, Center for International Earth Science Information Network, Columbia University. In collaboration with World Economic Forum, Geneva, Switzerland.