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Future-ready Learners: Learning, Lifework, Living, and Habits of Practices

David Ng, Wong Choun Pei
With the assistance of Sean Liu

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Future-ready Learners: Learning, Lifework, Living, and Habits of Practices

David Ng, Wong Choun Pei, Sean Liu

Introduction

This year, Singapore commemorates the 200th anniversary of its founding by Sir Stamford Raffles in 1819. As we celebrate Singapore's success, we reflect upon the challenges facing us to chart a better path forward for our people.

Fundamental shifts posing challenges to Singapore are occurring at the global, regional and national levels. For example, rapid technological advancements globally have led to the emergence of Industry 4.0, or the fourth industrial revolution (Schwab, 2016). Today, billions of people are connected via computers and mobile devices, giving rise to unprecedented information access. New technologies come to the fore, such as quantum computing, blockchain, artificial intelligence (AI), robotics, Internet of Things (IoT), 3D printing and driverless vehicles. New technologies give rise to even newer technologies, causing the industrial revolution to evolve at an exponential pace. The changes are profound and revolutionary in terms of speed, magnitude and scope; and present fundamental shifts in the way we live, work and play. On the economic front, new technologies interact with traditional businesses as competing substitutes or complementary enablers. Also, new technologies are reshaping business models—increasingly, businesses compete "not on physical assets but on intangible assets such as intellectual property, data and user networks" (Heng, 2018). Increasingly, job security depends on whether we are able to keep learning new technological skills and adapt to the changing workforce.

Not only does Singapore have to compete with the world's economic superpowers, it also faces competition regionally as an investment hub, with scores of new investments pouring into elsewhere in Southeast Asia (The Straits Times, 2018). To remain competitive, Singapore must shift from being a value-adding economy to a value-creating one (Tay, 2015). Mr Heng Swee Keat, Singapore's Minister for Finance said in 2015 (U.-W. Lee, 2015)

> "If we are simply producing what the rest of the world is producing, we won't be able to command a premium or sustain our competitive edge… we have to produce what the rest of the world is not producing, or at least, not much of. To do so, we have to build deep capabilities and linkages, in our industries and in our economy, to create new products and deliver better solutions, in cost-effective, innovative ways."

This contrasts with a value-adding economy, which add improvements to existing services, products and ideas (Tay, 2015). Mdm Chua Sock Koong, Group CEO of Singtel, provides another insightful perspective of a value-creating economy (Hardasmalani, 2016)

> "A value-creating economy is one that is innovation-led – it's about creating original ideas and intellectual property that can be exported globally. Value creation is more than just providing incremental value and riding the coat-tails of those who've come before. It's about creating new economic drivers – new solutions, new technologies, new capabilities, new businesses."

Therefore, Singapore must find ways to create economic value via building new capabilities and solutions to stay ahead of the competition,

Another shift which poses challenges to Singapore is its ageing population. This demographic change will lead to a shrink in the growth of the local workforce and a resulting tightening of the labour market. Economic growth will slow, "unless we remain dynamic in our outlook, are increasingly productive in the way we work, and supplement our workforce with a calibrated inflow of workers from abroad" (Heng, 2018). In addition to its impact on the workforce and economy, an

ageing population places strain on the social fabric of Singapore, together with other forces as mentioned next.

With religious extremism and terrorism on the rise globally, Singapore faces the challenge of maintaining peace and harmony in its religiously diverse society. As Emeritus Senior Minister Mr Goh Chok Tong said in March 2019, “Generations of Singaporeans and Singaporean governments have worked hard to make religious diversity our strength, not our weakness. And future generations must continue to do so” (L. Y. Lee, 2019). Maintaining social cohesion is a challenge for Singapore, with some groups trying to impose their religious beliefs on others. Also, hate crimes and terrorist acts can turn communities against one another. Therefore, Singapore must take active measures to guard against these dangers.

Another strain to the social fabric is the influx of foreigners into Singapore. Xenophobia and a concern among locals that foreigners are competing with them for jobs and placing strain on housing and transport are challenges that Singapore must grapple with (Angela Teng, 2018). How Singapore can accept more foreigners to make up for the shrinking growth of the local workforce and the societal friction that inevitably comes along with it are questions that Singapore must address.

Singapore also faces challenges on the environmental front. Like other cities, Singapore needs to balance its need for resources for its population with urbanisation’s impact on the environment (Ernstson et al., 2010; Wigginton, Fahrenkamp-Uppenbrink, Wible, & Malakoff, 2016). Largely because of its small size and dense population, Singapore ranks 26th out of 142 countries in terms of its carbon emissions per capita—this makes the carbon emission of each person in Singapore greater than that of each person in larger countries like Britain, Switzerland or France (A. Tan, 2018a). Singapore has to find ways to engage individuals and companies to reduce their carbon footprint.

In terms of environmental resources, water has always been a pressing concern for Singapore. According to PUB, Singapore’s national water agency, water demand in Singapore is currently 430 million gallons a day. The demand is projected to almost double by 2060

(PUB, 2018c). Singapore is currently not self-sufficient in water as it obtains 250 million gallons a day from Johor, Malaysia. The water issue with Malaysia has been a source of political conflict between the two countries over the years. Therefore, Singapore *must* develop capabilities for greater self-sufficiency in water via investing in leading edge water technologies.

All these challenges have fundamental implications for education in Singapore. The framework will be guided by the following questions:

- What are the current and future trajectories of Singapore's society, environment, and economy?
- How should Singapore respond to these current and future challenges?
- What kind of sustainable environment, society, economy do Singaporeans want for the future?
- How do we define future-ready learners?
- How can learners shape that sustainable future together?

All these challenges have fundamental implications on the readiness of our education system in enabling our learners to actively co-create the future of our environment, society, and the economy together with the government. How do we develop "future-ready" learners who will co-create living, lifework, and learning in Singapore? We proposed to substitute the concept of students with learners. The concept of students is tied to a fixed period of study. But the concept of learners suggests lifelong learning. Humans (Singaporeans) will continue to learn, unlearn, and relearn throughout their entire life.

There is a need to re-examine learning outcomes beyond assessment and standards as new realities emerge in Singapore's changing landscapes. Assumptions of our practices, especially those that involve teaching and learning must also evolve in tandem with new knowledge and new challenges. (Practices include leadership and management practices, teaching and learning practices, communication practices and more). These practices are based on assumptions, beliefs and theories; and these assumptions *must not* and *cannot* remain unchallenged paradigms when we discuss developing future-ready

students in Singapore's context. As Puncreobutr (2016) put it, "Education 4.0" has to cater to the needs of the society in an innovation era, and learning management must respond to societal and economic environments to address the human capital need.

We will re-examine the purposes of education, current and future learning, lifework, and living outcomes as analyzed from the contexts of Singapore in the next sections.

Redefining Educational Success (World-class Education and Learner Outcomes)

In this framework we define successful education as:

"A successful education system is able to develop future-ready individuals who will continue to learn beyond graduation, take on future lifework, and thrive in a changing society and environment."

This multi-dimensional framework re-defines educational success (world-class education). Being future-ready implies that learning outcomes must be dynamic and aligned to new realities that emerge over time. The framework consists of the following dimensions that provide an integrated approach to define educational success and future-ready learner outcomes:

- Dimension 1: Purposes of schooling (Development for life-long learning, lifework, and living)
- Dimension 2: Time (Past, present, and future)
- Dimension 3: Contexts (Economic, Social, Environmental – technology is integral in all the three primary contexts).
- Dimension 4: Practices (Teaching and learning practices, community practices, school leadership and management practices, inquiry practices)

Purposes of education: Dimension 1

As schools strive to be relevant and globally connected, school reform takes on both local and international contexts. International contexts have become widely associated with comparative results from

international tests, such as the Trends in International Mathematics and Science Study (TIMSS) and the Programme for International Student Assessment (PISA), which purport to measure certain aspects of educational quality. Countries have assumed that attaining high scores in these tests would be a strong indicator of having a world-class education system. However, education is more than just standardised testing. Thus, education success must be measured beyond these typical achievement standards. The three purposes (and outcomes) of education are in Dimension 1 (Figure 1): developing learning (knowledge); developing lifework (vocation); and developing living (citizenry, values, and sustainability) that enable individuals to live peacefully and collegially with one another in society. Successful schools must fulfil all these three purposes (D. F. S. Ng, 2019). These three purposes are intricately linked to the dimensions of Time, Contexts, and Practices. We will define the three purposes in detail in the latter sections.

The time continuum and being future-ready: Dimension 2

In discussing effective schools and educational success, we need to bring in another dimension to the purposes of education – Time. Figure 1 shows how the dimension of time fits into a more comprehensive framework for successful education. Time provides perspective and focus to the purposes of education. The perspective of time is like the physics concept of vector. Vector has direction and magnitude. Direction in the time continuum consists of the past, present and future (D. F. S. Ng, 2019). Learning, therefore, will involve studying the past (our history), meeting present standards of knowledge, and being prepared for the future. Magnitude is the extent or 'quantity' of school activities as per point of vector (past, present, and future) in the time continuum. What extent (magnitude) of our learning and school activities do we set aside for learning the past, the present, and the future? Magnitude, therefore, will give us an indication of what schools value. Generally, we tend to focus on the present perspective of time and have a larger magnitude (extent of activities) with measures that will bring immediate value to our education system. Example, high performance in assessment brings immediate high value in the form of recognition for the individual, school, system, and country. So, we have a greater magnitude of activities related to assessment. But we need to be keenly aware of the future

perspective of time. The future perspective is no less important or valued. Future value is about the future readiness of our graduates to meet evolving and changing future landscapes.

When we compare the amount of time students spent in the school system with the amount of time in future work, clearly working years are about three times more than schooling years. Example, students finish post-secondary education at the median age of 23 but work until at least a median age of 65. This future perspective in the Time dimension is as important or valued as a learning outcome when compared to the past, and the present outcomes of learning.

In this framework, we provide a definition of world-class education and "future-ready"—*An education system can only be successful if it is able to develop future-ready individuals who will continue to learn beyond graduation, take on future lifework, and thrive in a changing society and environment.* These are not just statements. Being future-ready implies that learning outcomes must be dynamic and aligned to new realities that emerge over time. The future is about new realities that are context-situated and context-dependent. Singapore and global contexts provide the foundation to define details of future readiness.

Context (frames): Dimension 3

Context provides the frame upon which we can have specifics/details to describe Purpose (Dimension 1) and Time (Dimension 2). In this framework, we have selected Economic, Social, and Environmental as the primary contexts to describe the purposes in Dimension 1 and 2. Technological aspects are interwoven into all the three primary contexts. For example, the economic context will require technological adoption, digitalisation among others. The economic context looks at two aspects of lifework:

- The nature of jobs that contribute to the economy and the GDP of a country and,
- The employment of manpower across sectors.

There are typically three sectors of jobs: Manufacturing/Industrial; Services; and Agriculture. The nature of services in the knowledge

economy is characterised by higher skilled and higher value-added knowledge. Unlike manufacturing which produces physical goods, services produce “intangible” goods. These intangible goods include know-how in governance, health, education, communication, information, and businesses. Producing services tends to require relatively less natural capital and more human capital than producing agricultural or industrial goods. With the declining natural resources, the world will have to look to developing future human capital. The context of Singapore’s economy will provide detail on what preparation for lifework looks like. This framework will draw from the future trajectories of the economy in Singapore and identify future-ready competencies and habits of practices that will prepare students for the future. Detailed analysis of these primary contexts will be discussed in later sections.

Practices: Dimension 4

The Practices dimension is multi-dimensional. Practices include leadership and management practices, teaching and learning practices, community practices, inquiry and research practices and more. Practices are based on sets of assumptions, beliefs, and theories. Practices cannot remain unchallenged paradigms. What is important in school improvement is that our practices must evolve and be relevant to match the evolving realities of purposes, time and context.

Inquiry methods of teaching and learning must provide us relevant answers to our quest for learning, knowledge and development. One example is the current dominant inquiry method in teaching and learning that is based on a set of behavioural objectives in learning. Behavioural objectives or specific instructional objectives are usually narrow, clearly defined and limited to planned learning. If we only require our students to learn from what we know and have also been defined by the texts, then there will be less opportunities to learn new knowledge or create new knowledge. We will continue to have instructional objectives, but we also need alternative inquiry methods and practices of learning. For researchers, our interests in scholastic pursuit of knowledge in the field must expand beyond our paradigm of research methods and adopt alternative methodologies that can answer our research questions that can contribute to theory formation, knowledge building and translation to practice.

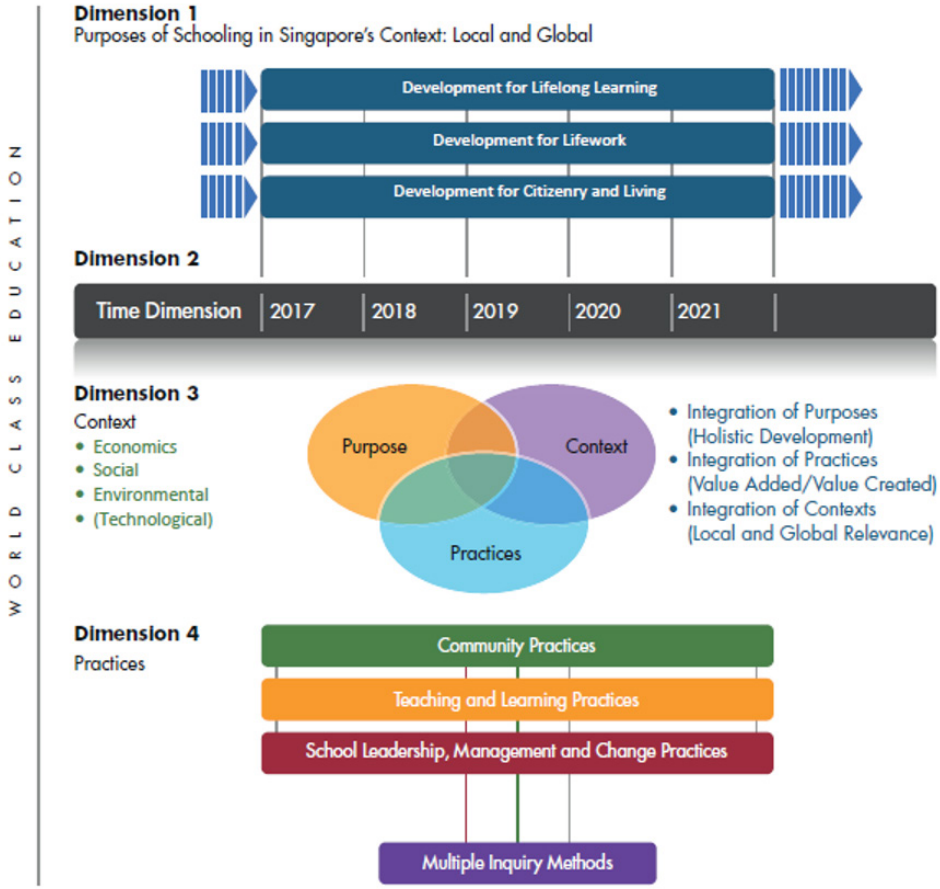

Figure 1. *Multi-dimension framework for educational success (D. F. S. Ng, 2019).*

Given the foregoing discussion, successful schools must fulfil all three purposes of education and be keenly aware of developing future-ready individuals. In Dimension 1 (purposes) we provided an example of benchmarks for educational success in standardized tests and exams. Singapore students consistently achieve top spots in TIMSS and PISA (Davie, 2016; Amelia Teng, 2016), bringing immediate recognition to its education system. These benchmarks are an indication of learning

outcome of our students, but they only partially fulfil the three purposes. There is a need to define learning/knowledge outcomes beyond standardised tests. Learning outcomes must also be defined for the other purposes of education.

As we shall see in the following sections, there are new concepts of learning and many future challenges for Singapore in the economic, social and environmental contexts that will shape the future learning outcomes of our students. The next sections will expand and define the three future-ready purposes—learning (knowledge), lifework (vocation), and living (citizenry/social). The details and definitions are analyzed from global, and national contexts. Specifically, Dimension 2 (Time) and Dimension 3 (Contexts) provide the basis of how we analyze and define the purposes.

Future-Ready for Learning

How do future-ready Singaporeans co-create learning opportunities and actively participate in sustainable life-long learning?

The "Learning Nation" component within the *Thinking School Learning Nation* initiative encourages the nurturing and sustaining of a culture in schools that promotes critical thinking, creativity, innovation, life-long learning and embracing change in the 21st century. The recent Committee on the Future Economy report (CFE, 2017) reiterates the government's hopes of developing a nation of life-long learners, who embrace learning as part of life. This is essential to help the workforce cope with technological shifts and the impact it has on how jobs are performed. A workforce that is ready to learn allows it to be adaptive and nimble when there are new job demands or a change in industry is needed. Staying relevant through continuous learning is not only for workers in the corporate world; its importance is amplified in schools—leaders need to ensure that teachers stay abreast of educational trends, practices and pedagogies to effect student learning. As Zepeda (2013) aptly puts it, "schools that succeed are schools in which every participant is a learner" (p.xxi). Synthesis from recent literature on learning highlight the imperative that future-ready learners must embrace and practice the following concepts of learning: life-long learning, life-wide learning and life-deep learning.

Life-long learning

A 21st century school in an advanced economy requires a vision that reflects its goals which include preparing students for the future of work and transferable skills and attributes which will build the foundation in becoming a life-long learner (Day et al., 2009; Häkkinen et al., 2017). At the 2015 Singapore Forum, then Deputy Prime Minister, Mr Tharman reiterated the importance of education to ensure a sustainable broad-based economic growth. He shared that the education system must be made less academically focused and be more conducive to life-long learning of skills. In addition, he proposes a system of life-long learning that is integrated with the real world and technological developments (Chan, 2015).

SkillsFuture was introduced in 2015 and implemented in 2016. It is Singapore's solution to life-long learning. The massive, holistic and integrated SkillsFuture programme involves the collaboration among multiple partners including government agencies, trade associations, unions, companies, training organisations and the workforce. While SkillsFuture targets to develop the necessary human capital to meet economic growth objectives, it is at the same time a tool to ensure equitable provision of educational opportunities for working adults and foster life-long learning. SkillsFuture, therefore, as a policy, works as a means of fostering economic growth through social stability (SkillsFuture Singapore Agency, 2017). Through SkillsFuture, the life-long learning approach aims to be inclusive throughout a citizen's entire work life and beyond. It is managed by a newly-created statutory board, SkillsFuture Singapore (SSG), parked under the Ministry of Education. This places SkillsFuture within the area of higher education policy (Woo, 2018). With the goal for employability, SkillsFuture is Singapore's response to the need for major transformation in the education system. Life-long learning is no longer a choice but necessity.

In order to get a different perspective of life-long learning, Figure 2 illustrates the time spent in formal school settings (life-long learning) and in informal learning environments. Stevens, Bransford, and Stevens (2005) asserted that even during the compulsory schooling period, children only spend some 18.5% of their time in formal learning situations. Indeed, learning continues throughout the lifespan of an individual—but if life-long learning only involves attending courses,

workshops, and learning in a formal setting, the total percentage is small. In contrast, the "blue space" where informal learning takes place and cuts across multiple contexts in a person's life—in school, at work or even at home, dwarfs that of formal learning. That blue space is called life-wide learning. The next section will highlight the effects of this informal learning environment. It is important for school leaders to recognise the importance of life-wide learning and to encourage it by providing students with opportunities to experience multiple situations and contexts.

Life-wide learning

Schools were once a main source of knowledge that was considered important. They are not today. In fact, any knowledge imparted on courses at all levels almost inevitably lags behind what can be found through electronic media and other resources (Hall, 2009). Informal learning which is depicted by the 'blue space' in Figure 2 takes place inside and outside of school where students are exposed to a whole range of what the writers (Banks et al., 2007; T.-S. Koh & Hung, 2018; Stevens et al., 2005) call life-wide and life-deep learning. Life-wide learning can include school activities such as playing with friends,

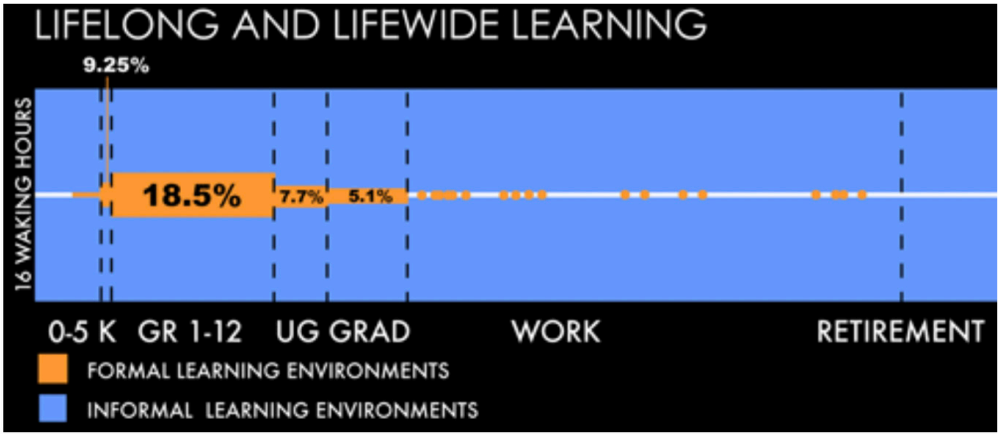

Figure 2. *Estimated time spent in school and informal learning environment. (Source: Stevens et al. (2005), as cited in Bell, Lewenstein, Shouse, and Feder (2009) p. 29).*

learning at home from family members, being placed in a buddy role for younger students, or other kinds of informal arrangements that allow for expertise development while simultaneously supporting aspects of identity development such as a sense of belonging in a community, feelings of competence, and interest development. The breadth and qualities of these activities are significant developmentally as they are the roles and relationships that emerge across contexts. Students routinely accessed a greater number of resources both in and out of school. Life-wide learning involves learning from physical and virtual experiences, encounters, associations and opportunities in the wider community locally and internationally.

Life-wide learning happens incidentally and not dictated by instructional objectives. At the same time, when students gain exposure from diverse experiences, the meaning-making process can be transformative for them as they reflect on their beliefs, shape their worldview and negotiate their identity (Jackson, 2012; Liang, Caton, & Hill, 2015) Other examples where life-wide learning can take place are: mentoring, caring for others, pursuit of learning that is not directly related to study area, travel, volunteering and social enterprise, start-ups, participating in virtual worlds, creative enterprise (e.g., putting on plays, playing in a band, making short movies).

Students must embrace learning that is life-long and life-wide. In fact, life-wide learning among students is occurring in semiotic domains that leverage on interactive, web-compatible, digital technologies such as smart phones, tablets and smart devices. One implication of the prevalent and pervasive learning opportunities available for students is that formal schooling (life-long learning) will need to change radically to be effective for many students today. Future generations of learners will increasingly use newer technologies as life-style experiences and continue to embrace such learning opportunities. Teachers need to also embrace their own life-wide learning opportunities that involve the use of technology to close the divide between teachers and students in the digital era. Schools need to help students make sense of this kind of learning which will be different not only for communities but also for individuals.

Life-deep learning

There are two facets of life-deep learning—deep mastery of knowledge and values formation. Deep mastery of knowledge is fundamental for invention and innovation. This involves a mastery of deep disciplinary and conceptual understanding, adaptive expertise and efficiency (T.-S. Koh & Hung, 2018). An example where deep mastery is essential is the planned development of the new Science Centre and surrounding residential enclave at Jurong Lake Gardens, slated to be ready around 2025. A proposal has been made to realign the stretch of the Ayer Rajah Expressway from Yuan Ching Road to Jurong Town Hall Road in order to free up land south of Jurong Lake for residential development, and to integrate the Pandan Reservoir area with the district to form a larger and more cohesive development area. This endeavour clearly needs deep mastery of engineering, design, planning, environmental management among others. Mastery of multiple disciplines and adaptive expertise will be needed in order to make this happen.

Life-deep learning involves facilitating students' adoption of mastery goals in their learning (Midgley, 2002). If teachers want their students to focus on mastery of content and tasks, they must allow students to work on tasks repeatedly, even if they were to fail many times, until they achieve mastery. If mastery is about solving a particular problem in science, such as forming hypotheses, collecting relevant data, analysing those data, and drawing reasonable and verifiable conclusions, then students must be given opportunities to practice those skills and receive formative feedback from the teacher on their performance as a part of their instructional experience. These are essential steps on the pathway to mastery.

Values formation in life-deep learning embraces religious, moral, ethical, and social values (Knafo & Schwartz, 2004; Loewenstein, Price, & Volpp, 2016). These values guide what people believe, how they act, and how they judge others and themselves. An important process in life-deep learning is scaffolding of challenges and change that students go through. Scaffolding can be in the form of support from families, the communities that surround them, and schools. This support structure is also critical to deal with the fear of failure. Fear of failure has been

strongly associated with avoidance (Elliot, & Thrash, 2004). In general, values formation in life-deep learning most often happen when students encounter critical incidents (Griffin, 2003). It is useful to identify the criteria to decide if the challenges and encounters are critical incidents that provide a rich stimulus to explore ethical, moral and social values. Typically, critical incidents include experiences of:

- conflict that troubles the emotion
- dilemma of choice
- become a stimulus for reflection

Students are also constantly exposed to global and local cultural forces in their lives. These forces are also powerful medium of influence and play a fundamental role in determining how students learn and assimilate values (Arnett, 2002; Marsh, 1986). An example is consumerism as a way of life through marketing, media, and entertainment influence. Whether a young person is living in Hollywood Hills or in rural Thailand, the global consumer culture reaches the young person. The dilemma encountered could lean towards embracing that culture in order to feel a sense of belonging or non-consumption of consumerism which is perceived as continuing in the cycle of poverty and withdrawal. This is an example where life-deep learning occurs—whether guided or not guided, scaffolded or left to the individual's own learning. Students' learning of values are very much experienced through global influence. What educators must concern themselves with is whether the dominant values to which young people ultimately acquired are the very values that promote family togetherness, national harmony and unity.

In some publications in the literature, values formation is conceptualised as "life-wise" learning. (T.-S. Koh & Hung, 2018; Kwek, Hung, Koh, & Tan, 2017) Life-wise learning includes the preparation of learners for values, morals and character; as well as the cultivation of practical wisdom and historical empathy. Details are provided in the cited literature.

Future-Ready for Lifework

How do future-ready Singaporeans shape the future of work and co-create future lifework?

As noted in the Introduction section, Singapore faces many challenges in the economic, social and environmental aspects. From 2010, global growth has been subdued and is expected to be lower than in the previous decade (CFE, 2017). Global value chains are also shifting where countries in the region (Asean) are moving up the value chain in their manufacturing and services. Moving up the value chain means that innovation and change are driving new products and services. These products and services that are currently regarded as among the most innovative and experimental ultimately end up as commodities that can be produced anywhere and by many producers. Developed economies like Singapore can grow by inventing new technology, new innovating products and services and creating new values in products and services. In addition, the confluence of rapid technology advancements with the economic, social and environmental changes bring about unprecedented challenges (as well as opportunities) for Singapore. The following sections will examine Singapore's contexts in these aspects in greater detail.

Economic context

> "We will partner businesses and workers to transform our economy. We welcome the best MNCs and SMEs from around the world, and help our start-ups and SMEs to grow, scale, and internationalise. We will help our workers deepen their capabilities and seek new opportunities. To catch the wave of the Fourth Industrial Revolution, we are positioning Singapore as a Global-Asia node of technology, innovation and enterprise."
>
> (Heng, 2019)

Current economic status

Singapore achieved a real GDP growth of 3.2% in 2018 (Department of Statistics Singapore, 2019a), amid global uncertainties such as Brexit and trade tensions between US and China. For 2019, Singapore's

GDP growth forecast is 1.5 to 3.5% (Ministry of Trade and Industry, 2019b). Figure 3 shows the breakdown of the contributions of the various industries to Singapore's nominal GDP in 2018. As can be seen from the figure, the services producing industries make up the greater portion of the nominal GDP at 70.4%, while the goods producing industries make up 26.1%. For the services producing industries, the top three contributors are wholesale & retail trade (18.0%), business services (14.9%) and finance & insurance (12.9%). For the goods producing industries, manufacturing is the major contributor (21.4%), followed by construction (3.5%) and utilities (1.2%). The largest single

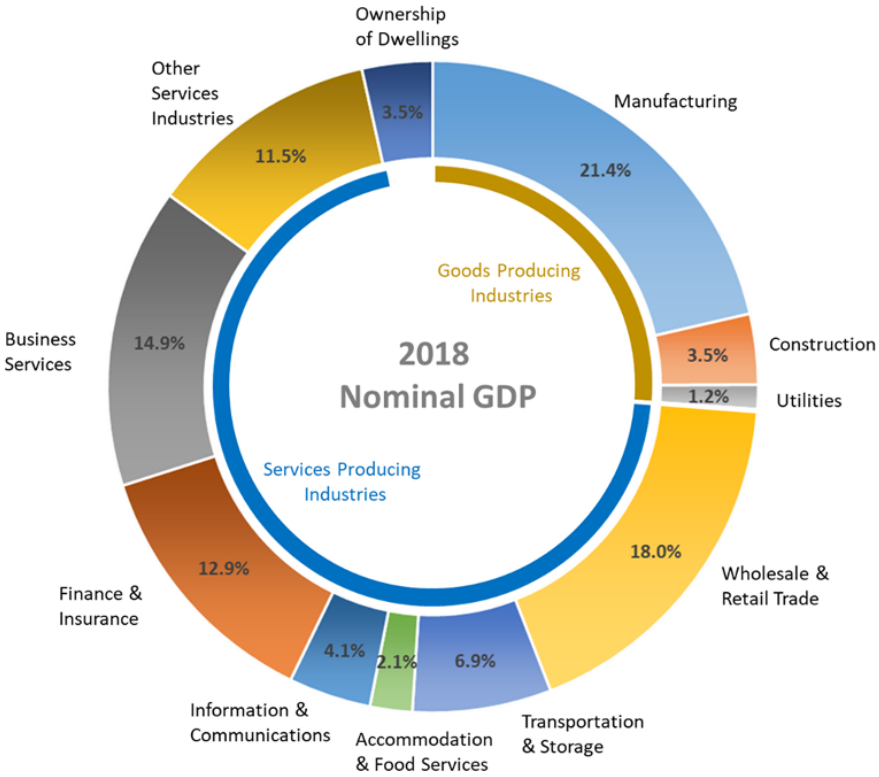

Figure 3. *Contributions of different industries to Singapore's nominal GDP in 2018. (Figure charted with data from Department of Statistics Singapore (2019b).*

industry is manufacturing, which consists of these clusters: electronics, chemicals, biomedical manufacturing, precision engineering, transport engineering and general manufacturing (Ministry of Trade and Industry, 2019a). Together, all the industries have their roles to play in contributing to the GDP of Singapore.

Trajectory of the future economy

Shift in focus of the economy (1990s, 2000s, 2010s to present)

Over the years, Singapore has shifted the focus of its economy. The following table summarises this shift from the 1990s onwards. Increasingly, there is an emphasis on innovation, value creation, and technology adoption and digitalisation.

Committee of the Future Economy (CFE)

Moving forward, Singapore has to remain competitive by maximising value creation to sustain economic growth for the nation and create quality jobs for the people. To achieve this, the Singapore government set up the Committee on the Future Economy (CFE) in January 2016 to review Singapore's economic strategies for the next decade. The CFE identified seven key strategies for developing Singapore's economy. The following briefly summarises each of these strategies (CFE, 2017):

1. Deepen and diversify Singapore's international connections: Singapore needs to continue with trade and investment cooperation with global partners, set up a global alliance for innovation, and enable its people to deepen their knowledge of Singapore's markets.

2. Acquire and utilise deep skills: Singapore needs its people to develop deep skills to stay relevant and create value in the economy.

3. Strengthen enterprise capabilities to innovate and scale up: Singapore's innovation ecosystem has to be strengthened via commercialising intellectual property and research findings. The government will assist enterprises to scale up and encourage partnerships between enterprises. Private sector financing will be encouraged.

4. Build strong digital capabilities: The government will promote the adoption of digital technologies across all sectors of the economy.

5. Develop a vibrant and connected city of opportunity: Singapore's status as a global air and maritime hub will be strengthened. Land use will be optimised. The government will develop precincts that foster economic and lifestyle activities. The government will partner with the private sector to develop exportable capabilities such as water technologies.

6. Develop and implement Industry Transformation Maps (ITMs): These are road maps to drive industrial transformation. ITMs will be tailored to each specific industry to help the industry achieve its potential and create jobs for Singaporeans.

7. Partner each other to enable innovation and growth: Trade Associations and Chambers (TACs), unions, enterprises and individuals will work together to generate innovation and growth, while creating a sustainable environment for the people in Singapore.

The CFE expects that the collective efforts will enable Singapore to grow by 2 to 3% per year on average over the next decade.

Emphasis on the adoption of new technologies and innovation

In recent years, two of the themes that have been reiterated in the government's Budget statements are the adoption of new technologies and the need for innovation (Heng, 2016, 2017, 2018, 2019). These have some overlaps with the key strategies identified by the CFE, which have been mentioned in the earlier section. The following sections will discuss deeper the two themes with some specific examples.

Adoption of new technologies. The need for industries, enterprises and workers to adopt new technologies is in tandem with the emergence of Industry 4.0. Across the globe, new technologies are reshaping the economies of nations, business models of enterprises and jobs of individuals. For example, the global trajectory towards high value for manufacturing requires that manufacturing companies move up the value chain (Livesey, 2006), which can be assisted through

	1990s	**2000s, 2010s to present**
Global backdrop	• China emerges as manufacturing powerhouse • United States leads the Internet boom • Asian financial crisis (1997-1998)	• Dot-com bubble burst (early 2000s) • Global recession (2007-2009) • Emergence of Industry 4.0 • Rise of Asia • Global trade tensions
Emphasis of Singapore's economy during this period	• The Economic Development Board (EDB) strengthens its focus on chemicals, electronics and engineering industries • Economy diversifies business units to include service sectors such as lifestyle and entertainment	• Developing higher skills in workforce, growing an innovative economy, and building a distinctive global city • Encouraging technopreneurship and fostering a vibrant startup ecosystem • Focusing on value creation and innovation: the productive use of resources and the creation of new businesses and new products • EDB continues to build on Singapore's strengths in industries such as semiconductors, energy and chemicals, biomedical sciences, aerospace, industrial machinery and infocomm technology • Building strong digital capabilities in finance, advanced manufacturing and healthcare. This will also include developing strong capabilities in data analytics and cybersecurity

(continued)		
Some milestones in Singapore's economy during this period	• EDB sets up the Creative Services Strategic Business Unit to promote film, music, arts, design and media • Toshiba establishes its operational headquarters in Singapore • Land reclamation for Jurong Island begins to further develop the energy and chemicals industry	• Singapore's research hub for biomedical science, Biopolis, is conceived and set up for key private and public research organizations • Renewable Energy Corporation (REC) breaks ground on its S$2.5 billion solar plant: the largest clean technology investment in Singapore • Major companies e.g. Dyson, Procter & Gamble, Applied Materials and Infineon set up R&D centres in Singapore • Singapore is ranked the 6th most innovative economy in the world by the 2017 Bloomberg Innovation Index and the 2016 Global Innovation Index

Table 1. *Focus of Singapore's economy for 1990s, 2000s to 2010s to present. References: Beh (2017), EDB Singapore (2014), EDB Singapore (2019).*

deploying suitable new technologies such as automation and robotics. High value manufacturing is important to Singapore as manufacturing is a significant contributor to the nation's economy. When we speak of high value manufacturing, we consider the financial, strategic and social aspects of value (Livesey, 2006). For example, for the financial aspect, automation can reduce manpower and thus make production more cost effective. Recognising these trends, the government has launched a new Automation Support Package in Budget 2016 (Heng, 2016). The package was intended for firms to utilise large-scale automation, including Internet of Things (IoT) and robotics. It comprises grant, loan and tax components. Since its launch, it has helped more

than 300 companies to automate their processes and raise productivity. To encourage more companies to follow their example, Budget 2019 announced the extension of the Automation Support Package by another two years (Heng, 2019).

Another example of Singapore's support for enterprises to adopt new technologies is the National Robotics Programme, which was announced in 2015. The purposes of the programme are to drive industry-level transformation via deploying new technologies to solve problems that are relevant for the entire industry, as well as to create high value jobs. Budget 2016 and 2018 announced the expansion of this effort (Heng, 2016, 2018).

Digitalisation becomes commonplace in Industry 4.0 and has the power to transform large and small companies. The Singapore government has recognised that the first way to help its enterprises, especially small and medium enterprises (SMEs) is to help them adopt digital solutions. The SME Go Digital Programme was introduced in Budget 2017 to make it easier for SMEs to build digital capabilities (Heng, 2017). In this programme, SMEs receive step-by-step advice on the digital solutions to adopt at each step of their growth (Infocomm Media Development Authority, 2019a).

The Tuas mega port project is a concrete example of how Singapore aims to make purposeful and radical adoption of technology and digitalisation to ensure that Singapore retains the competitive edge of being a maritime nation. The development of the mega port will take over two decades to completed and cost billions of dollars. When fully developed, the Tuas mega port will be the single largest terminal in the world that is fully automated (Paulo & Heng, 2018). Automation will help the port achieve predictable and consistent performance, which is important for the fast turnaround of the vessels. Local businesses will also benefit—for example, the need for digitalisation of the port gives local firms the business opportunities to develop virtual reality and artificial intelligence for the port. Individual workers will also benefit from the creation of high value jobs. It is important to note that the overwhelming majority of the jobs for the maritime industry are in the service businesses (Singapore Maritime Foundation, 2017). These services jobs have to adopt and dive deep into using technology.

Innovation. Innovation is enabled by technology but is not limited to that. It is about coming up with new solutions and ways of doing things that create value in the economy. To this end, it was announced in 2016 that Singapore would commit $19 billion as part of the five-year Research, Innovation and Enterprise 2020 (RIE 2020) plan. The plan is "for research, innovation and enterprise activities, to support and translate research, and to leverage science and technology to address national challenges and build up the innovation and technology-adaptation capacity of our companies to drive economic growth through value creation (National Research Foundation, 2016)." Further, Singapore would support startups in new and existing industries—a new entity called SG-Innovate would be set up to match new entrepreneurs with mentors and help them to open up new markets. The Jurong Innovation District will also be launched. It is envisioned to be a next-generation industrial district that fosters innovation for enterprise, learning and living. (Heng, 2016)

Innovation is one of the key enablers for enhancing the capabilities of enterprises. Indeed, strong enterprises are the cornerstone of a vibrant economy. To encourage businesses to innovate across the entire value chain, the government would support them to buy and use new solutions, build their own innovations, and find partners to create solutions together via various tax deductions and grants (Heng, 2018).

Innovation is also a prevalent theme in Singapore's efforts to tap into overseas resources. The Global Innovation Alliance was announced in Budget 2017 to enable Singaporeans to network and collaborate with their overseas partners. Under this alliance, the Innovators Academy programme would help tertiary students to establish connections overseas while the Innovation Launchpads would enable business persons to connect with service providers, investors and mentors overseas. Welcome Centres are also set up to link foreign companies with Singapore partners.

<u>Knowledge, skills, abilities (innovative ability) needed in high value manufacturing and high value service jobs</u>

Singapore's key competitive advantage lies in having a knowledgeable, skillful and high-ability workforce that is able to meet the challenges now and in the future.

With rapid technological advancements, many workers (especially the older ones) may feel marginalised because of the difficulties they face in keeping up with the changes in the workplace. Enterprises are only as good as their people get. Therefore, developing skills of the workforce in tandem with the technological transformations in companies is crucial. To achieve this, Singapore emphasises skills mastery and lifelong learning. SkillsFuture is a major national movement aimed at helping Singaporeans of different ages develop skills for the future (SkillsFuture Singapore Agency, 2019a). Many initiatives under the SkillsFuture framework have been implemented since the launch of SkillsFuture in end-2014. Also, other schemes like the Professional Conversion Programmes (PCPs) help Professionals, Managers, Executives and Technicians (PMETs) go for skills conversion for new jobs in sectors with good potential (Workforce Singapore, 2019).

Industry 4.0 sees a greater demand for skilled professionals in growing sectors such as information and communications technology (ICT). ICT is widely used across industries, be it manufacturing or services. To enable individuals learn new ICT skills quickly, the TechSkills Accelerator (TeSA) under the SkillsFuture initiative was announced in Budget 2016 (Heng, 2016). The purpose is to enhance training and job placement for the ICT sector, by supporting reskilling or upskilling (SkillsFuture Singapore Agency, 2019b). TeSA supports STEM (science, technology, engineering and mathematics) professionals to reskill in emerging industries such as network engineering, software development and network engineering (CFE, 2017). The CFE has also recommended that the TeSA model be replicated in other sectors.

Implications of high value manufacturing, service and innovation on future human capital

The plans and schemes above are definitely not exhaustive in Singapore's efforts to remain economically competitive. Changes and challenges ahead will be more rapid. It is up to Singapore and its people to turn challenges into opportunities now and in the future. For the government, planning with foresight is crucial. For the individual, being prepared for jobs for the future is important to stay relevant. With innovation and disruptive technologies, the nature of jobs will

change radically. In addition, some jobs will disappear while others emerge. The skills and mindsets of people need to change to keep up with the new economy. Outdated skills and old attitudes will no longer serve people well.

Employers will not simply look at paper qualifications alone—increasingly, they will be looking for abilities to learn new technologies and adapt quickly, analyze and solve problems and create value to the organization.

In the next decade and relevant to Singapore's context, value creation will be instrumental to create new jobs, products, and services and change the way we live, learn, and work. Value creation is derived from the actions of people working on current entity and utilise deep mastery, innovation, and creativity to create new use for existing entity (Lado & Wilson, 1994; Pfeffer, 1995; Wright, McMahan, & McWilliams, 1994).

The following Figure 4 illustrates value creation (Bowman & Ambrosini, 2000; Lepak, Smith, & Taylor, 2007).

Value creation will require educators to take a long-term view of learning. Learning for the immediate often focus on facts and meeting standards. The long-term view of learning in value creation will require cultivating a passion for learning, having an inquisitive mind,

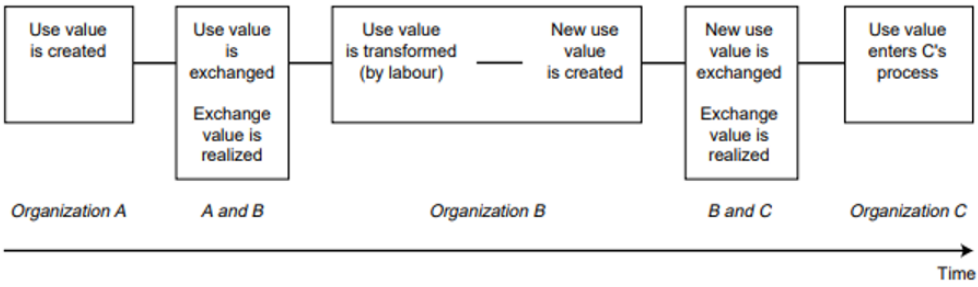

Figure 4. *Process of Value Creation (Bowman & Ambrosini, 2000)*

accepting failure as part of learning, experimenting (prototyping). Fear of failure is directly associated with motivation of avoidance (Elliot, & Thrash, 2004). In creating value, learners will have to overcome this fear of failure.

These must be part of the repertoire of habits of practices of ready for value creation and the future of lifework. Habits of practices are different from competencies (the latter section will expand on this).

Future-Ready for Living

How do Singaporeans contribute to a cohesive society and co-create sustainable utilization of earth's resources?

Future-ready for living includes citizenry (social) and sustainable utilisation of resources (environment). The following sections will examine the social and environmental contexts and trajectories of Singapore.

Social context

Increasing diversity of the society

For decades, Singapore has enjoyed peace and harmony on the whole. However, forces that threaten the peace and harmony remain, with increasing diversity within the nation brought about by factors such as religion, race and immigration. These forces are intensified by the liberal expression of views on these matters online.

A study conducted by the Institute of Policy Studies in late 2018 found that the level of religiosity of Singaporeans is high, with three out of four Singaporeans saying that they follow a religion (Mathew, Lim, & Selvarajan, 2019). Though the study found that 97% of the respondents think that it is "unacceptable or very unacceptable for religious leaders to incite violence or hatred against other religions", almost a quarter of respondents would "allow religious extremists the freedom to post their views online". This is a case for concern because there is only a fine line between freedom of speech and the instigation of harm towards other religions. With the proliferation of social media, addressing radical online content will be a "fight for the hearts and minds" (Channel NewsAsia, 2018). Online falsehoods

and fake news further tear at Singapore's interfaith unity and has the potential to undermine Singapore from within (A. Chua, 2018). Against the global backdrop of increasing religiosity and digital connectivity, the people in Singapore will become more and more exposed to pressures that potentially undermine interfaith unity. As Prime Minister Lee Hsien Loong noted, there is powerful appeal for a global Islamic community; and in the event of a terrorist attack, there will be great distrust among Muslims and other Singaporeans (Yuen, 2018b).

The influx of foreigners into Singapore brings about another dimension of diversity. For decades, Singapore has upheld a Chinese-Indian-Malay-Others (CMIO) framework for categorising the races of its people. Because of immigration, the category "Others" has increased by proportion the most for the last decade (Cheng & Chua, 2017). Even within the Chinese race and the Indian race, intra-racial diversity grows, with immigration of people from China and India. These new immigrants have different habits, mannerisms and speech compared with locals despite sharing the same ethnicity. Although the Singapore government has made efforts in making Singaporeans understand the economic rationale for foreigners, the man on the street may not understand it (Angela Teng, 2018). The common Singaporean experiences competition for jobs and schools, increased housing costs and crowded public transport because of foreigners. There is also the concern that having too many foreigners will dilute the national identity of Singaporeans (Nasir & Turner, 2014). Social tensions brought about by immigration are further intensified with foreigners and locals expressing hate speech of "the other" online.

The population makeup of Singapore is becoming more and more complex. As noted by Mathew (2016)—"A case in point would be the growing number of children of mixed parentage, who have parents not just from the different ethnic groups in Singapore but from diverse racial, nationality and socio-economic backgrounds."

Diversity in Singapore will only increase. How can Singapore foster, in its people, a sense of belonging to the country? How can the country retain a Singaporean core with a strong and unique national identity? What policies should be made to manage diversity and foster inclusivity? These are crucial questions for Singaporeans and their government.

Immigration and citizenship policies

To help alleviate the economic problems associated with an ageing population, Singapore accepts immigrants. In a population white paper released by the government in 2013—"A Sustainable Population for a Dynamic Singapore (The Straits Times, 2013)—the government projected that Singapore's population will grow to 6.5 million to 6.9 million by 2030.

In view of the negative sentiments from Singaporeans, the government has rolled back on its immigration and citizenship policies. The government also announced recently that Singapore's total population is likely to be "significantly below" 6.9 million by 2030 (Yuen, 2018a). According to Mrs Josephine Teo who is in charge of population matters in the Prime Minister's Office, the current rate of immigration "allows Singapore to achieve close to the same effect as if Singaporeans had a full-replacement Total Fertility Rate of 2.1." (Yuen, 2018a) Therefore, the government does not expect major changes to the current immigration policies. She also said that the government would continue to be selective about the profile of Singapore's immigrants, as it affects the growth of a strong national identity. The requirements for applying to become a Singapore citizen or a Permanent Resident are available on the Immigrations and Checkpoints Authority (2019) website.

A point to take note is the obligation for all male Singapore Citizens and Permanent Residents to serve National Service, unless they are they are exempted (Immigrations and Checkpoints Authority, 2019). All second-generation male SPRs must enlist for National Service together with their Singaporean counterparts once they reach 18 years of age (Ministry of Communications and Information, 2013). This has caused many foreigners to think twice about obtaining citizenship and permanent resident status in Singapore.

Importance of social integration and cohesion

Social integration and cohesion are important for political stability for GDP growth of the nation. They are also important for the social well-being of the people. The alternative would be distrust, chaos and

bloodshed. Despite enjoying peace and harmony for decades, the 1964 racial riots serve as a grim reminder to Singaporeans just how fragile harmony is, and how important it is for both Singaporeans and their leaders to play active roles in ensuring social integration and cohesion for the continuity of peace and harmony.

To ensure social harmony in Singapore, the country has adopted three principles – multiculturalism, secularism and meritocracy (Public Service Division, 2015). For multiculturalism, ethnic diversity is acknowledged and embraced, and individuals have the right to retain their culture. For secularism, the state is secular but not against religion; and individuals have the right to practice their religion freely. For meritocracy, opportunities are given to individuals based on merit and performance, without bias to race, creed or social-economic background (Public Service Division, 2015). There are a number of measures that are taken to uphold these principles. For example, the Group Representative Constituency (GRC) ensures minority representation in politics. The Housing and Development Boards' Ethnic Integration Policy (HDB EIP) ensures that racial communities do not form residential enclaves and that different races can live alongside one another. Also, the Maintenance of Religious Harmony Act was introduced in 1990 to empower authorities to act against anyone who potentially threatens religious harmony. In addition, there are other "soft" approaches to develop in Singaporeans the "heartware" to be receptive towards diversity (Mathew & Khidzer, 2015). The Character and Citizenship syllabus in school aims to foster in students an understanding that "A person who values harmony seeks inner happiness and promotes social cohesion. He appreciates the unity and diversity of a multi-cultural society" (Ministry of Education, 2018b). Singapore also observes the Social Harmony Day on 21 of July every year, with a plethora of activities organised by schools, grassroots organisations and religious groups. The Social Harmony Day was launched in 1997 to as a reminder of the racial riots of 21 July 1964. Other organisations involved in fostering inter-religion and inter-racial harmony are the Inter-Religious Organisation (IRO), the Inter-Racial and Religious Confidence Circle (IRCC), and OnePeople.sg (Mathew & Khidzer, 2015).

To help newcomers from other lands integrate into Singapore, the National Integration Council was set up. The objective for the council is to "encourage and support ground-up integration initiatives to facilitate social interactions between Singaporeans and newcomers, and raise awareness of Singapore society, norms, and values" (National Integration Council, 2019). Further, the Singapore Citizenship Journey is a mandatory programme for new citizens who have been granted in-principle approval for Singapore citizenship. The programme is a collaboration between National Integration Council, the People's Association and the Immigration & Checkpoints Authority of Singapore. The three components of the programme help new citizens understand Singapore and integrate better.

Singapore's journey in social integration is not over. To preserve the peace and harmony that Singapore enjoys now, its people need to work hard to build friendships and trust to form an inclusive society.

Demographic trends and implications for the economy

Singapore's population is ageing rapidly. From a young country with a resident median age of 17.8 years in 1965, its resident median age has increased to 40.8 years in 2018 (Department of Statistics, 2019). Within a short period of 53 years from the nation's independence in 1965, the median age of its resident population has more than doubled. Figure 5 depicts the change in the age structure of the resident population over the years. The ageing trend will continue, with persistent low birth rates and high life expectancies. According to projections, there will be one aged person (65 years and above) for every four Singaporeans in 2030, compared to about one in every eight Singaporeans in 2015 (Population SG, 2019).

The Resident Old Age Support Ratio is the ratio of the number of persons from the working age group (20 to 64 years) to that of the elderly (65 years and above). This ratio depicts the number of economically active persons available to support an elderly. As can be seen from Figure 6, the Resident Old Age Support Ratio has been declining steadily. The workforce is also maturing—the median age of the workforce has increased from 41 years to 43 years within a decade from 2008 to 2018 (Ministry of Manpower, 2019). These trends have

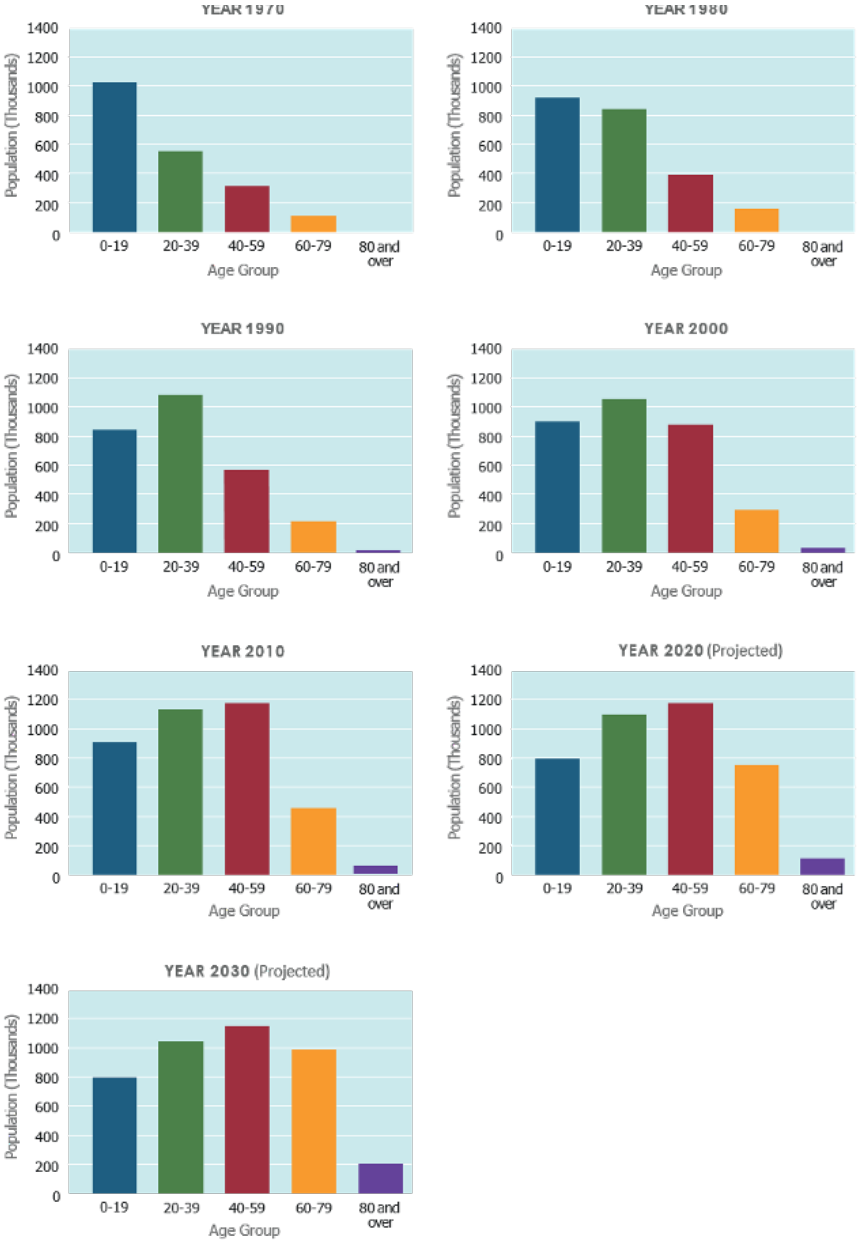

Figure 5. *Change in age structure of resident population of Singapore (Charted with data from the Department of Statistics).*

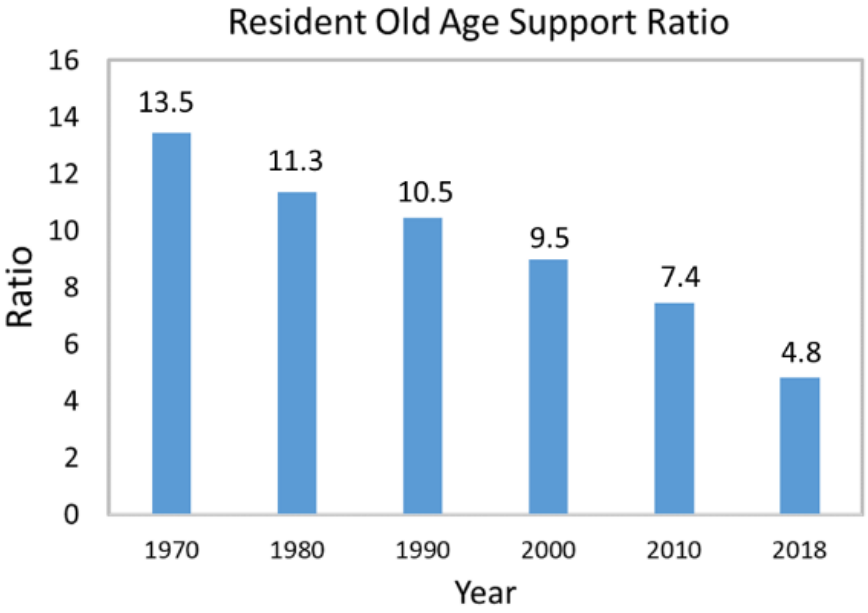

Figure 6. *Resident Old-Age Support Ratios (charted with data from the Department of Statistics).*

tremendous implications for the economy (Yap & Gee, 2015)—will the economy continue to grow? Will an older workforce adopt new technologies as fast as a younger one? Can productivity increase enough to offset the tightening workforce?

Recognising these trends, there have been efforts by the Singapore government to improve the employability of older workers and encourage those previously outside the workforce to return to employment. For older residents aged 65 and above, the employment rate has continued to rise, from 25.8% in June 2017 to 26.8% in June 2018 (Ministry of Manpower, 2018). This helped to offset the effect of ageing on the labour force participation rate. As a result, the labour force participation rate has broadly stabilized from 2017 to 2018, following an initial uptrend for the previous years (Ministry of Manpower, 2018). (The labour force participation rate is the percentage of the

labour force to the population aged 15 years and above.) However, as the Ministry of Manpower noted, “Nonetheless, structural challenges remain. Our ageing population continues to exert downward pressure on the labour force participation rate. Together with slower population growth, expansion of the resident labour supply is expected to be moderate.” (Ministry of Manpower, 2018)

As the average person is now expected to work longer into his or her golden years, lifelong learning for lifelong employability is now crucial.

An ageing population also requires a greater national expenditure on healthcare. The government has set aside more than $14 billion in total for the Pioneer Generation package introduced in 2014 and the Merdeka Generation package introduced recently in 2019. The bulk of these expenses go into healthcare support for elderly Singaporeans (Lai, 2019; Neo, 2014).

Demographic issues represent some of the most pressing challenges to Singapore and will persist to be so, in the years to come.

In summary, with rising religious extremism and proliferation of hate speech and falsehoods online, Singapore has to work even harder to ensure interfaith and inter-racial harmony. Immigration brings about another dimension of diversity. Singapore has to strike a delicate balance between the need to offset a shrinking growth in the workforce by immigration and the social challenges associated with having more immigrants. There are a number of laws, policies and organisations that aim to address the foregoing social challenges and Singapore’s work in ensuring social cohesion is far from over. Also, with falling birth rates and increasing life expectancies leading to an ageing population, Singapore faces difficulties in sustaining a young workforce. These demographic challenges have severe implications for the economy.

Environment context

Global environmental problems and Singapore’s pledge

There are more than 7 billion people in the world today. More than 50% of the world’s population now live in urban areas (Steffen, Broadgate, Deutsch, Gaffney, & Ludwig, 2015). The rapid pace of urbanisation

places strain on the earth's environment, with ever-increasing demand for energy and matter. The post 1950 period has been termed the Great Acceleration, where global socio-economic trends such as real GDP, urban population, transportation and water exhibit a sharp rise compared to the pre-1950 period (Steffen et al., 2015; Steffen, Crutzen, & McNeill, 2007; Steffen et al., 2011). This sharp increase parallels the rise in the emission of greenhouse gases, ozone depletion and other global-scale changes in the earth system, strongly indicating the coupling of environmental deterioration with urban population increase, GDP growth and material consumption. The dire consequences of these changes in the earth system include global warming, climate change, rise in the sea level and declining biodiversity.

Global temperatures have risen by about 1 degree Celsius since the industrial age began. Thermal expansion from warmer ocean waters and melting of ice-caps lead to rising sea levels, causing widespread devastation to coastal habitats. (Nunez, 2019) Weather patterns around the world are becoming more erratic, with increasing frequency and intensity of extreme weather events. Human activities and global climate changes threaten the extinction of species—1 million species face extinction unless massive action is taken to reduce the drivers of the decline in biodiversity (IPBES, 2019; McGrath, 2019). The loss in biodiversity has severe implications for global food security, as the resilience of agroecosystems are being undermined (IPBES, 2019). Singapore is not spared from these global threats. As part of earth's delicate ecosystem, Singapore's challenges of energy, water and food are intricately linked to the state of the global ecosystem. Despite being a small nation, Singapore has to play a role in environmental conservation.

In 2015, Parties to the United Nations Framework Convention on Climate Change (UNFCCC) adopted a landmark agreement on climate change in Paris. The goal of the Paris Agreement is to keep global warming well below 2°C above pre-industrial levels. Singapore signed the agreement on 22 April 2016 and ratified it on 21 September 2016 (National Environment Agency, 2019). Singapore has pledged to reduce its emissions intensity by 36% from 2005 levels by 2030, and

stabilise emissions with the aim of peaking around 2030 (Ministry of Communications and Information, 2015).

Energy

Improving energy efficiency is a key strategy for reducing carbon emissions. The industry sector contributes to more than half of Singapore's greenhouse gases emissions. Mandatory practices have been implemented to address the energy efficiency of Singapore's industry sector. The Energy Conservation Act (ECA) requires that energy-intensive users in the industrial sector monitor and report energy use and emissions-related information annually. They are also required to submit an energy efficiency improvement plan and review the plan annually (National Environment Agency, 2018). The government is also studying policy options to facilitate the switch to the use of cleaner fuels in industry. By switching to cleaner fuels such as natural gas, carbon emissions from heating processes can be reduced by about 25% (National Climate Change Secretariat, 2016).

"Green" buildings are those that reduce the negative impact on the environment by virtue of their design and operation. The Building and Construction Authority's (BCA) Super Low Energy Programme leads the green buildings movement by using energy efficiency and renewable energy solutions in buildings. The BCA has also developed a Super Low Energy Technology Roadmap that focuses on the development, pioneering and adoption of technologies for super low energy buildings. This is expected to reduce the carbon footprint of Singapore significantly as the buildings sector account for more than one third of the country's electricity consumption (Building and Construction Authority, 2018).

Singapore is also increasingly turning to renewable energy sources. Solar energy is the most promising renewable energy option for Singapore (National Climate Change Secretariat, 2016), and could possibly meet as much as a quarter of Singapore's energy needs in 2025 (Low & Rockell, 2017). The SolarNova programme led by the Economic Development Board (EDB) and the Housing Development Board (HDB) aims to accelerate the deployment of solar power

technology in Singapore. There are 10,000 blocks of HDB buildings on which solar panels may be installed, and HDB has pledged to install solar panels on 5,500 blocks by 2020 (Teh, 2018). Wind energy is being utilised as well, though on a small scale. In 2017, Singapore's largest wind turbine is unveiled in Semakau Island. Wind energy is part of the offshore island's power grid system, which integrates multiple renewable energy sources such as solar power (M. Z. Lim, 2017).

Households in Singapore are encouraged to make better energy choices, with the Mandatory Energy Labelling Scheme (MELS) introduced in 2008, which allows consumers to compare the energy efficiency of different appliances. The Minimum Energy Performance Standards (MEPS) also removes energy-inefficient appliance models from the market. (National Climate Change Secretariat, 2016)

Moving forward, innovation and the adoption of technology are crucial for addressing Singapore's energy needs, while ensuring that the impact on the environment is minimised. The Energy National Innovation Challenge was launched in 2011 to harness Singapore's R&D capabilities to increase energy efficiency, reduce carbon emissions and increase energy options within 20 years. The Challenge received $300 million in funding, targeting areas such as green buildings, green data centers, energy storage and waste-to-energy solutions (National Climate Change Secretariat, 2016). Singapore has a number of research groups and research centers working on energy research—notable ones include the Energy Research Institute @ NTU (ERI@N), which focuses on energy solutions for megacities and the tropical environment (ERI@N, 2019).

Water

Another environmental challenge facing Singapore is that of water. Water is a precious environmental resource that is required for survival. Singapore is a water-scarce country that is not self-sufficient in water. As a small country, there is limited area for local water catchment. Singapore depends on its "Four National Taps" for its water supply—local catchments, imported water, NEWater, and desalination (PUB, 2018c). The total water demand in Singapore currently is about 430 million gallons a day. Of this demand, imported water provides about

50%, NEWater supplies up to 40%, desalination meets up to 25%, and local catchments make up the rest (Seow, 2018). The water demand is expected to almost double by 2060 (PUB, 2018c).

Currently, there are 17 reservoirs in Singapore, which serve as local water catchment. A noteworthy reservoir is the Marina catchment, which is created by the Marina Barrage. It is the vision of the late former Prime Minister Mr Lee Kwan Yew, who envisioned the damming of the mouth of the Marina Channel to form a reservoir. Hailed as a Singapore success story, the Marina Barrage not only creates a source of water supply, it also serves as a control for floods and as a lifestyle attraction (PUB, 2018b).

As for imported water, Singapore is able to draw up to 250 million gallons of water a day from Johor River in Malaysia, under the 1962 Water Agreement, which will expire in 2061. Singapore's National Water Agency PUB operates the Linggui Reservoir that is built upstream of the river to collect and release rainwater. Singapore is also obliged to provide Johor with treated water up to 2% of what Singapore imports (PUB, 2018a).

NEWater is another Singapore success story. Making use of sophisticated membrane technologies, Singapore is able to recycle its treated used water. This helps to cushion Singapore's water supply in times of dry weather and to propel Singapore towards water sustainability and security. The high quality of the water has been verified by local and overseas experts. More than 20,000 tests have been carried out for around 190 water quality parameters. The results show that the water quality is well within international water standards (E. T. Lee, 2016).

Desalinated water from the sea is another source of water for Singapore. Desalination makes use of advanced reverse osmosis technology. Power consumption and costs are higher for desalination compared with NEWater (E. T. Lee, 2016). Nonetheless, desalinated water is an important pillar of Singapore's water inventory and is expected to provide up to 30% of Singapore's water demand by

2060 (PUB, 2018a). Singapore will continue to invest in research and technology to find more efficient ways of desalination.

In 2018, PUB launched the SMART PUB Roadmap (PUB, 2018d). The roadmap aims to develop PUB into the Smart Utility of the Future, by making intensive use of artificial intelligence, automation, big data and smart work redesign. PUB operators will also undergo virtual reality training. Digitalization of the entire water system of Singapore will be carried out to achieve better water quality management and network improvements, as well as smarter work processes. These help to increase the productivity of PUB, as well as the safety and security of Singapore's water supply.

With economic growth and an increasing population, Singapore has to find new ways and innovate to meet its increasing water needs. We have seen how harnessing innovation and technology for NEWater and desalination play a pivotal role in addressing Singapore's water problems, increasing self-sufficiency and reducing dependency on neighboring Malaysia. These technologies also buffer against the effects of falling water levels in reservoirs during prolonged dry spells brought about by global climate change. Singapore's development of water technology is far from over—Singapore has to commit to enhancing current technologies and to seeking new solutions to ensure the continuity of water security. Singapore's expertise in water treatment can even be an exportable commodity (Rahamat, 2013), allowing Singapore to capture market opportunities in other countries.

Food

In 2018, Singapore topped the Global Food Security Index (F. Koh, 2018). However, vulnerabilities exist, and Singapore's food security is susceptible to climate and natural resource risks, which can disrupt food supply to the import-dependent country. As a small country with limited land, Singapore cannot grow all the food it needs to feed its growing population. It has to turn to imports from other countries. To maximise food resilience, Singapore adopts a diversification strategy, importing from many different countries to ensure the continuity of food supply should the import from any country be affected. For example,

Singapore imports rice from India, Thailand, Vietnam, Malaysia, Cambodia, Myanmar and Pakistan (J. Lim, 2015).

Nonetheless, locally produced food plays a role in buffering against supply disruptions. Currently, less than 10% of Singapore's food is locally produced. Singapore aims to produce 30% of its nutritional needs by 2030 (Singapore Food Agency, 2019). This calls for higher productivity of farmlands, given the fact that land is scarce in Singapore. Farms have to produce a greater amount of food per unit area of land, while using manpower efficiently. The way to achieve this is through harnessing innovation, science and technology (Ministry of National Development, 2018). The following paragraphs give some examples of local farms that have achieved this with some success.

Sky Greens Farm, located in Lim Chu Kang, is the world's first low carbon hydraulic commercial farming system (Sky Greens, 2014). Its patented vertical farming system has rotating tiers of growing troughs mounted on aluminum frames. The troughs rotate around the frames to ensure that the leafy vegetables get enough sunlight and other nutritional needs. The use of energy and water is low, and labor is effectively utilised. Compared to traditional monolayer farms, Sky Greens is able to produce ten times more output per unit area of land. The farm has received a number of awards since their inception.

Seng Choon Egg Farm is a well-known egg farm among Singaporeans. It employs large-scale automation in its operations (Paulo, Yeh, & Say, 2019). For example, computers are used to weigh the exact proportion of each ingredient in its chicken feed. The feed is given to the chickens using automatic dispensers. For sorting the eggs, the farm uses high-tech egg graders, egg inspectors and crack detectors. Robotic arms are used to transport the egg crates into pallets, reducing manpower greatly.

In 2018, the government announced that more financial help would be given to farmers in their process of adopting technology (A. Tan, 2018b). Enhancements would be made to the Agriculture Productivity

Fund—a co-fund of up to $500,000 would be available for farmers to test-bed new technologies before implementing them fully. This move is expected to help farmers who are keen to adopt technology but are unable to do so because of its hefty price.

Moving forward, it is clear that innovation and technology must be incorporated into farming practices to raise farm productivity. As Senior Minister of State, Ministry of Trade and Industry, Dr Koh Poh Koon said (Ministry of National Development, 2018):

> "Singapore can carve a niche in urban solutions by becoming a living lab for food production technologies, just like what we've done for water recycling and desalination—turning a disadvantage into something we can be proud of."

As Singapore progresses into the future, Innovation and technology are crucial for Singapore's resource-limited environment for agriculture, while ensuring the impact on the environment remains low. By making use of innovative technologies such as indoor farming, multi-tier farming, automation and precision engineering via sensors and internet of things (Ministry of National Development, 2018), farms can intensify land use, raise output with minimal manpower and add resilience to Singapore's food supply. Low carbon-footprint practices such as those used by Sky Greens are also exemplary to the next generation of farmers.

In summary, Singapore's future development is intricately linked to environmental factors. Greater consumption of energy and matter will inevitably follow as the country continues to develop as a modern and sophisticated city-state. How Singapore will meet the increasing needs for energy and matter while achieving its environmental pledge is a challenge for the government and its people. There is an urgent and compelling need for Singapore to formulate sound policies, implement concrete actions, and apply great ingenuity to come up with novel and innovative solutions for environmental issues. Without a sustainable and livable environment, there will be no place to support future economic development or to live harmoniously.

Summary of Singapore's Trajectories and Future Skills, Knowledge and Values Required

The global economic landscape is getting more competitive and it is imperative for Singapore to create new value in the products and services that it delivers. Singapore cannot sustain a competitive edge simply by producing what the rest of the world is producing (U.-W. Lee, 2015). This calls for innovation in the jobs of the future. Also, Singapore's economic trajectory requires workers who are able to learn and apply technology quickly to keep up with the speed of change in the age of Industry 4.0 (Schwab, 2016). Paper qualifications are no longer sufficient for employers. Increasingly, employers are looking for workers who can adapt quickly and provide creative solution to problems. Lifelong learning becomes the norm (SkillsFuture Singapore Agency, 2019a). Those who cannot catch up will face great challenges in the future economic landscape of high-value manufacturing and high-value services jobs. An education system can only be successful if it is able to develop future value in individuals to prepare them to take on and thrive in jobs in the future (the second purpose of education, with a future perspective). For example, education must make innovation an ingrained mindset in students to prepare them for future jobs. Developing an innovative mindset will require consistent teaching and learning environments that will foster such a mindset. Rote learning and efficient learning will no longer be enough in the new economic reality (D. F. S. Ng, 2019).

As for the social context, we have seen how Singapore is increasingly diverse in its population makeup because of work and immigration related drivers (Cheng & Chua, 2017). Religiosity is also on the rise (Mathew et al., 2019). These twin forces threaten to pull the people of Singapore in different directions and strain the social fabric of nationhood. Increasingly, the people of Singapore will be working and living with people who do not share the same race, country of birth, or religion as they. Tolerance and inclusivity are a must for the people of Singapore to come together as a united nation. Successful education must play the role of inculcating the right values for the people of Singapore to live and work harmoniously and collegially with one another—now, and even more so in the future (the third purpose of education, with a future perspective).

We have also looked at the environmental context of Singapore and seen how innovation and ingenuity are again needed for Singapore to solve its environmental problems. With economic growth and an increasing population, Singapore has to find novel ways to address its increasing need for energy, water and food, while minimising impact on the environment (Ministry of National Development, 2018; National Climate Change Secretariat, 2016; PUB, 2018c). Energy, water and food security hinges upon the ability of the people of Singapore to come up with creative yet feasible ways to address Singapore's challenges in these areas now and in the future. Education must foster this ability—inculcating habits for innovation in individuals while they are still in school.

We have defined Future-ready learners (successful education system) as:

> **"A successful education system is able to develop future-ready individuals who will continue to learn beyond graduation, take on future lifework, and thrive in a changing society and environment."**

The following table summarises the trajectories of Singapore's economic, social and environmental contexts and the skills, knowledge and values required of individuals for these trajectories.

The Need for a Shift in Education Practices

Referring back to the section on *"Practices: Dimension 4"* on page 10, Practices are another dimension in our discussion of educational success. This dimension includes leadership and management practices, teaching and learning practices, community practices and more. Practices are based on sets of assumptions, beliefs, and theories. These assumptions MUST NOT and CANNOT remain unchallenged paradigms in the discussion of future-readiness. Educational practices MUST shift from the current assumptions of practices where most activities are focused on the present. There is a need to develop students for the future. The skills, knowledge,

Context	Trajectory	Skills, Knowledge, Values
Economic	• High value manufacturing • New and novel services (High- tech services requiring IoT, blockchain etc.) • Commercialization of innovative solutions • Competitive advantage through purposeful and radical adoption of technology and digitalization in services and manufacturing	• Skills mastery • Lifelong, life-wide and life-deep learning • Innovation • Value creation • Technology adoption • Digitalization • Creative thinking
Social	• Increased religiosity: the threat of religious extremism • Increased immigration: the need for integration and acceptance of newcomers • Racial issues: the need for racial harmony • Aging population: the need for continuous education • Misinformation and influence of social media platforms	• Tolerance • Mutual understanding • Mutual respect • Logical reasoning (critical thinking) skills • Rootedness • Information assessment literacy
Environmental	• Increased urbanization: increased consumption of energy and matter • Global environmental problems: the need for reducing carbon footprint • Renewable energy • Energy efficiency through green and innovative solutions • High-tech water solutions for meeting the increasing water needs • High-tech and green farms for increasing local food produce	• Skills mastery • Innovation • Value creation • Technology adoption • Digitalization • Creative thinking • Sustainable lifestyle

Table 2. *Summary of Singapore's contexts and future skills, knowledge, and values.*

and values summarised in the table above should be the basis for re-examining the assumptions of current educational practices. Fundamental questions such as,

- What type of learning environment must institutions create to develop innovative mindsets?
- How much future value is created AS AN OUTCOME of learning? (Measures)
- How will the value of current learning for students be translated into FUTURE VALUE for human capital? (Process)
- To what extent do school activities along the time continuum affect a student's future learning outcome and perspectives?

For educational success, practices must evolve and be relevant to match the evolving realities of purpose, time and Singapore's context. For example, referencing the future economic and environmental contexts of Singapore, students must have an innovative mindset as future value that will enable them to fit into the next decade of economic and environmental development. The capacity of generating and developing ideas is the starting point for innovation. Next, testing the ideas will allow the translation of the abstract (ideas) into reality (product). If the outcome is to turn the idea into a useful product, the final phase of entrepreneurship involves convincing users to adopt the new product. Translating these phases into the school's teaching and learning will involve a shift in educational practices, as current practices emphasises on knowledge acquisition. For example, there is little room for students to generate ideas that are not in the planned curriculum. Current educational practices that result in this state of affairs must change (D. F. S. Ng, 2019).

In short, successful education needs to fulfil all its three purposes, with a keen awareness of the future perspective of time. Being context-specific, education also needs to be relevant to the social, economic and environmental contexts of Singapore. This requires a change in current educational practices. We will look at the aspects of future-ready habits of practices that have to be developed for students in Singapore in the next few sections.

Habits of Practices Required of Learners for Singapore's Future Landscape

Introduction

Rapid developments in the economic, social and environmental landscapes of Singapore have fundamental implications for education in Singapore. There is a need to draw up key attributes required of learners to develop their future value in the Singapore context. The Ministry of Education has provided a framework for competencies required of students for the 21st century to help them thrive in the changing landscape of Singapore (Ministry of Education, 2018a). Competencies include skills and knowledge. At the core of this framework lies Values, as values underpin competencies and define a person's character. For example, one of the values identified by the Ministry of Education is integrity. Surrounding the Values core in this framework are the Social and Emotion Competencies. For example, self-management requires the student to have the ability to manage his or her own emotions. The outermost layer surrounding the Social and Emotion Competencies layer is the Emerging 21st Century Competencies layer. For instance, having information skills means that students have the skills to sieve through information and extract what is relevant from the internet. Readers interested in the various values and competencies identified by the Ministry of Education can refer to the cited reference.

Here, we introduce an additional dimension to the framework—Habits. There are fundamental differences between competencies and habits. While the former refers to knowledge and skills, the latter refers to carrying out behavior repeatedly in response to various situations. Both competencies and habits are crucial for learning to ensure that practices are both supported by competencies (knowledge and skills) and by the *readiness to practice or execute certain behaviors without being told*. The latter also refers to '*habits of practices*'. What habits of practices must Singaporeans have in order to co-create and shape the future of Singapore? Schools should provide the context for developing habits of practices that are important for preparing students for the future of Singapore. In other words, formation of habits of practices can be done through the everyday practices and the teaching and learning

environment of the school. This is different from the need to be more explicit in developing competencies.

The implications of habits of practices on education and on Singapore's future are tremendous. For example, if a student does not develop the habit of asking questions and challenging assumptions while she is still in school, she would likely accept the status quo in the workplace of her future job. This is neither beneficial for creativity nor innovation. So, what habits are required of learners to prepare them for Singapore's future landscape? We have seen previously that Singapore's future economic, social and environmental landscapes require these values, skills and knowledge:

Dimension of future-ready learning, lifework, and living	**Brief Definition**
Mastery of learning	Mastery is "comprehensive knowledge or skill in a particular subject or activity" (Oxford dictionary). Mastery of learning in a particular domain, therefore, means having learnt the domain in a comprehensive manner. Mastery is a construct that "cannot be observed directly but can be inferred from observable performance on a set of items or tasks related to a particular concept, skill, or subject". (Guskey & Anderman, 2013)
Lifelong, life-wide and life-deep learning	Lifelong learning: Formal continuous learning to stay relevant throughout the individual's entire work life and beyond. Life-wide learning: Informal learning that takes place and cuts across multiple contexts in a person's life that allows for multiple expertise development while simultaneously support identity. Life-deep learning: Deep mastery of multiple disciplines, adaptive expertise, and values (religious, moral, ethical) formation. (See Executive Summary, Section 3 and references therein.)

(continued)	
Innovation	"Innovation is the multi-stage process whereby organizations transform ideas into new/improved products, service or processes, in order to advance, compete and differentiate themselves successfully in their marketplace." (Baregheh, Rowley, & Sambrook, 2009)
Value creation	"Value" has two components – perceived use value, which is subjectively perceived by users; and exchange value, which is the amount paid by the user to the producer for the perceived use value. Value is created through processes that create use value and subsequently realize exchange value. (Bowman & Ambrosini, 2000)
Technology adoption	Technology refers to the "machinery and equipment developed from the application of scientific knowledge", or "the branch of knowledge dealing with engineering or applied sciences" (Oxford dictionary). Technology adoption, therefore, refers to the use of engineering or applied sciences knowledge and/or machinery and equipment to solve problems.
Digitalization	Digitalization refers to the "the adoption or increase in the use of digital or computer technology by an organization, industry, country etc." (Brennen & Kreiss, 2014) It also refers to digital transformation – the changes associated with the application of digital technology in all aspects of human society. (Parviainen, Kääriäinen, Tihinen, & Teppola, 2017)
Creative thinking	Creative thinking can be described as the process of "forming of associative elements into new combinations which either meet specified requirements or are in some way useful." (Mednick, 1962) Creativity requires both originality and effectiveness. (Runco & Jaeger, 2012)
Tolerance	Tolerance means that "others are entitled to their opinions and have the right to express them and that even though one may disagree with them, and one can live in peace with such differences". (Von Bergen, Von Bergen, Stubblefield, & Bandow, 2012)

(continued)	
Mutual understanding	Understanding means "sympathetic awareness or tolerance". (Oxford Dictionary) Therefore, mutual understanding means two or more people or groups share sympathetic awareness or tolerance towards each other.
Mutual respect	Respect is "the feeling you show when you accept that different customs or cultures are different from your own and behave towards them in a way that would not cause offence". (Cambridge Dictionary). Mutual respect, therefore, means two or more people or groups share the same feeling towards each other.
Logical reasoning skills	Logical reasoning skills can be thought of as the ability of people to engage in the logical reasoning and critical thinking process – asking questions to define a problem/issue/situation and designing a model, gathering evidence and testing conjectures, and argumentation and reporting. (Jones & Texas, 2017)
Critical thinking	"Critical thinking is reflective and reasonable thinking that is focused on deciding what to believe or do." (Ennis, 1985)
Rootedness	Rootedness is a strong sense of attachment to a place and it accompanying socio-political culture. It involves physical familiarity, social connection, attachment, sense of belonging, and a sense that citizens have a say in national affairs. (G. Koh, 2008)
Information assessment literacy	Information literacy refers to the capacity of people to recognize their information needs, locate and evaluate the quality of information, store and retrieve information, make effective and ethical use of information, apply information to create and communicate knowledge. (Catts & Lau, 2008). Information assessment literacy, therefore, emphasizes the evaluation of the quality and relevance of information.
Networks	Networks may be physical or non-physical (e.g. digital). Nodes connected by links make up the basic elements of networks. Nodes may be individuals, organizations, cities or nations; and links may be of the social, cultural, business or economic type etc. (Comunian, 2011; Karlsson & Westin, 1994; Libert, Beck, & Wind, 2016) Networks are characterized by the connectivity, interaction and interdependency between the nodes.

Table 3. *Dimensions of future-ready learning, lifework, and living and their brief definitions.*

Considering the above points, we identify six habits of practices that are required of learners to prepare them to meet the challenges of the future of Singapore. The six habits are discussed next.

Habit of practice 1: Inquisitiveness

"I have no special talent, I am only passionately curious."
—Albert Einstein

In the field of philosophy, Watson (2015) identifies questioning as the distinctive and defining feature of inquisitiveness. Watson (2015) asserts that an inquisitive person must ask questions, and that he or she must be good at asking questions. Meanwhile, the Oxford dictionary defines the word "inquisitive" as "having or showing an interest in learning things; curious." Taking these two definitions together, we can view inquisitiveness as the characteristic of being good at asking questions and/or having curiosity.

Questioning helps learners to make meaning out of information, explore and scaffold ideas, and guide thinking into specific directions (Chin, 2004). It drives the mind to see patterns and connections between things and concepts. For questions that stem from curiosity, learners are stimulated to come up with explanations for puzzling things or situations and to propose solutions for them.

Questioning can have various hierarchies or categories. Taboada and Guthrie (2006) identified four levels of questioning where the complexity of the question increases from Level 1 to Level 4, with Level 1 questions requesting for factual knowledge and Level 2 to Level 4 questions requesting for conceptual knowledge with increasing specificity and complexity. They have found that the presence of higher-level questions facilitates higher levels of reading comprehension. Meanwhile, Graesser and Person (1994) identified 18 categories of questions—for example, "verification" questions are those that require just a yes or no answer, "consequence" questions are those

asking "what if". The latter is an example of what they call a "deep reasoning question". The quality of students' ability to self-regulate their knowledge is related to the depth and sophistication of the questions they ask (Graesser & Person, 1994). From these studies, it is clear that learning is facilitated by asking higher-order questions.

Self-questioning promotes metacognition about learning (Tanner, 2012; Wilson & Smetana, 2009). Metacognition, which refers to thinking about one's thinking (Wilson & Smetana, 2009), is crucial to students' success in school (Sternberg, 1998). Self-questions that a student can ask in the metacognitive process include (Tanner, 2012): What questions do I already have about this topic that I want to find out more? How can I make this material personally relevant? How did the ideas of today's class relate to those of the previous class? Metacognitive questions promotes deep understanding beyond acquiring simple factual information (Wilson & Smetana, 2009).

Constantly asking oneself questions that direct learning is also a hallmark of a reflective and self-directed learner (Chin & Brown, 2002). Reflection, which plays an important role in allowing the learner to construct meaning out of knowledge, is often initiated by asking questions (Hommel & Clarke, 2015). As for the role of self-questioning in directing self-learning, self-questioning allows the learner to test his or her understanding, acting as a source of feedback to help refine and redirect learning strategies (Chin, 2002). Therefore, the habit of asking questions (i.e., inquisitiveness) is crucial for skills mastery and lifelong, life-wide, and life-deep learning for Singapore's future landscape where self-directed learning is necessary.

Referring back to the future landscape of Singapore—innovation, lifelong learning and creative thinking, for example—are future values that share the same fundamental characteristics—inquisitiveness (asking the right questions and curiosity). Asking questions is an important ingredient for innovation. One example where asking questions triggered innovation is that of the invention of the instant camera. Edwin Land, the co-founder of Polaroid, took a photo of his three-year-old daughter while they were on vacation. However, the daughter was unable to see the picture right away and asked

him why. This question prompted Edwin Land, who was an expert in photographic emulsions, to think of how "instant" photography could be made into a reality. He then developed insights that eventually resulted in a breakthrough innovation—the instant camera—which transformed his company and disrupted the entire photography industry. (Dyer, Gregersen, & Christensen, 2011)

The other aspect of inquisitiveness is curiosity, which overlaps with the characteristic of asking questions. Curiosity can be defined as "a desire for acquiring new knowledge and new sensory experience that motivates exploratory behavior" (Litman & Spielberger, 2003). In practice, curiosity can be demonstrated in many ways. For example, looking up the meaning of unfamiliar words, discussing abstract concepts, thinking about what might happen in hypothetical situations, learning about new subjects, asking how a piece of complex machinery works and theorising and testing out some new concepts are all manifestations of curiosity (Litman & Spielberger, 2003). It is important to note that the individual is predisposed towards these behaviors or cognitive processes and engages in them without being told.

Curiosity has been long considered to be an antecedent of creativity (Csikszentmihalyi, 2013). Recently, a study systematically investigated the relationship between curiosity and creativity (Hardy, Ness, & Mecca, 2017). It was found that "diversive" curiosity (seeking out many different kinds of information) leads to increased creative performance. Therefore, developing the habit of seeking out various new and novel kinds of information is important for creative thinking, which we have identified in the previous section as one of the skills required for Singapore's future landscape.

Habit of practice 2: Ideation

Humanity's progress is dependent on the creative generation of ideas that make our lives better. From the idea of a simple wheel to that of the touch-screen smartphone, innovative ideas have resulted in revolutionary and profound changes in society. Innovative ideas are even more important and relevant now and in the future, as organisations compete or collaborate with one another to come up with the best ideas to solve modern-day problems. Idea generation (ideation) is the first phase in

the innovation value chain of organisations (Hansen & Birkinshaw, 2007)—without this phase, there would be no innovation to talk of. With the emphasis on value creation and innovation for Singapore's future landscape, developing the habit of practice of ideation in learners is therefore crucial. Ideation is a fundamental habit of innovation, creative thinking, value creation and mastery of learning. Innovation, creative thinking and value creation aim to create something "new". These new creations stem from ideation.

How does ideation arise? We advocate the idea that ideation does not take place just by serendipity, or simply out of nowhere. Rather, it is site-situated and dependent upon the interaction at a site. In other words, as a person or a group of people come to work or learn at a site (such as a school, business or community), issues, problems and challenges are encountered. This causes the people involved to start questioning the status quo and assumptions, such as asking "what if", and "why not" questions. This leads to ideation that addresses these site-specific problems and challenges. Ideation also requires the understanding of paradigms. For ideation, one needs to understand how things work, or are premised upon. These are the paradigms surrounding the situation, concept or issue. Only with this understanding can one ask the right questions that lead to ideation and challenges to the status quo. Without an understanding of the paradigm, the right questions are not asked and the status quo remains unchallenged. In understanding paradigms, mastery is essential. Mastery involves understanding concepts, theories, and the practices of the "what, why, and how" things work. Therefore, ideation is not about random ideas but derived from an understanding of underlying theories and methodology. For example, analytics, which is based on the understanding of meaningful patterns in data, is used to provide insight and ideas and to answer big questions.

In the literature, Ideation has been described to be part of a larger framework known as the Creative Problem Solving (CPS) framework (Isaksen, Dorval, & Treffinger, 2011). CPS was initially developed by Alex Osborne and described in his book, *Applied Imagination* (Osborn, 1963). In its current form, there are four components of

CPS—Understanding the Challenge, Generating Ideas, Preparing for Action and Planning Your Approach (Isaksen et al., 2011). Therefore, generating ideas (ideation) is meaningful only with understanding the challenge, and not out of the context of any particular problem or challenge. Understanding the challenge involves framing the problem—generating many varied and unusual ways to state the problem, as well as selecting and forming a specific problem statement (Isaksen et al., 2011). In other words, identifying and clarifying the problem is essential for meaningful ideation. Exploring data is another aspect of Understanding the Challenge (Isaksen et al., 2011). At this stage, information is gathered, connections and new functions are visualized, and sometimes rules are broken.

By far, brainstorming is the most well-known approach for generating ideas. Alex Osborn, who was an advertising executive, was frustrated at employees' inability in idea generation for ad campaigns. By holding group thinking sessions, he found an increase in the quality and quantity of ideas produced by employees. (Osborn, 1963) Though the term "brainstorming" has come into popular use, brainstorming is also widely studied in academia (see for example Mongeau and Morr (1999), Toubia (2006), Korde and Paulus (2017)). There have been comparisons of face-to-face brainstorming with electronic brainstorming, the latter of which refers to brainstorming over a network of linked computers. The interconnectivity and interdependency within such networks provide a platform for individuals and groups to come together for the exchange of ideas. Ideas generated by each member of electronic brainstorming are distributed to the entire network. A large electronic brainstorming group has the benefit of providing anonymity for each member, thus alleviating the fear of each member for being judged for his or her ideas (Mongeau & Morr, 1999).

Solitary idea generation by individuals also has its merit. However, it has been found that the best ideation process is a hybrid of both individual and group ideation (Korde & Paulus, 2017). Therefore, teams should dedicate time for individual reflection and ideation as well as time for coming together for the synergy of ideas to produce innovative solutions to problems.

Habit of practice 3: Prototyping

A prototype is "an approximation of a product (or system) or its components in some form for a definite purpose in its implementation"(C. K. Chua, Leong, & Lim, 2010). Prototypes can be virtual (e.g., a computer-aided design model) or physical; they can be physically scaled and/or functionally scaled; and they can use materials that are similar to or different from the final design (Christie et al., 2012). Prototyping is the process of actualising the prototype.

Prototypes play a number of roles in the product development process (C. K. Chua et al., 2010). Prototypes can aid the thinking and experimental phase where questions and doubts about the product are addressed by building and studying the prototypes. In addition, practitioners can test and prove ideas and check if they work as intended (i.e., for evaluation and validation). Prototypes also serve to communicate information and demonstrate ideas to the intended audience. Further, companies also use prototypes to help schedule the development of a product. Therefore, prototyping is an important part of the product development process of companies, which enables ideas to be translated into action. In addition to having an impact on the business aspects of product development, prototyping also has psychological effects on the design team. In a grounded-theory study of how "low-fidelity" prototyping impacts the psychological experience of a design team in a high-tech company, it has been found that "the production and rapid visualisation of multiple ideas through low-fidelity prototyping allows practitioners to reframe failure as an opportunity for learning, supports a sense of forward progress, and strengthens beliefs about creativity ability." (Gerber & Carroll, 2012) Therefore, prototyping is intricately linked to innovation, creative thinking and value creation, what we have identified previously as being crucial for the future of Singapore. Developing the habit of prototyping in learners while they are still in school is hence necessary, to prepare them for the future landscape of Singapore.

In a study involving a middle school classroom in the United States, students made prototypes out of simple materials of how they wanted their school compound to be. It was found that "prototyping can be a powerful classroom tool to engage students quickly and does not focus

on perfection" (Carroll et al., 2010). The students understood that the focus was on rapid development and not on trying to be perfect. It was important to fail early and often during the prototyping process, learning what works and what does not, and then modify and iterate based on feedback. According to Carroll et al. (2010), prototyping is a way to convey an idea quickly, and the more ideas that one can come up with, the more one can learn. Also, flexibility enables one to make rapid changes and learn along the way. (Carroll et al., 2010)

Technology can be suitably used for prototyping in schools. In addition to the benefits of prototyping as mentioned above, there is the additional value of exposing students to design, technology adoption and digitalization, what we have identified previously as some of the skills required for Singapore's future landscape. The use of 3D printing for prototyping in schools is a case in point (Lacey, 2010). It challenges students to use CAD (computer-aided design) software to design models and operate a sophisticated piece of equipment (a 3D printer) to realise their prototype. In doing so, the adoption of technology as well as digitalisation for creative problem solving is emphasised. During each stage of prototyping process, students also engage in critical thinking and logical reasoning.

In short, prototyping fosters creativity, innovation, value creation, technology adoption and digitalisation, as well as develops initiative and a spirit of enterprise in teams and individuals. All these are desirable to prepare learners for the future landscape of Singapore. The literature on innovation clearly identified that tolerance of failure is critical in motivating innovation (Hellmann, & Thiele, 2008, Manso, 2008). Prototyping to a certain extent, mitigates the fear of failure on a large scale because it allows the learner to experiment, encounter failure, and relearn without incurring huge loss.

Habit of practice 4: Entrepreneurship

Our mission is to help people enjoy their lives. We remove the frustrations of eating out by providing contextual discovery, and improve dining experiences by connecting customers and merchants through meaningful feedback.

—Burpple's Mission Statement

Perhaps nothing captures the idea of Entrepreneurship more than the original French root word for “entrepreneur” which roughly translates to an adventurer (Carlen, 2016). Having little to none natural resources, Singapore’s economic growth is dependent on innovative macroeconomic approaches (Anthony, 2015). Yet, much of the entrepreneurship in the past were in the form of low tech SMEs (Small-Medium Enterprises) (W.-L. Tan & Lee, 2002). Though these SMEs still employ two thirds of the Republic’s workforce and contribute significantly to its GDP (Infocomm Media Development Authority, 2019), much of the SMEs, born in the yesteryears, have been hampered with problems of the 21st century, being absent of the modern entrepreneurial mindset and failing to embrace modern technology (Joshi, 2019). Indeed, 21st century should beget 21st century entrepreneurship (Robehmed, 2013). Over the span of less than a decade, Singapore has reinvented itself into an entrepreneur hub with exciting start-up companies (Anthony, 2015).

The new entrepreneurship is one motivated not out of necessity (Urban, 2010). This is so especially when a developed economy like Singapore would be relying on High Value Manufacturing in the age of the fourth industrial revolution (Livesey, 2006). Over the years, various literature have explored the Entrepreneurial Cognition (Michell et al., 2002; Urban, 2010). According to these literature, entrepreneurs should have highly developed behavioural scripts relating to opportunity seeking, commitment tolerance and opportunity pursuit (Mitchell, Smith, Seawright, & Morse, 2000). Through these skills, entrepreneurs are able to piece together previously unconnected information which would enable them to create new products or services (Michell et al., 2002). As such, the new entrepreneurship model should be one that is motivated to solve problems of the day through new products and services. This is essentially future value proposition. By predicting the demands for the solutions of today’s problems and by increasing the value of the current dominant products, an entrepreneur would be able to create the next revolution in the market and thereby creating lasting change (Jeffries, 2017).

In addition to Entrepreneurial Cognition, in a multi-cultural hyper-globalised 21st Century, entrepreneurship would also require excellent communication abilities. This communication ability would not just be in

the form of interpersonal communication, which is by itself something of a much-needed skillset. This communication ability would be in the form of intercultural communication. Communication skills are more than just language proficiency, and this is especially so for intercultural communication. According to Alexandru (2012), various factors that makes inter-cultural communication challenging are the different initial source of knowledge, divergent models of interpretation, divergent systems of reference, different contextualisation indexes, and different communication styles. Although inter-cultural communication is difficult, it is not impossible. To communicate effectively between cultures, one would require cultural and contextual knowledge and sensitivity and motivation and flexibility in communicating (Alexandru, 2012).

The growing importance of networks and network concepts in society in the 21st century is driving new forms of economic production. Karlsson and Westin (1994) attributes this importance of networks to the following:

- Increased intensity and complexity of human interaction
- Decreasing importance of geographical territory as a determinant of accessibility
- Failure of markets as a means to solve inter-firm relations when customised commodities are developed in complex environments.

Karlsson and Westin (1994) further elaborated that the fundamental force behind entrepreneurs who create “new accessibility” and growth of complexity is found in technologies and platforms of communication and information systems. These *entrepreneurs* belong to networks that complement collective learning obtained through interactions and the evolvement of new networks of connections that open new economic possibilities.

Habit of practice 5: Inter-cultural Acumen

Race, language and religion have been fundamental issues since the beginning of Singapore’s nationhood, and Singapore’s founding fathers enshrined their vision of a multiracial and multi-religious society in the Republic’s Constitution.

—Madam Halimah Yacob (Rui, 2019)

In her recent visit to China, Singapore's President Madam Halimah Yacob, when interviewed by People's Daily, explained that Singapore's success at multiculturalism is not achieved by chance but by hard work and deliberate policies based on the rule of law, meritocracy, justice and equality (Rui, 2019). She has also said that multicultural harmony will always be a work in progress for Singapore (Siong, 2019). Indeed, and as previously described in the paper, Singapore's multiculturalism is achieved through carefully crafted policies and decades of relentless work. As Singapore looks to immigration to offset its falling birth-rate, its demographics will inevitably change and as a result, as a nation, it will become more multiracial and multicultural than it has been. The need for inclusivity of diversity will be an increasingly valuable trait for Singapore in the future.

Fairness, Openness, Cooperativeness, Supportiveness and Empowerment are five factors that promote inclusivity (Stewart, 2018; Vaughn, N.D.). Nishii (2013) shows that in an inclusive society, the perceived fairness of treatment is extremely important. Preferential treatments to improve the historically disadvantaged groups have caused resentments or backlash from communities who were not on the receiving end of such treatment (Fiol, Pratt, & O'Connor, 2009). Singapore has implemented the policies of meritocracy and equality in order to avoid the issues documented in preferential treatments. These two policies have provided the community with a basis for multicultural harmony with opportunities available for all of its citizens regardless of his/her demographical background (Noor & Leong, 2013).

Working together towards a common goal and to solve shared problems through participative decision making, people are able to look beyond the stereotypes that would otherwise be placed on individuals of diverse backgrounds (Ensari & Miller, 2006). As a land with very little natural resources, Singapore, for the better part of its independence, has struggled to survive. It was through hardships which its citizens come together that Singapore has miraculously elevated itself from a regional backwater to one of the richest countries in the world. It was these hardships that had precisely been the catalyst that allowed its citizens of diverse backgrounds to bond together as they have endured the "shared problems" and have worked towards "a common goal" (K. Ng, 2017).

Intercultural communication requires one to invest effort in making sure that one gets beyond the stereotypical image of 'the other' and know the person as an individual. This would require more than just sharing the same language as language only forms part of the communication. As mentioned in the preceding section, other factors such as cultural contexts, influence communication greatly (Alexandru, 2012). Communication is, after all, the gateway to understanding another. The need for good inter-cultural communication is, thus, necessary for inclusivity and multiculturalism. While the traits mentioned in the previous paragraphs are more shaped by policies and environments which are macro factors, this is a more personal micro trait. As such, the capacity and ability for inter-cultural communication, such as the capacity of understanding cultural differences and the capacity of assuming perspectives belonging to other culture would be crucial in an inclusive multicultural Singapore.

As Singapore becomes more culturally and ethnically diverse through immigration, its citizens need to be even more aware of inclusivity not just as a habit but as a way of life. Singapore needs to continue to be a fair and open country that offers avenues for cooperation amongst its people through support and empowerment.

One of the challenges that Singapore would face that would affect its multiculturalism would be online falsehoods. Online falsehood, or colloquially known as "fake news", first came under international spotlight during the 2016 American Presidential Elections. In the investigations that ensue, it was found that most of these fake news were divisive in nature and intent to disunite and polarise the country (Solon & Levin, 2017). Just as it had happened in the United States, it has happened in Singapore (Infocomm Media Development Authority, 2019b). According to national statistics, more than three-quarter of Singaporeans have come across fake news on WhatsApp and Facebook (Ministry of Communications and Information, 2018). What is perhaps more concerning is that only 50% of the citizens polled said that they were confident with their own ability of recognising fake news and more than two-third felt that most Singaporeans would not be able to recognise fake news. The competence to discern fake news requires deep inter-cultural acumen where understanding of different cultures

can only be achieved through deeper interactions and engagement. Future citizens must readily seek to understand the implications of the differences and the skills required to act and decide appropriately and in a culturally sensitive way.

Singapore's ruling party, the People's Action Party, has recently passed the controversial Protection from Online Falsehoods and Manipulation Bill in the parliament as a remedy attempt against fake news (Tham, 2019). This was done much to the chagrins of the West, including tech giants such as Google and Facebook (Toh, 2019) who view the law as an attempt of stifling the freedom of expression. The jury for the effectiveness of this new law is still up for debate. Media literacy is another way of combating against fake news (Burkhardt, 2017). As the adage goes, "Do not believe everything you see on the internet", by being aware of fake news and by being educated on media literacy, one would be prevent the spread of fake news rather than trying to cure it using laws and regulations which may be abused in the hands of people with ill intentions. Singapore has set up media literacy sites such as IMDA in an attempt to educate its citizens on digital and online literacy (Infocomm Media Development Authority, 2020). This form of literacy would be astronomically important for the future of Singapore, including and not limiting to the area of multiculturalism. After all, another adage says, "Prevention is better than cure".

Habit of practice 6: Passion

From Tiger Woods in the field of sports to Steve Jobs in the field of technology, individuals displaying excellence in their chosen fields continue to awe and inspire us. Such high-level performance can only be achieved and sustained through a lifetime of dedication to the chosen craft. Passion, we believe, is the driving force behind such persistence, which enables individuals to be fully immersed in their activity and to persist in the face of obstacles.

In the field of psychology, "passion" has been defined as "a strong inclination toward an activity that people like, that they find important, and in which they invest time and energy." (Vallerand et al., 2003) An important aspect of passion is that the activity is part of a person's identity. For example, a person who loves playing the violin does not

merely “play the violin”, but is a “violinist”. Playing the violin is part of the person’s identity and he or she engages in it regularly. The person practices the violin for hours daily, talks about it with friends, joins an orchestra and finds meaning and purpose in doing these things. The way the activity is internalised into the person’s identify takes on two distinct forms. According to Vallerand et al. (2003), the first form is “harmonious passion” and the second form is “obsessive passion”. Harmonious passion stems from an “autonomous internalisation”, where the person freely chooses to engage in the activity for the sake of pleasure and without external or internal pressure. The person is not compelled to do the activity but rather chooses to do so freely. On the other hand, obsessive passion originates from a “controlled internalisation”, where there are certain contingencies attached to the activity, such as social acceptance from teachers and peers, or feelings of excitement or self-esteem. These external or internal pressures causes the activity to control the person’s life and create conflicts with other aspects of the person’s life. Harmonious passion has been found to be positively correlated with subjective well-being while obsessive passion was either unrelated or negatively related to it (Vallerand et al., 2007). In a way, harmonious passion can be thought of as being healthy while obsessive passion can be considered unhealthy. (Peterson, 2010). The cultivation of harmonious passion is what we advocate for learners.

So why is passion important for the future landscape of Singapore? We have previously identified mastery of learning as one of the future values required of learners. Passion is the stimulus that allows people to engage in deliberate practice continuously and relentlessly, enabling them to improve their skills in the specific domain and eventually achieving mastery (Bonneville-Roussy, Lavigne, & Vallerand, 2011). Also, passion plays an important role in lifelong, life-wide and life-deep learning, another of the future values that we have identified. Passion for learning is the fuel that enables one to keep learning throughout life, in spite of all the roadblocks and difficulties encountered over an entire lifetime. Passion enables the learner to accept failure as part of learning. Without a passion for learning, a person will succumb to difficulties and failures and will eventually give up.

Harmonious passion has also been linked to innovation (Shi, 2012), another of the future values that we have identified. Shi (2012) found that the employees in their study who had harmonious passion for their jobs had a heightened cognitive state, and put in greater cognitive energy into their work. It is this cognitive state of engagement that eventually translates passion into innovative behavior. With the emphasis on innovation for the future of Singapore, cultivating passion in learners is therefore important.

In short, passion is important for mastery of learning, lifelong, life-wide and life-deep learning and innovation—all of which are crucial for Singapore's future.

Summary

The following table summarises the foregoing discussion on habits, their practices, and their relation to future-ready learning, lifework and living.

To summarise, developing the above habits in learners is crucial to prepare learners for the evolving realities of the future landscape of Singapore. To be successful, an education system has to take on a long-term view of educational outcomes and prepare future-ready individuals who are able to thrive in, and contribute to, the changing

Habit	**Practices**	**Habits of practices associated with future-ready learning, lifework, and living**
1. Inquisitiveness	• Ask various kinds of questions to self and others (higher order questions, metacognitive questions etc.), which helps individuals make meaning, reflect and learn • Being curious	• Mastery of learning • Life-long, life-wide, life-deep learning • Innovation • Creative thinking

(continued)		
2. Ideation	• Respond to stimulus and context-dependent and can be through serendipity • Requires understanding of assumptions of practices and paradigms • Define, clarify, and reframe problems • Challenges the status quo • Adopt a wide repertoire of approaches to ideation that leverages on physical and virtual networks • Adopt analytics to answer big questions	• Innovation • Creative thinking • Critical thinking • Value creation • Mastery of learning • Technology adoption • Networks
3. Prototyping	• Translate ideas into action • Evaluate, verify and communicate ideas and possibilities • Allows iteration for feedback – learning from failures • Test possibilities, challenges, and potential spin offs	• Innovation • Creative thinking • Value creation • Technology adoption • Digitalization • Logical reasoning (critical thinking) skills
4. Entrepreneurship	• Seeks opportunities and pieces together information that were previously unconnected • Develops new products and services that capture new markets/users • Creates new uses • Occurs in a stimulating environment where diversity, multi-cultural, and differences exist	• Value creation • Technology adoption • Innovation • Digitalization • Critical thinking • Networks

(continued)		
5. Inter-cultural acumen	• Accepts diversity of values, ethnicity, and religions • Manage conflicts and seek optimal solutions • Cultivate networks of collaboration and deepen ties and friendship • Decipher false information from real in a digitalized landscape	• Tolerance • Mutual understanding • Mutual respect • Logical reasoning (critical thinking) skills • Rootedness • Information assessment literacy
6. Passion	• Full immersion in activity and persistence in the face of obstacles • The passionate activity becomes part of a person's identity • Finds meaning and purpose in the activity • Accepts failure as part of learning	• Mastery of learning • Life-long, life-wide, life-deep learning • Innovation

Table 4. *Habits, their practices, and their relation to future-ready learning, lifework and living.*

landscape of Singapore. Preparation of individuals for the three purposes of education—learning, lifework, and living—has to be viewed through a future lens; and learning outcomes need to be aligned with the trajectories and dynamics of the future of Singapore. The future is context-situated and context-dependent; and in this paper, we have provided a discussion on how the future economic, social and environmental contexts of Singapore require some specific future skills, knowledge and values of individuals, which can be developed and expressed through particular habits of practices.

All these imply that practices cannot remain unchanged and unchallenged in the new realities that emerge. Teaching and learning practices need to be aligned to new and evolving realities of purposes, time and context. The school environment and its teaching and learning practices must shift to foster beneficial habits of practices in learners that will prepare them to actively contribute to a sustainable future. In addition to instructional objectives, there has to be alternative inquiry methods and practices of teaching and learning. With better and more relevant teaching and learning practices, we can then nurture individuals who are truly life-long, life-deep and life-wide learners, who can actively co-create and shape the future of Singapore. The National Institute of Education (NIE) in Singapore has adopted these three “lifes”, as well as life-wise learning, as a four-life model in its strategic vision to guide the development and design of learning technologies to prepare future-ready learners. (National Institute of Education, 2019) This four-life model is the research agenda of the Office of Education Research (OER) in NIE, to develop future-ready learners who will be able to cope in a world associated with "Volatility, Uncertainty, Complexity and Ambiguity." By emphasising these four aspects of learning, the agenda shifts the pedagogical emphasis from preparing for performance in high-stakes assessments to preparing for the future through purposeful learning. (Office of Education Research, 2020).

Appendix: Summary of Reviews by Experts

1.	**Anthony Mackay** CEO and President of the Washington DC based National Center on Education and the Economy. Chair of the Australian Council for Educational Research, Deputy Chancellor Swinburne University, Melbourne and Deputy Chair of New Zealand's Education Council 4 Sep 2019	Framework is highly relevant, strategic, and useful. It is at the forefront of international thought leadership It is a conceptually robust framework reflecting and informed by – but going beyond – a growing body of international work in this field Having established the purposes of schooling (learning/working/living) & the vital significance of time (past/present/future) the Framework makes clear the crucial importance of contexts (economic / social / environmental) and the integral role of technology in each context. The analysis is powerful & persuasive. Proposed additional points to be considered to strengthen the framework: Learning Sciences, AI, and Learner agency"
2.	**Philip Hallinger** TSDF Chair Professor of Leadership College of Management, Mahidol University Thailand 1 Dec 2019 *Hallinger is widely known as the 'father' of Instructional Leadership	…it produced a new, original and significant contribution to our thinking about the role of education in lifelong learning for innovation and sustainability. I appreciated the way that you synthesized knowledge from the sustainability, innovation and human learning literatures. It is very mature work of which you should be very proud. I found that your conceptualization is very consistent with Singapore's aspirations of producing thought leadership.

3.	**George Siemens** Professor and the Executive Director of the Learning Innovation and Networked Knowledge Research Lab at University of Texas, Arlington and cross-appointed with the Centre for Distance Education at Athabasca University. NIE 14th CJ Koh Professor, Professor and Director, Centre for Change and Complexity in Learning at the University of South Australia 12 Oct 2019	The framework is a solid and complete model to understanding both learning and the settings in which it happens. The emphasis on understanding the context of learning is particularly useful. Each of the dimensions capture an aspect of the learning process and the integrated way in which the overall model operates will have an impact in raising student performance. My only suggestion is build in specific practices to listen to what the data says about the performance of the model as a whole. Where you start won't be as important as where you end up. When you build in processes and practices of capturing and evaluating data, you'll have a way to guide subsequent iterations
4.	**Ken Leithwood** Professor Emeritus, University of Toronto 5 Sep 2019 * Leithwood is widely known as the 'father' of Transformational Leadership in Education	I read the two pieces you sent me. Very impressive work. Congratulations. No doubt many jurisdictions will want to build on this for their own purposes.

5.	**Jennifer Davies**
	
	Dean, Association of Independent Schools (AIS) Leadership Centre New South Wales, Australia
	
	11 Sep 2019
		I am drawn to David's summary of the skills, knowledge and values required for future ready leadership which appear consistent across countries, together with his aspirational and erudite paper *"Defining educational success: The time continuum for leadership learning"* (2019).
		
		…I would share with you an outcome of your paper in helping our team forge a new direction for the way forward with our work *(programs)*.
		
		• This involves the commencement of a future focussed strategic initiative – an 11 month strategically aligned project focused on preparing future ready leaders for future ready learners. In preparing aspirant principals to do this work we:
		  • build the narrative about the purposes of schooling, that is sensitive to context at a local and global level, aware of time and proportioning learning against this continuum to enable to purpose of schooling to be accomplished.
		  • lead the development of their future focused strategic initiative (FFSI) through collaborative, agile processes using innovation methodology – in particular, the Theory of Change, presented to us by from the Innovation Unit UK.

6.	**Global Ed Talk** National Center on Education and the Economy, Washington DC, USA. 18 Oct 2019	Interview: In this Global Ed Talks interview, Anthony Mackay sits down with David Ng, associate professor and head of academic quality at the National Institute of Education (NIE) in Singapore, to discuss leadership learning and leadership development for a successful education system. Ng defines a successful education system as one that is able to graduate students who are future-ready, meaning they are able to thrive in a changing society and environment, take on future life work and continue to learn beyond graduation. http://ncee.org/2019/10/global-ed-talks-david-ng/ An inside look at Singapore's Education System Building the Nation Builders: How Singapore Supports Its World-Class Teaching Profession features the voices of the teachers and leaders who propel Singapore's world-class education system forward. Their perspectives provide new texture and understanding of how to foster successful teaching and learning and at the same time build rewarding and desirable career trajectories for the professionals that make it all possible. http://ncee.org/2019/10/building-the-nation-builders/

7.	**International Leadership Centres**	Future-ready Learners' framework has been adopted by International Educational Leadership Centres (IELC) for redesigning educational leadership programmes IELC includes: NCEE (USA), Bastow Institute (Australia), Three Nations Leadership Network (Scotland, Ireland, Wales), AISNSW Leadership Institute (New South Wales), Ontario Principals' Council (Canada), New Zealand Teaching Council, Australia Institute for Teaching and School Leadership, Hong Kong. The concepts related to the above framework and my work on complexity learning were part of a common set of agenda accepted by a network of International Educational Leadership Centres. The agenda includes: • Complexity • Future ready learners • Future ready leaders • Future ready learning organizations • Enabling environments mediating leaders • Future ready leadership learning
8.	**Toby Greany** Professor of Education School of Education University of Nottingham UK 12 Mar 2020	I think it is excellent. Several of the earlier reviewers noted the sophistication with which you ground your analysis in the current context of Singapore, and the economic, demographic, socio-cultural, and environmental challenges that it faces today and in the future. I would agree that this analysis is very strong – though I can also see how universal many of these issues are, even if they play out somewhat differently in different national contexts. This means that I also see huge value in your assessment of the learning and educational opportunities that Singapore faces – since so many of these are also universal.

8.		The framework itself is cogent and persuasive – I particularly like the way in which the six habits are articulated and related back to the concept of lifelong, life-wide, and life-deep learning. One of the strengths of the habits approach you adopt is that it is possible to glimpse how they could be developed and applied in the context of formal education – so your work on a machine learning approach to assessment is particularly exciting – I look forward to hearing more! A few thoughts on areas where I had questions: • Leadership and agency – several of the habits could be seen as geared towards developing individual agency (through passion, entrepreneurial skills etc), but the need for developing such agency among the young people of today is not drawn out as much it could be. I would argue that such agency is critical in a time when societies are arguably becoming more atomised and individuals can so often feel powerless to effect change. This has important implication for how educators might need to reconceptualise their own roles – for example, Annelies can say more about the work she is doing in NZ on developing student leadership. • Technology – you say a lot about this, and your points on fake news etc are very strong. One area I am interested in is the extent to which the amount of time that young people spend online is increasing exponentially across PISA nations. As yet we don't know enough about how this relates to areas such as mental well-being and the development of interpersonal skills, but I am certainly trying to develop the habit of self-regulation in this area in my own children! • Finally, I like your section on mastery, but I wondered how you see this fitting with the need for specialist knowledge, skills and expertise in specific subject areas? Here in England there is a strong neo-trad movement away from 21st century skills and towards traditional subject teaching and disciplines, with a parallel push for schools to be more explicit about their curriculum intent/design. The drivers of this are partly the same as yours – a rejection of assessment outcomes as the be all and end all of education, but the direction of travel is obviously very different. I am struck how often parents/the media/wider public have also rejected efforts to develop 21st century skills approaches (eg in Netherlands, Canada etc). Where do you see all this fitting?

References

Atkinson, J. W. (1957). Motivational determinants of risk-taking behavior. *Psychological Review, 64,* 359–372.

Alexandru, F. (2012). The Context of Developing Intercultural Communicative Competence. *Euromentor Journal, 3*(1), 35–53.

Anthony, S. D. (2015). How Singapore Became an Entrepreneurial Hub. Retrieved from https://hbr.org/2015/02/how-singapore-became-an-entrepreneurial-hub 7/6/19

Arnett, J. J. (2002). The Psychology of Globalization. *American Psychologist, 57*(10), 774–783.

Banks, J. A., Au, K. H., Ball, A. F., Bell, P., Gordon, E. W., Gutiérrez, K. D., . . . Zhou, M. (2007). *Learning in and out of school in diverse environments: Life-long, Life-wide, Life-deep:* The LIFE Center (The Learning in Informal and Formal Environments Center) and the Center for Multicultural Education, University of Washington, Seattle.

Baregheh, A., Rowley, J., & Sambrook, S. (2009). Towards a multidisciplinary definition of innovation. *Management Decision, 47*(8), 1323–1339.

Beh, S. G. (2017). Singapore's long game in innovation. Retrieved from https://www.edb.gov.sg/en/news-and-resources/insights/innovation/singapores-long-game-in-innovation.html 1 April 2019

Bell, P., Lewenstein, B., Shouse, A. W., & Feder, M. A. (2009). *Learning Science in Informal Environments: People, Places, and Pursuits.* Washington DC: National Academies Press.

Bonneville-Roussy, A., Lavigne, G. L., & Vallerand, R. J. (2011). When passion leads to excellence: the case of musicians. *Psychology of Music, 39*(1), 123–138.

Bowman, C., & Ambrosini, V. (2000). Value Creation Versus Value Capture: Towards a Coherent Definition of Value in Strategy. *British Journal of Management, 11*(1), 1–15.

Brennen, S., & Kreiss, D. (2014). Digitalization and Digitization. Retrieved from http://culturedigitally.org/2014/09/digitalization-and-digitization/ 4 July 2019

Building and Construction Authority. (2018). Super Low Energy Building Technology Roadmap. Retrieved from https://www.bca.gov.sg/GreenMark/others/SLE_Tech_Roadmap.pdf 7 May 2019

Burkhardt, J. M. (2017). Combating Fake News in the Digital Age. *Library Technology Reports, 53*(89), 29–33.

Carlen, J. (2016). *A Brief History of Entrepreneurship: The Pioneers, Profiteers, and Racketeers Who Shaped Our World.* New York, NY: Columbia University Press.

Carroll, M., Goldman, S., Britos, L., Koh, J., Royalty, A., & Hornstein, M. (2010). Destination, Imagination and the Fires Within: Design Thinking in a Middle School Classroom. *The International Journal of Art & Design Education, 29*(1), 37–53.

Catts, R., & Lau, J. (2008). Towards Information Literacy Indicators. Retrieved from https://unesdoc.unesco.org/ark:/48223/pf0000158723

CFE. (2017). *Report of the Committee on the Future Economy - Pioneers of the Next Generation.* Retrieved from Singapore https://www.mti.gov.sg/-/media/MTI/Resources/Publications/Report-of-the-Committee-on-the-Future-Economy/CFE_Full-Report.pdf

Chan, F. (2015, 12 April 2015). DPM Tharman: Look outward to hit Asia's full potential. *The Sunday Times.* Retrieved from https://ifonlysingaporeans.blogspot.com/2015/04/dpm-tharman-look-outward-to-hit-asias.html

Channel NewsAsia. (2018, 9 February). 'A fight for the hearts and minds': K Shanmugam on addressing radical content online. Retrieved from https://www.channelnewsasia.com/news/singapore/a-fight-for-the-hearts-and-minds-k-shanmugam-on-addressing-9945742

Cheng, K., & Chua, J. X. T. (2017). Debate over CMIO model as diversity grows. *Today.* Retrieved from https://www.todayonline.com/singapore/debate-over-cmio-model-diversity-grows 12 April 2019

Chin, C. (2002). Student-Generated Questions: Encouraging Inquisitive Minds in Learning Science. *Teaching and Learning, 23*(1), 59–67.

Chin, C. (2004). Students' questions: Fostering a culture of inquisitiveness in science classrooms. *School Science Review, 86*(314), 107–112.

Chin, C., & Brown, D. E. (2002). Student-generated questions: a meaningful aspect of learning in science. *International Journal of Science Education, 24*(5), 521–549.

Christie, E. J., Jensen, D. D., Buckley, R. T., Menefee, D. A., Ziegler, K. K., Wood, K. L., & Crawford, R. H. (2012). *Prototyping strategies: literature review and identification of critical variables.* Paper presented at the 2012 ASEE Annual Conference & Exposition, San Antonio.

Chua, A. (2018, 2 March). Social cohesion could be compromised if S'poreans are swayed by divisive falsehoods: Dr Maliki. *Today.* Retrieved from https://www.todayonline.com/singapore/social-cohesion-could-be-compromised-if-sporeans-let-themselves-swayed-divisive-falsehoods

Chua, C. K., Leong, K. F., & Lim, C. S. (2010). *Rapid Prototyping: Principles and Applications (3rd Ed.).* Singapore: World Scientific.

Comunian, R. (2011). Rethinking the Creative City: The Role of Complexity, Networks and Interactions in the Urban Creative Economy. *Urban Studies, 48*(6), 1157–1179.

Csikszentmihalyi, M. (2013). *Creativity: The Psychology of Discovery and Invention.* New York: HarperCollins.

Davie, S. (2016, 6 December 2016). Singapore students top in maths, science and reading in Pisa international benchmarking test. *The Straits Times.* Retrieved from https://www.straitstimes.com/singapore/education/singapore-students-top-in-maths-science-and-reading-in-international

Day, C., Sammons, P., Hopkins, D., Harris, A., Leithwood, K., Gu, Q., . . . Kington, A. (2009). The Impact of School Leadership on Pupil Outcomes. Retrieved from https://dera.ioe.ac.uk/11329/1/DCSF-RR108.pdf

Department of Statistics. (2019). Population and population structure. Retrieved from https://www.singstat.gov.sg/find-data/search-by-theme/population/population-and-population-structure/latest-data 11 April 2019

Department of Statistics Singapore. (2019a). Retrieved from https://www.singstat.gov.sg/modules/infographics/economy 21 Feb 2019

Department of Statistics Singapore. (2019b). Singapore Economy. Retrieved from https://www.singstat.gov.sg/modules/infographics/economy 27 March 2019

Dyer, J., Gregersen, H., & Christensen, C. M. (2011). *The Innovator's DNA.* Boston: Havard Business Review Press.

EDB Singapore. (2014). 1965-2014: Industrial Development in Singapore. Retrieved from https://www.edb.gov.sg/content/dam/edb/en/news%20and%20events/News/2014/SBN_Report_Images/national-day-infographic/0828_EDB%20NationalDay.pdf 1 April 2019

EDB Singapore. (2019). Five Focus Areas to Drive Investment Commitments in 2019. Retrieved from https://www.gov.sg/~/sgpcmedia/media_releases/edb/press_release/P-20190214-1/attachment/EDB%20YIR%202018%20-%20Media%20Release.pdf 1 April 2019

Ennis, R. H. (1985). A Logical Basis for Measuring Critical Thinking Skills. *Educational Leadership, 43*(2), 44–48.

Ensari, N., & Miller, N. (2006). The application of the personalisation model in diversity management. *Group Processess and Intergroup Relations, 9,* 589–607.

ERI@N. (2019). Energy Research Institute @NTU. Retrieved from https://erian.ntu.edu.sg/Pages/Home.aspx 7 May 2019

Ernstson, H., Leeuw, S. E. v. d., Redman, C. L., Meffert, D. J., Davis, G., Alfsen, C., & Elmqvist, T. (2010). Urban Transitions: On Urban Resilience and Human-Dominated Ecosystems. *AMBIO, 39*(8), 531–545.

Fiol, C. M., Pratt, M. G., & O'Connor, E. J. (2009). Managing intractable indentity conflicts. *The Academy of Management Review, 34*(1), 32–55.

Gerber, E., & Carroll, M. (2012). The psychological experience of prototyping. *Design Studies, 33*(1), 64–84.

Graesser, A. C., & Person, N. K. (1994). Question Asking During Tutoring. *American Educational Research Journal, 31*(1), 104–137.

Griffin, M. L. (2003). Using Critical Incidents to Promote and Assess Reflective Thinking in Preservice Teachers. *Reflective Practice, 4*(2), 207–220.

Guskey, T. R., & Anderman, E. M. (2013). In Search of a Useful Definition of Mastery. *Educational Leadership, 71*(4), 18–23.

Häkkinen, P., Järvelä, S., Mäkitalo-Siegl, K., Ahonen, A., Näykki, P., & Valtonen, T. (2017). Preparing teacher-students for twenty-first-century learning practices (PREP 21): a framework for enhancing collaborative problem-solving and strategic learning skills. *Teachers and Teaching, 23*(1), 25–41.

Hall, R. (2009). Towards a Fusion of Formal and Informal Learning Environments: the Impact of the Read/Write Web. *Electronic Journal of e-Learning, 7*(1), 29–40.

Hansen, M. T., & Birkinshaw, J. (2007). The Innovation Value Chain. *Havard Business Review, June 2007,* 121–130.

Hardasmalani, R. (2016, 22 Feb). How would you interpret the term 'value-creating economy'? *Today.* Retrieved from https://www.todayonline.com/business/how-would-you-interpret-term-value-creating-economy

Hardy, J. H., Ness, A. M., & Mecca, J. (2017). Outside the box: Epistemic curiosity as a predictor of creative problem solving and creative performance. *Personality and Individual Differences, 104,* 230–237.

Heng, S. K. (2016). *Budget 2016.* Retrieved from Singapore: https://www.singaporebudget.gov.sg/data/budget_2016/download/FY2016_Budget_Statement.pdf

Heng, S. K. (2017). *Budget 2017.* Retrieved from Singapore: https://www.singaporebudget.gov.sg/data/budget_2017/download/FY2017_Budget_Statement.pdf

Heng, S. K. (2018). *Budget 2018.* Retrieved from Singapore: https://www.singaporebudget.gov.sg/data/budget_2018/download/FY2018_Budget_Statement.pdf

Heng, S. K. (2019). *Budget 2019.* Retrieved from Singapore: https://www.singaporebudget.gov.sg/docs/default-source/budget_2019/download/pdf/fy2019_budget_statement.pdf

Hommel, M., & Clarke, D. (2015). *Reflection and questioning in classrooms in different cultural settings.* Paper presented at the CERME 9 - Ninth Congress of the European Society for Research in Mathematics Education, Prague.

Immigrations and Checkpoints Authority. (2019). Applying to Stay. Retrieved from https://www.ica.gov.sg/application 15 April 2019

Infocomm Media Development Authority. (2019a). Factsheet – Helping SMEs in their digital journey through IMDA's SMEs Go Digital. Retrieved from https://www.imda.gov.sg/-/media/imda/files/industry-development/small-and-medium-enterprises/smes-go-digital/factsheet_smes-go-digital.pdf?la=en 22 March 2019

Infocomm Media Development Authority (2020). About IMDA. Retrieved from https://www.imda.gov.sg/Who-We-Are/about-imda

Infocomm Media Development Authority. (2019b). The Danger of Fake News. Retrieved from https://imsilver.imda.gov.sg/2019-danger-of-fake-news/

IPBES. (2019). *IPBES Global Assessment Summary for Policymakers (PDF) - Summary for Policymakers.* Retrieved from Germany: https://www.ipbes.net/sites/default/files/downloads/spm_unedited_advance_for_posting_htn.pdf

Isaksen, S. G., Dorval, K. B., & Treffinger, D. J. (2011). *Creative Approaches to Problem Solving: A Framework for Innovation and Change (3rd Ed.)*: SAGE Publications.

Jackson, N. (2012). Lifewide Learning: History of an idea. In *Lifewide Learning, Education & Personal Development e-book.*

Jeffries, I. (2017). Value Propositions of the Future. Retrieved from https://isaacjeffries.com/blog/2017/8/14/value-propositions-of-the-future 1/7/19

Jones, T. L., & Texas, L. A. (2017). *Strategic Journeys for Building Logical Reasoning, 9–12: Activities Across the Content Areas.* New York: Routledge.

Joshi, M. (2019). Challenges Faced By Singapore SME. Retrieved from https://www.msn.com/en-sg/money/topstories/challenges-faced-by-singapore-smes/ar-BBVImd3#page=2 7/6/19

Karlsson, C., & Westin, L. (1994). Patterns of a network economy: an introduction. In B. Johansson, C. Karlsson, & L. Westin (Eds.), *Patterns of a Network Economy.* Berlin - Heidelberg: Springer-Verlag.

Knafo, A., & Schwartz, S. H. (2004). Identity formation and parent-child value congruence in adolescence. *British Journal of Developmental Psychology, 22*(3), 439–458.

Koh, F. (2018, 18 October 2018). Singapore tops global index for food security. *The Straits Times.* Retrieved from https://www.straitstimes.com/singapore/singapore-tops-global-index-for-food-security

Koh, G. (2008, 10 September 2008). Developing a sense of rootedness. *The Straits Times.* Retrieved from https://lkyspp.nus.edu.sg/docs/default-source/ips/pa_gillian_st_developing-a-sense-of-rootedness_1009081.pdf 8 July 2019

Koh, T.-S., & Hung, D. W.-L. (2018). Leadership for Change in Singapore's Schools: An Introduction. In *Leadership for Change: The Singapore Schools' Experience*. Singapore: World Scientific.

Korde, R., & Paulus, P. B. (2017). Alternating individual and group idea generation: Finding the elusive synergy. *Journal of Experimental Social Psychology, 70,* 177-190.

Kwek, D., Hung, D., Koh, T. S., & Tan, J. (2017). *OER-CRPP Innovations for Pedagogical Change: 5 Lessons.* Singapore: National Institute of Education.

Lacey, G. (2010). 3D Printing Brings Designs to Life. *Tech directions, 70*(2), 17–19.

Lado, A. A., & Wilson, M. C. (1994). Human Resource Systems and Sustained Competitive Advantage: A Competency-Based Perspective. *The Academy of Management Review, 19*(4), 699–727.

Lai, L. (2019, 18 February). Singapore Budget 2019: $6.1b for Merdeka Generation package includes Medisave top-ups, higher Chas subsidies. *The Straits Times.* Retrieved from https://www.straitstimes.com/singapore/singapore-budget-2019-61-billion-for-merdeka-generation-package-includes-medisave-top-ups 11 April 2019

Lee, E. T. (2016). The Search for NEWater: The Singapore Water Story. In Y. S. Tan (Ed.), *50 Years of Environment.* Singapore: World Scientific.

Lee, L. Y. (2019, 18 March). Singapore's multi-religious harmony is 'exception rather than norm': ESM Goh. *Channel NewsAsia.* Retrieved from https://www.channelnewsasia.com/news/singapore/singapore-s-multi-religious-harmony-is-exception-rather-than-11356254

Lee, U.-W. (2015). Shift to value-creating economy is the way to go: Swee Keat. *The Business Times.* Retrieved from https://www.businesstimes.com.sg/government-economy/singapores-future-economy/shift-to-value-creating-economy-is-the-way-to-go-swee

Lepak, D. P., Smith, K. G., & Taylor, M. S. (2007). Value Creation and Value Capture: A Multilevel Perspective. *Academy of Management Review, 32*(1), 180–194.

Liang, K., Caton, K., & Hill, D. J. (2015). Lessons from the Road: Travel, Lifewide Learning, and Higher Education. *Journal of Teaching in Travel & Tourism, 15*(3), 225–241.

Libert, B., Beck, M., & Wind, J. (2016). *The Network Imperative: How to Survive and Grow in the Age of Digital Business Models.* Boston: Harvard Business Review Press.

Lim, J. (2015, 1 May 2015). More eating rice, with more choices now. *The Straits Times.* Retrieved from https://www.asiaone.com/singapore/more-eating-rice-more-choices-now 30 April 2019

Lim, M. Z. (2017, 21 October 2017). Singapore's largest wind turbine built on Semakau Island. *The Straits Times.* Retrieved from https://www.straitstimes.com/singapore/singapores-largest-wind-turbine-built-on-semakau-island 7 May 2019

Litman, J. A., & Spielberger, C. D. (2003). Measuring Epistemic Curiosity and Its Diversive and Specific Components. *Journal of Personality Assessment, 80*(1), 75–86.

Livesey, F. (2006). *Defining High Value Manufacturing.* Retrieved from Cambridge: https://www.ifm.eng.cam.ac.uk/uploads/Research/CIG/DefiningHVM.pdf

Loewenstein, G., Price, J., & Volpp, K. (2016). Habit formation in children: Evidence from incentives for healthy eating. *Journal of Health Economics, 45,* 47–54.

Low, I., & Rockell, T. (2017, 2 November 2017). Commentary: The future for Singapore's energy burns bright. *Channel NewsAsia.* Retrieved from https://www.channelnewsasia.com/news/commentary/commentary-the-future-for-singapore-s-energy-burns-bright-9366042 23 April 2019

Marsh, H. W. (1986). Global self-esteem: Its relation to specific facets of self-concept and their importance. *Journal of Personality and Social Psychology, 51*(6), 1224–1236.

Mathew, M. (2016, 12 August 2016). Managing Singapore's new diversities. *The Straits Times.* Retrieved from https://www.straitstimes.com/opinion/managing-singapores-new-diversities 15 April 2019

Mathew, M., & Khidzer, M. K. B. (2015). Preserving Racial and Religious Harmony in Singapore. In D. Chan (Ed.), *50 Years of Social Issues in Singapore.* Singapore: World Scientific.

Mathew, M., Lim, L., & Selvarajan, S. (2019). *Religion in Singapore: The private and public spheres.* Retrieved from Singapore: https://lkyspp.nus.edu.sg/docs/default-source/ips/ips-working-papers-33---religion-in-singapore-the-private-and-public-spheres.pdf

McGrath, M. (2019). Nature crisis: Humans 'threaten 1m species with extinction'. Retrieved from https://www.bbc.com/news/science-environment-48169783 9 May 2019

Mednick, S. A. (1962). The associative basis of the creative process. *Psychological Review, 69*(3), 220-232.

Michell, R. K., Busenitz, L., Iant, T., McDougall, P. P., Morse, E. A., & Smith, J. B. (2002). Toward a Theory of Entrepreneurial Cognition: Rethinking the People Side of Entrepreneurship Research. *Entrepreneurship Theory and Practice, 27*(2), 93-104.

Midgley, C. (2002). Preface. In C. Midgley (Ed.), *Goals, Goal Structures, and Patterns of Adaptive Learning.* Mahwah, NJ: Lawrence Erlbaum Associates, Inc.
Ministry of Communications and Information. (2013). Must Permanent Residents (PRs) do National Service? Retrieved from https://www.gov.sg/factually/content/must-permanent-residents-do-national-service 15 April 2019
Ministry of Communications and Information. (2015). Singapore's submission to the United Nations Framework Convention on Climate Change (UNFCCC). Retrieved from https://www.gov.sg/resources/sgpc/media_releases/NCCS/press_release/P-20150703-1 7 May 2019
Ministry of Communications and Information. (2018). Singapore's fight against Fake News: What you can do. Retrieved from https://www.gov.sg/news/content/singapore-fight-against-fake-news 12/07/2019
Ministry of Education. (2018a). 21st Century Competencies. Retrieved from https://www.moe.gov.sg/education/education-system/21st-century-competencies 17 June 2019
Ministry of Education. (2018b). Character and Citizenship Education. Retrieved from https://www.moe.gov.sg/education/syllabuses/character-citizenship-education 16 April 2019
Ministry of Manpower. (2018). Labour Force in Singapore Advance Release 2018. Retrieved from https://www.mom.gov.sg/newsroom/press-releases/2018/1129-labour-force-in-singapore-advance-release-2018 11 April 2019
Ministry of Manpower. (2019). Summary Table: Labour Force. Retrieved from https://stats.mom.gov.sg/Pages/Labour-Force-Summary-Table.aspx 11 April 2019
Ministry of National Development. (2018). *Urban Systems Studies - Food and the City: Overcoming Challenges for Food Security.* Singapore: CLC Publications.
Ministry of Trade and Industry. (2019a). Economic Survey of Singapore 2018. Retrieved from https://www.mti.gov.sg/Resources/Economic-Survey-of-Singapore/2018/Economic-Survey-of-Singapore-2018 21 February 2019
Ministry of Trade and Industry. (2019b). MTI Maintains 2019 GDP Growth Forecast at "1.5 to 3.5 Per Cent". Retrieved from https://www.mti.gov.sg/Newsroom/Press-Releases/2019/02/MTI-Maintains-2019-GDP-Growth-Forecast-at-1_5-to-3_5-Per-Cent 22 March 2019
Mitchell, R. K., Smith, B., Seawright, K. W., & Morse, E. A. (2000). Cross-Cultural Cognitions and the Venture Creation Decision. *Academy of Management Journal, 43*(5), 974-993.
Mongeau, P. A., & Morr, M. C. (1999). Reconsidering brainstorming. *Group Facilitation: A Research & Applications Journal, 1*(1), 14–21.
Nasir, K. M., & Turner, B. S. (2014). *The Future of Singapore: Population, Society and the Nature of the State.* Oxfordshire: Routledge.
National Climate Change Secretariat. (2016). *Singapore's Climate Action Plan: Take Action Today, For a Carbon-Efficient Singapore*. Retrieved from Singapore: https://www.nccs.gov.sg/docs/default-source/publications/take-action-today-for-a-carbon-efficient-singapore.pdf

National Environment Agency. (2018). Mandatory Energy Management Practices for Existing Industrial Facilities. Retrieved from https://www.nea.gov.sg/our-services/climate-change-energy-efficiency/energy-efficiency/industrial-sector/mandatory-energy-management-practices-for-existing-industrial-facilities 7 May 2019

National Environment Agency. (2019). Singapore's Efforts in Addressing Climate Change. Retrieved from https://www.nea.gov.sg/our-services/climate-change-energy-efficiency/climate-change/singapore's-efforts-in-addressing-climate-change 7 May 2019

National Institute of Education. (2019). NIE Strategic Vision 2022. Retrieved from https://www.nie.edu.sg/about-us/nie-strategic-vision-2022 27 March 2020

National Integration Council. (2019). National Integration Council. Retrieved from https://www.nationalintegrationcouncil.org.sg/home 8 April 2019

National Research Foundation. (2016). *Singapore Government commits S$19 billion to research, innovation and enterprise for next five years.* Retrieved from https://www-nrf-gov-sg-admin.cwp.sg/docs/default-source/press-releases/201601082039441690-20160108_rie2020-press-release-(final).pdf.

Neo, C. C. (2014, 21 February). Budget 2014: Pioneer Generation to benefit 'for the rest of their lives'. *Today.* Retrieved from https://www.todayonline.com/singapore/budget-2014-pioneers-get-yearly-medisave-top-ups-life 12 April 2019

Ng, D. F. S. (2019). Future-ready Leadership Development. In T. Townsend (Ed.), *Leading Learning in Schools: Instructional Leadership and Leadership for Learning.* London Switzerland: Palgrave Macmillan.

Ng, K. (2017). The policies that shaped a multiracial nation. *Today Online.* Retrieved from https://www.todayonline.com/singapore/policies-shaped-multiracial-nation

Nishii, L. H. (2013). The benefits of climate for inclusion for gender-diverse groups. *Academy of Management Journal, 50*(6).

Noor, N., & Leong, C.-H. (2013). Multiculturalism in Malaysia and Singapore: Contesting Models. *International Journal of Intercultural Relations, 37*(6), 714–726. doi:https://doi.org/10.1016/j.ijintrel.2013.09.009

Nunez, C. (2019). Sea level rise, explained. Retrieved from https://www.nationalgeographic.com/environment/global-warming/sea-level-rise/ 9 May 2019

Office of Education Research. (2020). Office of Education Research - About our Research. Retrieved from https://www.nie.edu.sg/research/research-offices/office-of-education-research 27 March 2020

Osborn, A. F. (1963). *Applied Imagination: Principles and Procedures of Creative Problem-Solving (Third Revised Edition)*. New York: Charles Scribner' Sons.

Parviainen, P., Kääriäinen, J., Tihinen, M., & Teppola, S. (2017). Tackling the digitalization challenge: how to benefit from digitalization in practice. *International Journal of Information Systems and Project Management, 5*(1), 63–77.

Paulo, D. A., & Heng, D. (2018, 7 February). Why Singapore needs Tuas mega port to keep ruling the seas. *Channel News Asia.* Retrieved from https://www.channelnewsasia.com/news/cnainsider/singapore-needs-tuas-mega-port-maritime-trade-automated-9934474 26 March 2019

Paulo, D. A., Yeh, R., & Say, X. (2019, 31 March 2019). Inside the high-tech operations of Singapore's largest egg farm. *Channel NewsAsia.* Retrieved from https://www.channelnewsasia.com/news/cnainsider/inside-high-tech-operation-singapore-largest-egg-farm-seng-choon-11396776 29 April 2019

Peterson, C. (2010). Passion and Positive Psychology. Retrieved from https://www.psychologytoday.com/intl/blog/the-good-life/201001/passion-and-positive-psychology 3 July 2019

Pfeffer, J. (1995). Producing Sustainable Competitive Advantage Through the Effective Management of People. *Academy of Management Executive, 9*(1), 55–69.

Population SG. (2019). Trendspotting - Older Singaporeans to double by 2030. Retrieved from https://www.population.sg/ 11 April 2019

PUB. (2018a). Four National Taps. Retrieved from https://www.pub.gov.sg/watersupply/fournationaltaps 8 May 2019

PUB. (2018b). Marina Barrage. Retrieved from https://www.pub.gov.sg/marinabarrage/aboutmarinabarrage 24 April 2019

PUB. (2018c). Singapore Water Story. Retrieved from https://www.pub.gov.sg/watersupply/singaporewaterstory 21 March 2019

PUB. (2018d). Transforming PUB into the Smart Utility of the Future. Retrieved from https://www.pub.gov.sg/news/pressreleases/transformingpubintothesmartutilityofthefuture 24 April 2019

Public Service Division. (2015). Cultivating a Harmonious Society, Becoming One People. Retrieved from https://www.psd.gov.sg/heartofpublicservice/our-institutions/cultivating-a-harmonious-society-becoming-one-people/ 3 April 2019

Puncreobutr, V. (2016). Education 4.0: New Challenge of Learning. *St. Theresa Journal of Humanities and Social Sciences, 2*(2), 92-97.

Rahamat, M. O. B. (2013). *Turning a Necessity into an Export: The Development of Singapore's Water Industry.* (Master of Arts), National Institute of Education, Singapore. Retrieved from https://repository.nie.edu.sg/bitstream/10497/14154/6/MohamedOsmanRahamat-MA.pdf

Robehmed, N. (2013). What is a startup? Retrieved from https://www.forbes.com/sites/natalierobehmed/2013/12/16/what-is-a-startup/#3475e3394044 7/6/19

Rui, L. (2019, 14 May 2019). "Mutual learning among Asian Civilisations promotes harmony, peace and prosperity" – Interview with Singaporean President Halimah. *People's Daily.* Retrieved from http://en.people.cn/n3/2019/0514/c90000-9577902.html

Runco, M. A., & Jaeger, G. J. (2012). The Standard Definition of Creativity. *Creativity Research Journal, 24*(1), 92–96.

Schwab, K. (2016). *The Fourth Industrial Revolution.* Geneva: World Economic Forum.

Seow, B. Y. (2018, 17 January 2018). Finding ways to increase water supply from Johor River. *The Straits Times.* 7 May 2019

Shi, J. (2012). Influence of passion on innovative behavior: An empirical examination in Peoples Republic of China. *African Journal of Business Management, 6*(30), 8889-8896.

Singapore Food Agency. (2019). Food Farming. Retrieved from https://www.sfa.gov.sg/food-farming 22 April 2019

Singapore Maritime Foundation. (2017). Singapore Maritime Services Guide 2017/2018. Retrieved from https://www.timesdirectories.com/ebook/smsg/2017/mobile/index.html#p=5 26 March 2019

Siong, O. (2019, 15/05/19). Religious harmony will always be work in progress for Singapore: Halimah Yacob. *Channel News Asia.* Retrieved from https://www.channelnewsasia.com/news/singapore/halimah-yacob-religious-harmony-work-in-progress-singapore-11534422

SkillsFuture Singapore Agency. (2017). New SkillsFuture Series to train 50,000 annually in eight priority and emerging skills areas. Retrieved from https://www.skillsfuture.sg/NewsAndUpdates/DetailPage/971f31d5-78db-4b26-8e1d-de89833ed9b9 12 Jul 2019

SkillsFuture Singapore Agency. (2019a). About SkillsFuture. Retrieved from https://www.skillsfuture.sg/AboutSkillsFuture 22 March 2019

SkillsFuture Singapore Agency. (2019b). TechSkills Accelerator. Retrieved from https://www.skillsfuture.sg/tesa 22 March 2019

Sky Greens. (2014). Sky Greens. Retrieved from www.skygreens.com/ 22 April 2019

Solon, O., & Levin, S. (2017). Divisive Russian-backed Facebook ads released to the public. *The Guardian.*

Steffen, W., Broadgate, W., Deutsch, L., Gaffney, O., & Ludwig, C. (2015). The trajectory of the Anthropocene: The Great Acceleration. *The Anthropocene Review, 2*(1), 81–98. doi:10.1177/2053019614564785

Steffen, W., Crutzen, P. J., & McNeill, J. R. (2007). The Anthropocene: Are Humans Now Overwhelming the Great Forces of Nature? *AMBIO, 36*(8), 614–621.

Steffen, W., Persson, Á., Deutsch, L., Zalasiewicz, J., Williams, M., Richardson, K., . . . Svedin, U. (2011). The Anthropocene: From Global Change to Planetary Stewardship. *AMBIO, 40*(7), 739–761. doi:10.1007/s13280-011-0185-x

Sternberg, R. J. (1998). Metacognition, abilities, and developing expertise: What makes an expert student? *Instructional Science, 26*(1-2), 127-140.

Stevens, R., Bransford, J., & Stevens, A. (2005). The LIFE Center's Lifelong and Lifewide Diagram. Retrieved from http://life-slc.org/about/citationdetails.html 12 July 2019

Stewart, J. B. (2018). To Make Inclusion Work You Have to Create Habits: The Five Inclusive Habits. *Medium.* Retrieved from https://medium.com/@j_brucestewart/to-make-inclusion-work-you-have-to-create-habits-the-five-inclusive-habits-435acf075607 04/06/19

Taboada, A., & Guthrie, J. T. (2006). Contributions of Student Questioning and Prior Knowledge to Construction of Knowledge From Reading Information Text. *Journal of Literacy Research, 38*(1), 1–35.

Tan, A. (2018a, 26 January). Most Singaporeans worry about impact of climate change but few think their actions matter. *The Straits Times.* Retrieved from https://www.straitstimes.com/singapore/environment/singapore-launches-its-year-of-climate-action-masagos-urges-people-and

Tan, A. (2018b, 6 March 2018). Parliament: Farmers in Singapore to be given more help to raise productivity. *The Straits Times.* Retrieved from https://www.straitstimes.com/politics/parliament-farmers-in-singapore-to-be-given-more-help-to-raise-productivity 22 April 2019

Tan, W.-L., & Lee, B.-C. (2002). Small and Medium Enterprises in Singapore and the New Economy. *Research Collection Lee Kong Chian School of Business,* 369–374.

Tanner, K. D. (2012). Promoting Student Metacognition. *CBE—Life Sciences Education, 11*(2), 113–120.

Tay, K. (2015, 4 November). Shift from value-adding to value-creation: Swee Keat. *The Business Times.* Retrieved from https://www.businesstimes.com.sg/government-economy/shift-from-value-adding-to-value-creation-swee-keat

Teh, C. (2018, 25 November 2018). Singapore's green energy push. *The Straits Times.* Retrieved from https://www.straitstimes.com/singapore/singapores-green-energy-push 24 April 2019

Teng, A. (2016, 29 November 2016). Singapore students top global achievement test in mathematics and science. *The Straits Times.* Retrieved from https://www.straitstimes.com/singapore/education/singapore-students-top-global-achievement-test-in-mathematics-and-science

Teng, A. (2018, 3 February). The Big Read: The foreigner issue - are we ready for a rethink? *Today.* Retrieved from https://www.todayonline.com/singapore/big-read-foreigner-issue-are-we-ready-rethink

Tham, Y.-C. (2019). Parliament: Fake news law passed after 2 days of debate. *The Straits Times.*

The Straits Times. (2013, 30 January). Sustainable population for a dynamic Singapore. Retrieved from https://www.straitstimes.com/singapore/sustainable-population-for-a-dynamic-singapore

The Straits Times. (2018, 19 November). Singapore to face more competition as investment hub as South-east Asia deal value doubles to US$70b over next 5 years: Report. *The Straits Times.* Retrieved from https://www.straitstimes.com/business/banking/more-competition-for-singapore-as-investment-hub-as-south-east-asia-deal-value

Toh, M. (2019). Google says Singapore risks hurting innovation with fake news law. *CNN.*

Toubia, O. (2006). Idea Generation, Creativity, and Incentives. *Marketing Science, 25*(5), 411–425.

Urban, B. (2010). Cognitions and motivations for new venture creation decisions: linking expert scripts to self-efficacy, a South African study. *The International Journal of Human Resource Management, 21*(9), 1512–1530.

Vallerand, R. J., Blanchard, C., Mageau, G. A., Koestner, R., Ratelle, C., Léonard, M., . . . Marsolais, J. (2003). Les Passions de l'Âme: On Obsessive and Harmonious Passion. *Journal of Personality and Social Psychology, 85*(4), 756–767.

Vallerand, R. J., Salvy, S.-J., Mageau, G. A., Elliot, A. J., Denis, P. L., Grouzet, F. M. E., & Blanchard, C. (2007). On the Role of Passion in Performance. *Journal of Personality, 75*(3), 505–534.

Vaughn, B. (N.D.). What is Inclusive Intelligence? *Diversity Officer Magazine.* Retrieved from https://diversityofficermagazine.com/what-is-inclusive-intelligence/ 04/06/2019

Von Bergen, C. W., Von Bergen, B. A., Stubblefield, C., & Bandow, D. (2012). Authentic Tolerance: Between Forbearance and Acceptance. *Journal of Cultural Diversity, 19*(4), 111–117.

Watson, L. (2015). What is inquisitiveness. *American Philosophical Quarterly, 52*(3), 273–287.

Wigginton, N. S., Fahrenkamp-Uppenbrink, J., Wible, B., & Malakoff, D. (2016). Cities are the future - Rapid Urbanization is overtaxing the planet, but it may not have to. *Science, 352*(6288), 904–905.

Wilson, N. S., & Smetana, L. (2009). Questioning as Thinking: A Metacognitive Framework. *Middle School Journal, 41*(2), 20–28.

Woo, J. J. (2018). Educating the developmental state: policy integration and mechanism redesign in Singapore's SkillsFuture scheme. *Journal of Asian Public Policy, 11*(3), 267–284.

Workforce Singapore. (2019). Professional Conversion Programmes for Programme Partners. Retrieved from http://www.wsg.gov.sg/programmes-and-initiatives/professional-conversion-programmes-programme-partners.html 26 March 2019

Wright, P. M., McMahan, G. C., & McWilliams, A. (1994). Human resources and sustained competitive advantage: a resource-based perspective. *The International Journal of Human Resource Management, 5*(2), 301–326.

Yap, M. T., & Gee, C. (2015). Ageing in Singapore: Social Issues and Policy Challenges. In D. Chan (Ed.), *50 Years of Social Issues in Singapore.* Singapore: World Scientific.

Yuen, S. (2018a, 1 March 2018). Parliament: Singapore's total population likely to be 'significantly below' 6.9 million by 2030. *The Straits Times.* Retrieved from https://www.straitstimes.com/politics/parliament-no-major-changes-expected-to-immigration-policy-josephine-teo 15 April 2019

Yuen, S. (2018b, 16 May). Parliament: Singapore more cohesive now, but forces that could split society have also become stronger: PM Lee. *The Straits Times.* Retrieved from https://www.straitstimes.com/politics/singapore-more-cohesive-now-but-forces-that-could-split-society-have-also-become-stronger

Zepeda, S. J. (2013). *Professional Development: What Works.* New York: Routledge.

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