



BACKGROUND PAPER

Education for Innovation: Sorting Fact from Fiction

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EDUCATION FOR INNOVATION: SORTING FACT FROM FICTION

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ACKNOWLEDGEMENTS

This study wouldn't have been possible without the advice, support and enthusiasm of Michael Frese, Yoonjeon Kim, Stewart MacDonald, Ezequiel Molina, Rajesh Nair, Michael Peak, Lant Pritchett, Marla Spivack, and Yun You as well as the Asian Development Outlook 2020 team, including Abdul Abiad, Editha Laviña, Rhea Molato-Gayares, Donghyun Park, and Rhommell Rico. We thank all colleagues who offered help and advice, including Asako Maruyama, Brajesh Panth, and Yasuyuki Sawada. We also thank seminar attendees at the Asian Development Bank for their helpful comments on earlier versions of the paper.

I. INTRODUCTION

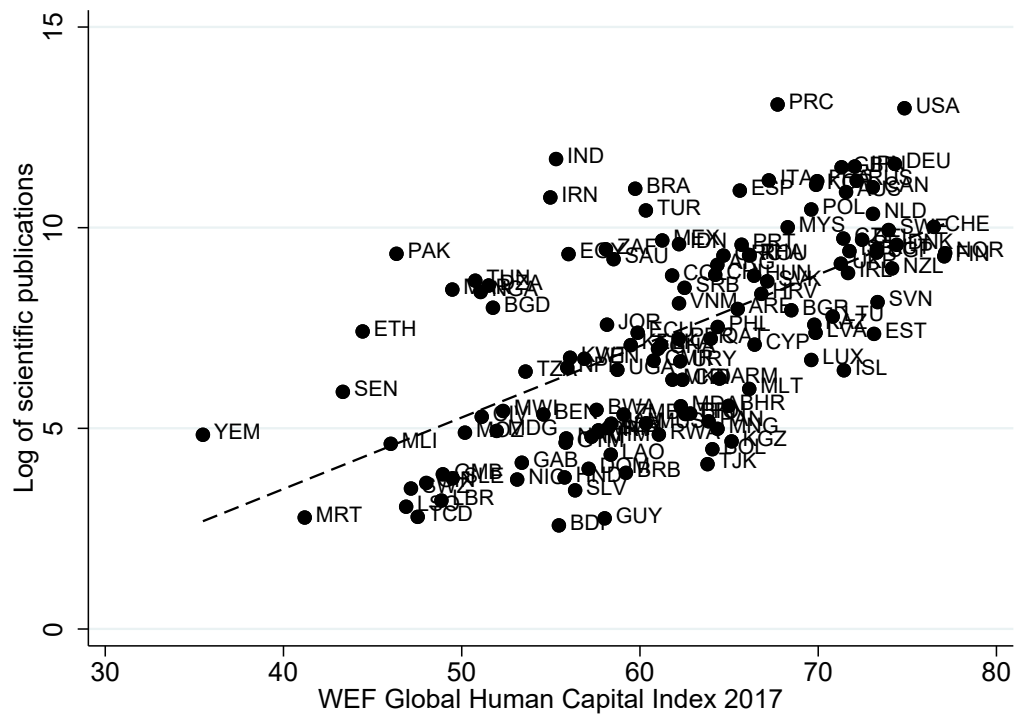
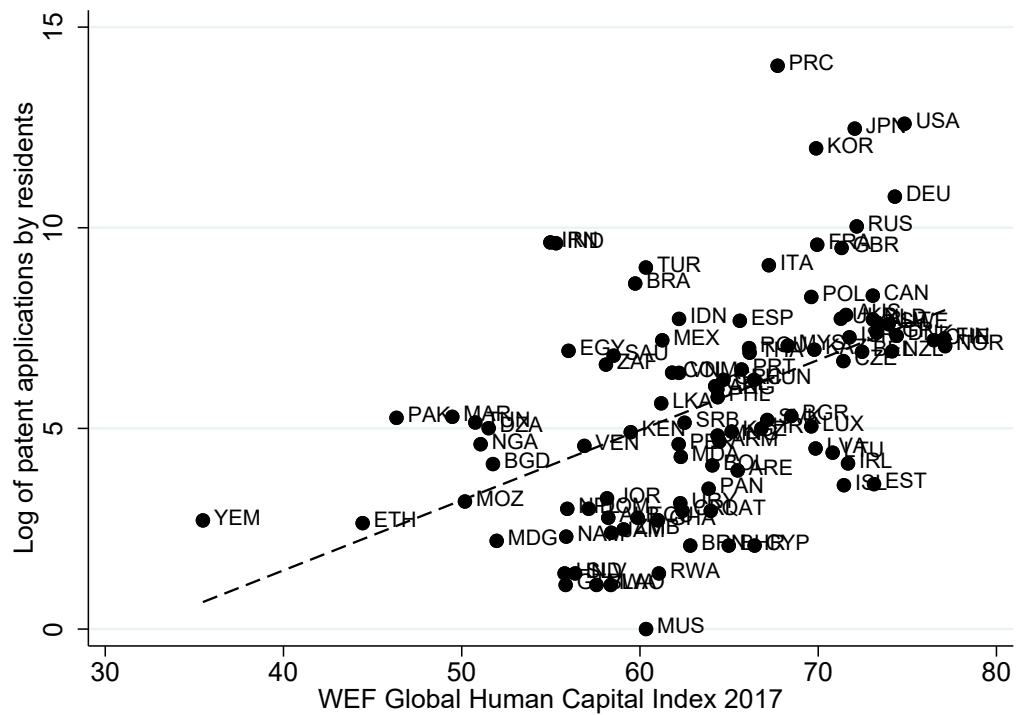
The economic literature has long established both the importance of human capital as an essential determinant of economic development and the complex nature of this relationship. Human capital affects development directly by increasing labor productivity and indirectly by encouraging innovation.¹ An increase in human capital can boost the number of innovative entrepreneurs and products; incentivize investment in technology adoption and creation; for example, in cases when it is only feasible if there are enough workers with the necessary skills; and create an environment conducive to innovation through rule of law, political stability, and increased tax revenue. Figure 1 shows the strong positive correlation between human capital and two major output indicators for frontier innovation: patent applications by residents and scientific publications.

Human capital has many determinants. Good health and nutrition are necessary prerequisites for individuals to work productively and to learn. As such, health is not only part of human capital itself, but it is also an input to producing other forms of human capital. Education and training play a fundamental role in the accumulation of human capital, from foundational skills such as literacy and numeracy; to transversal skills such as critical thinking, creativity, and communication; to specialized skills that relate to a specific job or knowledge area (Asian Development Bank 2018). Education is also an input to producing other forms of human capital; for example, educated individuals are more likely to adopt a healthy lifestyle for themselves and their families. Human capital has motivationally relevant elements, such as employees' job satisfaction, organizational commitment, and willingness to change in the workplace. Finally, in the age of social media and digital fandoms, individual fame and brand image have also become components of human capital.

This report focuses on human capital in the form of education. We consider the education system to include all educational provision, from early childhood to tertiary education, including both the teaching and research functions of universities. It should be noted that this report does not mean to imply that formal education is the only way to produce innovators: other factors such as life experience and environment can also contribute. However, decades of empirical evidence have established that access to adequate education is a significant determinant of innovation (Nelson and Phelps 1966, Schultz 1961, and Aghion and Howitt 1992).

¹ Innovation is not the only channel through which human capital indirectly affects economic development. For example, a higher level of human capital in the population may result in better governance; or a skilled workforce could attract foreign direct investment.

Figure 1: The Relationship between Human Capital and Innovation



WEF = World Economic Forum.

Note: The Global Human Capital Index 2017 by the World Economic Forum ranks 130 countries on how well they are developing and deploying their human capital potential across four thematic dimensions: capacity, deployment, development

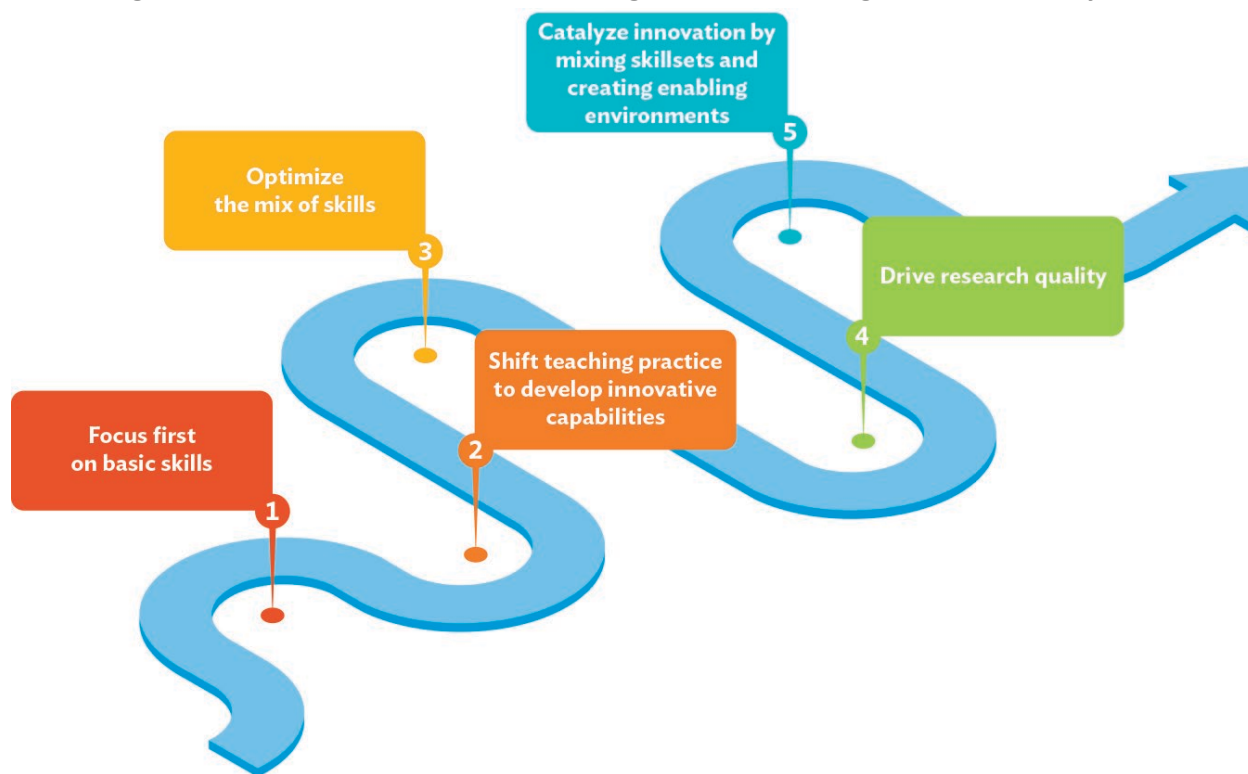
and know-how. Data on patent applications by residents from the World Intellectual Property Organization. Data on scientific publications from the World Development Indicators.
Source: Authors.

Most of the early work in the human capital literature used the length of education, measured by average years of schooling or the attainment of specific educational levels, as the indicator for human capital. This approach was adopted by international organizations such as the United Nations and UNESCO, whose Millennium Development Goal to achieve universal primary education focused on the quantity of education. However, quality and not quantity matter for education: achievement rather than attainment (Hanushek and Woessmann 2015). In recent years, a number of international achievement tests have emerged including the Organisation for Economic Co-operation and Development's Programme for International Student Assessment and Programme for the International Assessment of Adult Competencies; the Trends in International Mathematics and Science Study; and the Progress in International Reading Literacy Study. Economic growth rates are much more closely related to international achievement test scores than the traditional attainment data (Hanushek and Woessmann 2016). Therefore, this report focuses on international achievement tests as indicators of cognitive skills. While non-cognitive skills such as conscientiousness, perseverance, and teamwork are also important to produce potential innovators, measures are either unavailable or there is no consensus on them (Hanushek and Woessmann 2008).

This report takes a multidisciplinary approach to studying how education can contribute to a more innovative society. It taps into evidence from economics, education sciences, organizational behavior, and innovation. Figure 2 shows five recommendations for countries that want to ensure education is driving innovation. We elaborate on these recommendations in the remainder of this report.

Countries will have different starting points, but it is important to note that these recommendations are sequential. There is evidence that many developing and emerging economies attempt to jump to supporting the types of interventions outlined in later recommendations before they have achieved the preceding steps; and that this strategy has not worked (Bakouros et al. 2002, Heher 2005, Newman 2014, and Veugelers and Schweiger 2016). The evidence clearly demonstrates that there is no shortcut to innovation; the foundations need to be built first.

Figure 2: Five Recommendations for Driving Innovation Through the Education System



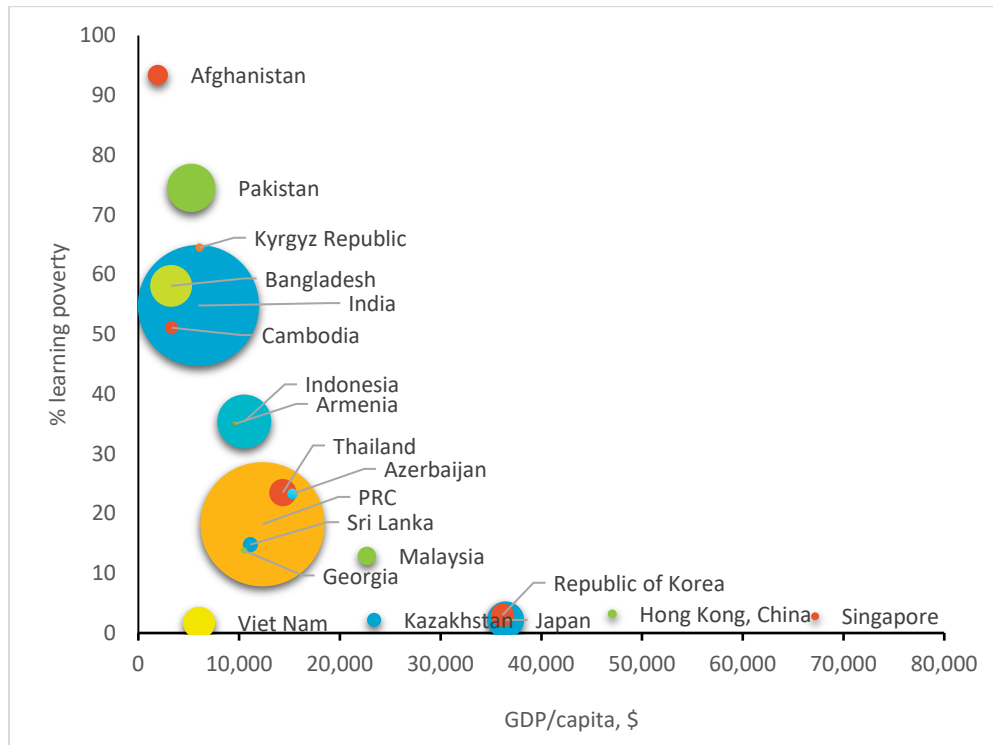
Source: Authors.

II. FOCUS FIRST ON BASIC SKILLS

A. The Learning Crisis

The world is facing a learning crisis and hundreds of millions of children and young people in Asia and the Pacific today are learning very little. Figure 3 shows the estimated proportion of 10-year olds in a range of Asian countries who are unable to read a simple sentence – a metric which the World Bank has termed ‘Learning Poverty’. There are a number of countries where this figure is greater than 50% meaning that the majority of children are not learning even basic literacy. Asia’s learning crisis is most pronounced in South Asia with millions of children in school but learning at low levels (ASER-Pakistan 2019 and ASER 2018). The performance in other parts of developing Asia and the Pacific is very mixed. Some countries are performing better in terms of achieving basic literacy in primary school but still underperform in secondary school as shown in Figure 4; in a number of Asian countries, the majority of 15-year olds are not achieving even the minimum expected proficiency in reading.

Figure 3: Learning Poverty and Gross Domestic Product per Capita in Asian Economies



GDP = gross domestic product, PRC = People's Republic of China.

Note: Bubble size represents population size. Learning poverty is the percentage of children aged about 10 who are unable to read and comprehend a short text appropriate for their age. Data from World Bank (2019).

Source: Authors.

Having said that, there are also examples of Asian countries which perform far better than you might expect based on their gross domestic product. And amongst the developed countries of Southeast and East Asia you also find some of the best performing education systems in the world.

For most countries, we only have data on basic skills (mainly literacy and numeracy). However, we can assume that if education systems are not managing to develop even these basic skills, it is very unlikely that they are developing higher-order skills such as problem solving and critical thinking.

Figure 4: Learning Poverty and Gross Domestic Product per Capita in Asian Economies



B-S-J-Z = Beijing, Shanghai, Jiangsu, and Zhejiang, OECD = Organisation for Economic Co-operation and Development, PRC = People's Republic of China.

Note: Figures in parentheses following the country name are the percentage of 15-year olds covered by the sample. Students were classified as having reading skills from below level 1 to level 6. Students performing at level 1 can read and understand short, simple sentences. Students performing at level 6 can understand lengthy, complex texts and make complex inferences about the sources of information. The United Nations Sustainable Development Goals state that level 2 is the minimum proficiency that all students should have by the end of secondary school.

Source: Authors.

B. The Need for Policy Action

Given the huge variation in learning outcomes across Asia and the Pacific, the first step for any country that wants to drive innovation through its education system is to assess the current state of its education system. Countries that are achieving good outcomes have a range of options to drive more innovation. But countries where learning outcomes are low will need to acknowledge this and focus relentlessly on aligning the system to achieve learning within basic education (Pritchett 2013). Human capital is a crucial driver of innovation and the foundation for developing any further academic and technical skills are the skills of numeracy, literacy, and, increasingly, digital literacy. Without these skills, it will be almost impossible for students to go on and achieve higher levels of learning.

To drive improvements in the education system, policy makers will need to ensure that learning outcomes are being measured and that the education system is aligned with the goal of improving learning (Pritchett and Spivack 2020). This will need to go beyond statements of intent but instead be deeply embedded in how the system is run. Some questions that policy makers will need to consider include: are teachers being equipped with the skills to continually monitor learning and to adapt their teaching to ensure all students learn? Are schools monitoring learning outcomes and is this information being fed back to regional bodies and ultimately to the Ministry of Education? Does a decrease in learning outcomes in a particular school or region trigger remedial action?

Facing up to the learning crisis can be painful for governments and societies. But without doing so, countries will not be able to embrace innovation to drive development.

III. SHIFT TEACHING PRACTICE TO DEVELOP INNOVATIVE CAPABILITIES

A. Innovation Capabilities

Innovation requires a range of capabilities that can be grouped into two categories – opening and closing capabilities.² Both kinds are needed in the general population (whether in a firm, in society, or in a government agency) and in leadership positions (Figure 5).

² We are using the terms ‘opening’ and ‘closing’ capabilities following Rosing et al. (2011). Other authors have used the terms ‘creating’ and ‘implementing’ or ‘exploring’ and ‘exploiting’ to describe similar concepts (Bledow and Frese 2009).

Figure 5: Opening and Closing Innovation Capabilities



Source: Authors.

Opening capabilities are the set of skills and approaches required to enable the generation of new ideas. At the population level, this includes a range of overlapping ‘soft skills’ such as creativity, problem solving, evidence literacy and critical thinking (Ueki and Guaita Martinez 2019, Saidi et al. 2019, and Brazdauskas 2015). However, having innovative people with strong opening capabilities in an organization is not sufficient. Also needed is enabling environment created by leaders who possess capabilities such as openness to questioning, failure tolerance, and a consultative management style (Barsh et al. 2008, Burpitt et al. 1997, Fischer et al. 2018, Lewis et al. 2018, and Baer and Frese 2003). These leadership attributes are critical, as innovation often fails not for lack of innovative ideas but because leaders have not created an environment that enables innovation to flourish. Indeed, evidence exists that having people with many new ideas in an organization that does not enable innovation can actually be worse for performance than having no innovative people at all (Baer and Frese 2003).

Closing capabilities, on the other hand, are the set of skills and approaches needed to see a new idea through to completion. In a population, they include such attributes as grit, perseverance, and long-term orientation. They enable people to push forward the implementation of new ideas even in the face of challenges. In the leadership, these capabilities include the ability to monitor and enforce goal attainment, a focus on results, and performance management.

As innovations proceed through organizations, a gradual shift will see less time spent on opening processes and more time on closing processes. This requires careful balancing by leaders in particular, as the approaches that enable opening may be in conflict with those that facilitate closing (Bledow et al. 2011).

Some of the capabilities needed for innovation are influenced by culture, so different countries need to consider where their strengths and opportunities lie (Bledow et al. 2011). For example, failure intolerance is a particular issue in parts of Asia, where people tend to harbor more fear of failure than in other parts of the world (OECD 2019). Indeed, a number of countries in the region now explicitly nurture tolerance of failure. Recent results from Hubner et al. (forthcoming) highlight differences in the distribution of innovation capabilities across Asia and the Pacific. The study observed that teams in the People's Republic of China (PRC) were particularly strong in closing capability but weaker in opening capability, while teams in India had the opposite distribution.

B. Teaching Approaches to Develop Innovation Capabilities

For decades, education experts have discussed how pedagogical approaches affect learning. One way to consider teaching approaches is to see them as a continuum running from teacher-centered approaches, which use traditional and didactic techniques to impart knowledge, to learner-centered approaches, which use more interactive approaches that help students direct their own learning (Brown 2003 and Weimer 2013). Learner-centered approaches—which include problem-based learning, group discussions, learning by doing, individual and group assignments, discussion, experimentation, competitions, debate, and games—have long been advocated as means to develop opening innovation capabilities. The theory is that by enabling students to experiment, seek out information, and solve problems imparts skills that can be applied throughout their lives.

C. Culturally Embedded Teaching for Innovation

No globally comparable data exists on teaching practice. Studies have been carried out using ratings by observers, teachers, or students, but it is unclear how comparable such scores are across cultures. Evidence from cross-cultural comparisons found that self-reported cultural values are not a good indicator of cultural practices, as ratings are greatly affected by cultural norms (Taras et al. 2010) and the same problem may affect data on teaching practice. For example, in a study that gathered student ratings of teaching practice, students in Taipei, China tended to score teachers highly on some practices because they did not want to criticize or question teachers, whereas Australian students were more willing to question and criticize (Aldridge et al. 2000). Further, students in Taipei, China gave high scores for 'shared control' (i.e., the extent to which students work with the teachers to design and manage learning), but on further questioning it was revealed that they either did not understand what the concept meant, or scored it highly because they did not expect or desire any more control than they had (Aldridge et al. 2000).

Table 1 presents a traffic light assessment of teaching practice in selected economies in Asia and the Pacific. Two indicators are chosen to assess the degree of learner-centeredness in teaching practice and are graded using qualitative descriptions from classroom observation studies: “group work and interactive learning” and “stimulation of higher-order thinking.” These teaching practices are known to stimulate opening innovation capabilities in students (Scott 2015). Red indicates evidence that practice is generally not present. Amber indicates either evidence that practice is partly present or conflicting evidence from two or more studies. Green indicates evidence that practice is often or usually present. Gray indicates the absence of evidence on this practice.

The first indicator for learning outcomes in Table 1 is “early literacy,” which is based on the World Bank Learning Poverty Indicator. Red indicates that more than 50% of 10-year olds are unable to read a simple text, amber indicates the proportion is between 10%–49%, and green indicates a proportion less than 10%. The second learning outcome is the average Programme for International Student Assessment (PISA) 2018 reading, math, and science scores, with red indicating a score below 450, amber 450–500, and green above 500. It is expected that those with high learning outcomes will have strong closing innovation capabilities since there is a significant correlation between students’ academic achievement and their possession of qualities like grit and perseverance (Kutlu, Kartal, and Şimşek 2017, Karlen et al. 2019, and Christopoulou et al. 2018). High academic learning outcomes—and therefore closing innovation capabilities—can be developed through either learner-centered or teacher-centered approaches; however, by using learner-centered approaches teachers can also instill opening innovation capabilities.

Table 1 shows that teaching practice varies significantly across the region. This is consistent with other studies that challenge the stereotype of Asian education as uniformly didactic and dependent on rote learning (Takayama 2017 and You 2019). A number of Asian countries have teaching practices that are both poor quality and teacher-centered. Developing high-quality, learner-centered teaching strategies will help these countries to improve both opening and closing innovation capabilities. Other countries achieve high learning outcomes using relatively teacher-centered approaches. Policy makers in these countries may wish to promote the further evolution of teaching practice to optimize innovation capabilities.

Table 1: Description of Teaching Practice in Asia and the Pacific

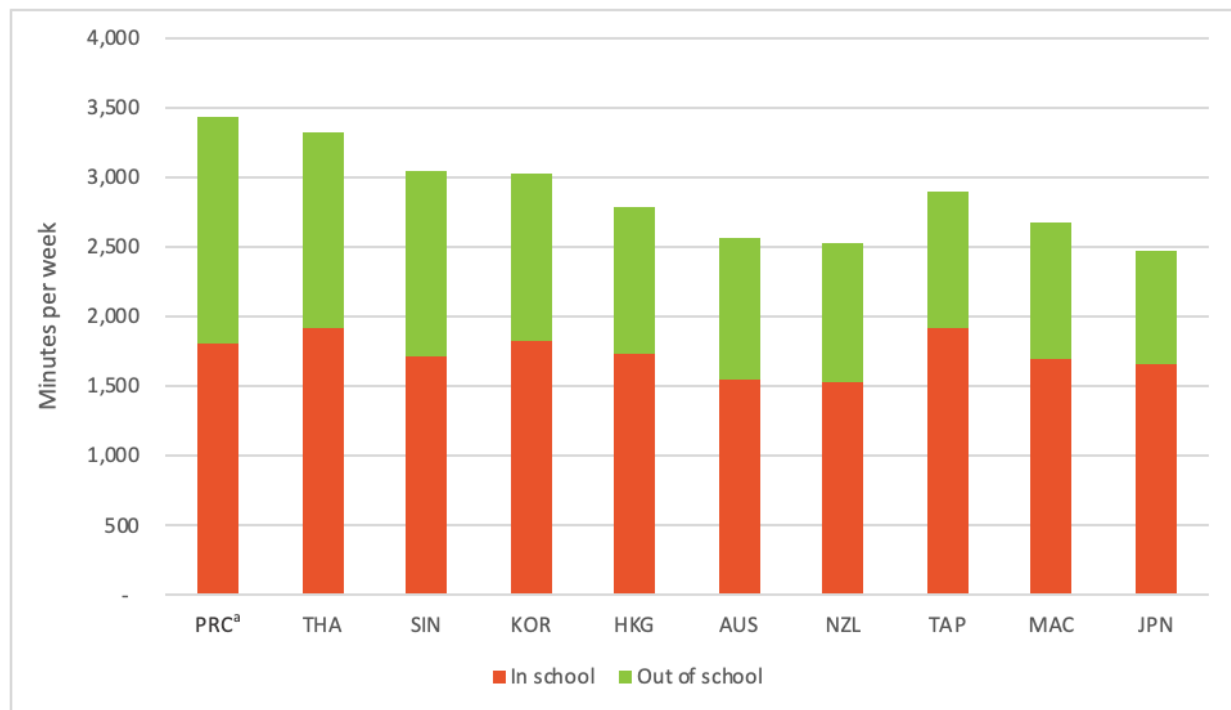
	Teaching practice		Learning outcomes	
	Group work and interactive learning	Stimulation of higher-order thinking	Early literacy	Average reading, math, and science score at age 15
Afghanistan	Red	Red	Red	Gray
Australia	Green	Gray	Green	Amber
Bangladesh	Red	Red	Red	Gray
Cambodia	Red	Red	Red	Gray
Hong Kong, China	Red	Amber	Green	Green
India	Amber	Red	Red	Gray
Indonesia	Amber	Red	Amber	Red
Japan	Amber	Green	Green	Green
Malaysia	Amber	Red	Amber	Red
People's Republic of China ^a	Amber	Amber	Amber	Green
Philippines	Red	Red	Gray	Red
Republic of Korea	Red	Green	Green	Green
Singapore	Amber	Amber	Green	Green
Viet Nam	Amber	Amber	Green	Gray

^a The average reading, math, and science score at age 15 for the People's Republic of China is not representative of the country because only Beijing, Shanghai, Zhejiang, and Jiangsu participated in the Programme for International Student Assessment 2018.

Notes: The two indicators for teaching practice, "group work and interactive learning" and "stimulation of higher-order thinking," were graded in the study based on qualitative descriptions from published classroom observation studies. Red indicates evidence that practice is generally not present. Amber indicates either evidence that practice is partly present or conflicting evidence from two or more studies. Green indicates evidence that practice is often or usually present. Gray indicates the absence of evidence on this practice. The two indicators of learning outcomes were chosen on the assumption that the achievement of academic outcomes is a proxy for closing innovation capabilities. 'Early literacy' is based on the World Bank Learning Poverty Indicator, with red indicating a score greater than 50%, amber 10%–49%, and green less than 10%. Learning outcomes at age 15 are based on average Programme for International Student Assessment 2018 reading, math, and science scores, with red indicating a score below 450, amber 450–500, and green above 500.

Source: Authors.

Figure 6: Students' Learning Time per Week



PRC = People's Republic of China, THA = Thailand, SIN = Singapore, KOR = Republic of Korea, HKG = Hong Kong, China, AUS = Australia, NZL = New Zealand, TAP = Taipei, China, MAC = Macau, China, JPN = Japan

^a The data for the People's Republic of China is not representative of the country because only Beijing, Shanghai, Zhejiang, and Jiangsu participated in the Programme for International Student Assessment 2018.

Source: Authors based on data from the Programme for International Student Assessment 2018.

As shown in Figure 6, there are also significant differences in both the total amount of time students in different countries spend on learning activities and the proportion of it spent in out-of-school study time. Students from the PRC score highest on time spent studying and almost half of it is in out-of-school settings. A portion of the out-of-school study time is likely spent in so-called 'cram schools:' private tutoring schools that are particularly common in Asia and have a reputation for highly teacher-centered approaches (Bray 1999, De Castro and De Guzman 2014, Lowe 2015). Further research is required to understand what is the impact of spending so much time in these environments on students' innovative capabilities.

D. Shifting Pedagogical Practice

Achieving change in pedagogical practice is notoriously difficult (Weimer 2013). Attempts by external actors to transplant learner-centered practices developed in one culture into an entirely different one have usually failed to achieve the intended outcomes (Schweisfurth 2013). Even where learner-centered

rhetoric has been adopted by policy makers, this may translate into a relatively superficial impact on actual teaching practice (You 2019 and Brinkmann 2019). However, policy makers across the region have scope to consider the types of capabilities their society needs and to design culturally embedded approaches to teaching and learning to develop them. There is nothing particularly Western about educational practices that can drive innovation. Cultural practices influence teaching practice across Asia and can contribute to developing innovative capabilities. For example, Confucius advocated that learners should take ownership of their learning and develop higher-order thinking skills, and this has had a strong influence on teaching in the PRC (Tan 2015). Similarly, India celebrates *jugaad*, or improvisation to create solutions when constraints are harsh, or resources limited. This clearly encourages problem solving and experimentation (Prabhu and Jain 2015).

In recent decades, countries across Asia have exerted considerable effort to shift their educational practices toward strengthening innovative capability. Singapore initiated its Thinking Schools, Learning Nation reform in 1997 and its Teach Less and Learn More policy in 2006 (Takayama 2017).

The PRC initiated its New Curriculum Reform in 2001 with the aim of promoting “pupils’ creative and critical spirits and capabilities” (You 2019). Japan introduced initiatives designed to promote “zest for living” and “low pressure, room for growth” in 2002 (Takayama 2017). Philippine basic education policy states that “every graduate of basic education shall be an empowered individual who has learned...the capability to engage in autonomous, creative, and critical thinking” (Care and Luo 2016).

Policy makers need to be realistic and bear in mind that achieving change in pedagogical practice can be challenging. However, only by fostering new ways of teaching and by investing in new approaches in schools can Asian countries tackle the learning crisis and forge ahead to bolster innovative capability.

IV. OPTIMIZE THE MIX OF SKILLS

Academic and technical skills are a vital pre-requisite for innovation (Toner 2011). Innovation in firms, particularly in developing and emerging economies, is mainly adaptive and the biggest constraint to improving firm performance is generally the absorptive capacity for existing knowledge/technology rather than the ability to generate ‘new to the world’ knowledge (Choi et al. 2013, Navaretti and Tarr 2000, and Samet 2011). It is therefore particularly important to have employees with the ability to learn about existing knowledge and adapt it to their context.

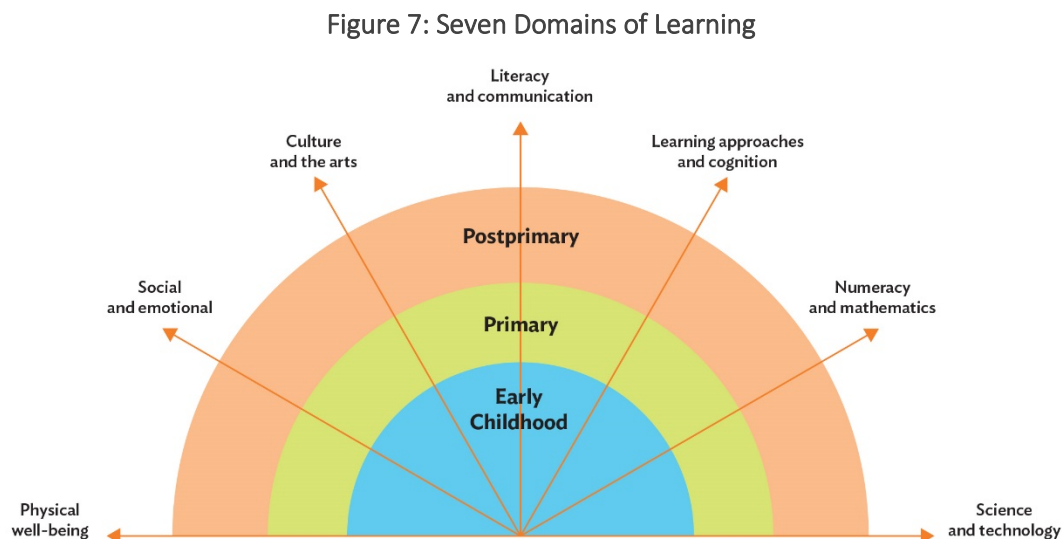
A. Broad Curricula

No single formula exists for blending school subjects to drive innovation. The ability to experiment and test ideas, which can be developed through effective science, technology, engineering, and math (STEM) teaching, is certainly important for innovation. Experts warn, however, against overemphasizing STEM subjects at the expense of those that can develop creativity (e.g., art and design) or critical thinking (e.g., social science and humanities). In fact, the literature suggests that a mix of different skills is key to driving innovation (Toner 2011).

A “Breadth of Learning Opportunities” tool kit³ has been developed to allow countries to assess whether their curricula are offering the breadth of subjects necessary for the 21st century (Anderson et al. 2018). The developers of the tool kit state that:

“...the most effective preparation we can give young people is one that develops their personal capacities and equips them with a broad set of flexible competences. It will be for them to respond to challenges as yet unknown and create new futures. In this new world, the advantage will be with well-rounded individuals who are able to apply their acquired knowledge and skills to new and different situations (Anderson et al. 2018).”

The authors emphasize the need to develop a full range of learning opportunities as shown in Figure 7.

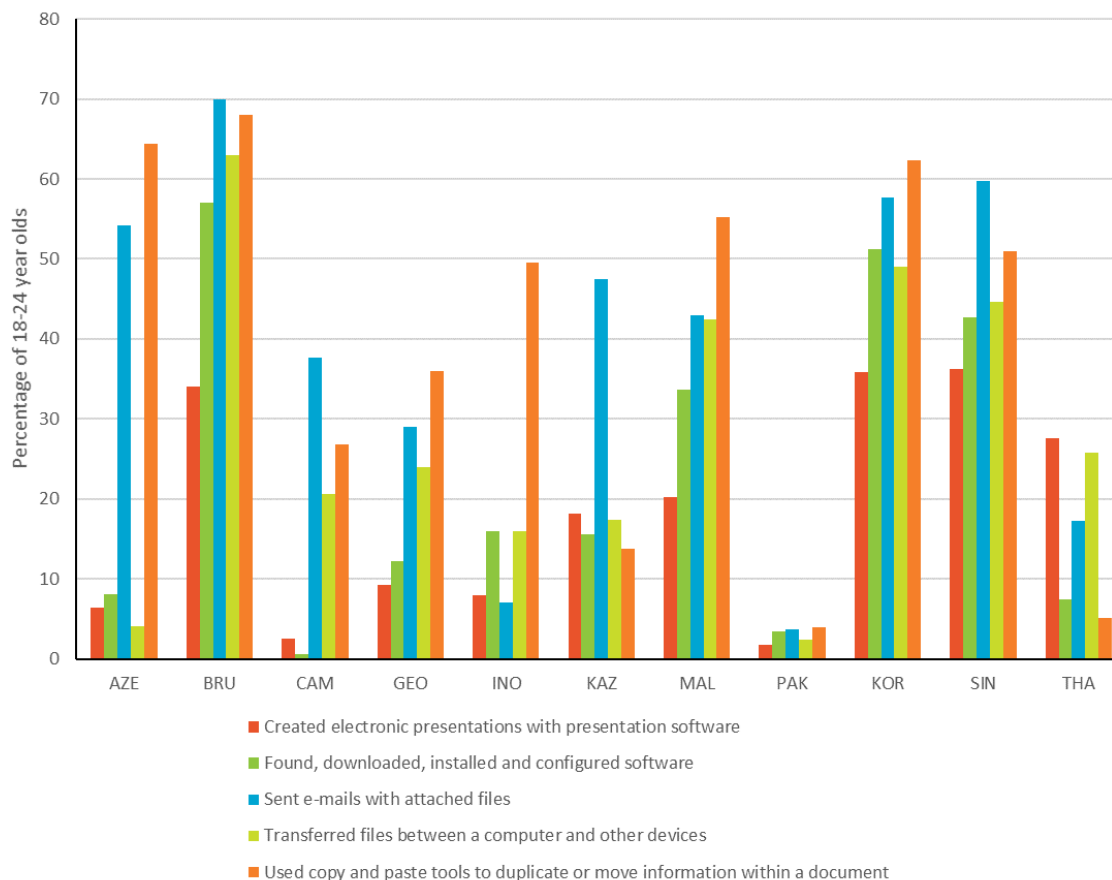


Source: Learning Metrics Taskforce (2018).

³ The tool kit includes three tools: a policy tool to examine the breadth of learning opportunities defined by the official curriculum at a national and/or subnational level; a school tool to examine how school-level policies and practice support breadth of learning; and a teacher tool which examines how teaching at the classroom level supports breadth of learning. All tools are available at <https://www.brookings.edu/research/breadth-of-learning-opportunities/>.

At present, it is difficult to get data on the full breadth of learning opportunities. As discussed under recommendation 1, there are learning outcome data on literacy, numeracy and science subjects but there are no data on arts or humanities subjects. Data is being gathered on information and communication technology skills as one part of measuring progress towards Sustainable Development Goal 4, i.e., 'Ensure inclusive and equitable quality education and promote lifelong learning opportunities for all'—and the data demonstrates big discrepancies in skill levels across Asian countries (Figure 8). But, while information and communication technology literacy will undoubtedly be an important 21st century skill, data on many other 'softer' skills such as social and emotional well-being, teamwork, critical thinking, and creativity are not routinely gathered.

Figure 8: Information and Communication Technology Skills in 15–24-Year Olds



Note: Graph shows the percentage of 15–24-year olds who report having carried out the task indicated.

Source: Authors based on UNESCO Institute of Statistics Data for Sustainable Development Goal 4.4.

B. Higher and Technical Skills

Innovation in some sectors requires advanced technical skills and therefore requires graduates with qualifications as high as doctoral degrees (Marvel and Lumpkin 2007, Larson 2011, and Toner 2011). It is almost impossible for someone to develop an innovative treatment for Malaria, for example, without first honing advanced skills in microbiology and pharmacology. Similarly, innovations in car manufacturing are only likely to be made by someone highly skilled in engineering. However, innovation in services or the public sector may depend less on technical skills than on general management and business skills (Marvel and Lumpkin 2007 and Toner 2011). Policy makers need to assess which skills are needed and ensure the availability of mechanisms to link the tertiary education provided with the needs of industry.

Also important is to maintain diversity of skills, as innovation often results when different skill sets collide. One way to achieve this is for individuals to develop skills in more than one area. A doctor with skills in coding may be excellently prepared to identify novel approaches to digital health delivery, for example, as would an architect with knowledge of social development to identify and overcome physical barriers to inclusion. The advantages of developing more than one area of expertise are demonstrated by a study that found students pursuing dual majors more innovative than those focused on a single major (Selznick and Mayhew 2018).

Some universities are now exploring how to guide students along more flexible learning journeys that allow them to develop skills across disciplines. In the PRC, for example, a number of prestigious universities are attempting to make undergraduate learning more diverse. Fudan University has changed the undergraduate curriculum to allow students to study a broad range of subject in their first two years before having to choose a specialization in their third year. Similarly, Yuanpei College at Peking University requires students to take general education courses in one of four areas: humanities, social issues, science, and art (Goodwin and Pickus 2017). Another approach to stimulate innovation is to supplement single major studies with courses specifically designed to build innovation skills (Wright et al. 2007 and Thongpravati et al. 2016).

C. Geographic and Social Mobility Within the Education System

Participating in an exchange programs or pursuing a degree abroad can be a transformative experience that enables students to think both locally and globally and engage with the world to exchange ideas

and engender action. Studying abroad empowers students and teachers alike to take on unfamiliar challenges and seize opportunities. Evidence shows that studying in universities with people from other countries significantly increases innovation both by the immigrants and by the host population (Chellaraj et al. 2008 and Sharif 2019).

Another approach to maximizing innovation is ensuring that educational institutes are drawing on the talents of a broad range of individuals. There are many schemes designed to bring students from lower economic backgrounds into education at all levels. Interestingly, research from Peru demonstrated that mixing students from low- and high-income backgrounds in classwork increased academic performance of both groups (Adrianzén et al. 2019).

Research from the United States shows that currently, inventors are disproportionately white, male and from higher socioeconomic classes. This suggests that there must be huge untapped reserves of talent which is not currently being channeled into innovation (Bell et al. 2018). One reason for the relatively low numbers of inventors being black or minority ethnic, female or coming from low-income families is that these groups have lower levels of exposure to innovation during their childhood. Therefore, it has been suggested that schemes which increase exposure of low-income and female children to innovation could help drive innovation across a more diverse population. It is probable that similar situations exist in Asian and Pacific countries with certain socioeconomic, cultural or linguistic groups being under-represented amongst innovators.

Involving a broader range of actors in innovation will have an impact not just on the quantity but also on the quality of innovation; in particular, individuals who have witnessed the challenges of living in poverty are better placed to identify new solutions to overcome them. This can be seen in the frugal innovation movement in India where home-grown, low-cost solutions to everyday challenges are developed (Bound and Thorton 2012). For example, the 'Jaipur Foot' was an Indian-invented prosthetic leg which was more suitable to the lifestyle and culture of India and significantly cheaper than existing models (Arya and Klenerman 2008).

V. DRIVE RESEARCH QUALITY

Technology transfer from universities to industry can be one source of innovation, but it relies on high-quality research. Meaningful technology transfer is therefore mainly limited to the top tier of universities. In Europe, for example, 85% of licensing income comes from the top 10% universities and many technology transfer offices operate at a loss (Newman 2014). Implementing recommendations 1–

3 will inevitably result in a boost to research quality since the skills required for research will be built. In addition, where education systems are heading in the right direction, policy makers may wish to take some additional steps to ensure that universities are producing high-quality research.

A. Research Capacity Building

A range of development partners have supported research capacity building interventions on the assumption that better research will lead to innovative practices and technology that will feed into public and private sector practices. While many of these interventions are focused on health research, there are also initiatives focusing on social science, basic research, and engineering.⁴ Clearly, capacity building does not need to be initiated by actors from developed countries; there is also scope for more advanced institutions within one country to provide support to others or for programs to improve research capacity to be initiated within a given institution.

Decades of experience in research capacity building have resulted in numerous best practice guides that set out the need for capacity building to be long-term, locally owned, and systemic (Newman 2014). However, evaluations of research capacity building programs reveal decidedly mixed results. On the one hand, there are good examples that use sustainable and effective approaches; on the other hand, there are many examples of interventions consisting of short-term, ad-hoc approaches that will probably not lead to longer-term improvements in capacity (Christoplos et al. 2019, Cochrane et al. 2014, ICAI 2019, and Technopolis 2017).

To ensure sustainability, one key aim of research capacity building should be to build up the abilities of senior academics to nurture and support junior academics so that the next generation of researchers is equipped to succeed. Senior academics may need to develop skills to instill competencies that may not have been developed in the school system, such as critical thinking, problem-solving, and a sense of enquiry (Nauman 2017, Tiwari et al. 2003, and Hepworth and Duvigneau 2012). They may also need to explicitly teach students about research ethics and integrity issues, including how to avoid plagiarism (Roman 2018, Maxwell et al. 2008, Ali et al. 2014, and Barrett and Malcolm 2006).

⁴ Examples from Asia include Wellcome Trust-funded health research capacity building in India, Thailand, and Viet Nam; United States Agency for International Development's Science, Technology, Research and Innovation for Development (STRIDE) Program in the Philippines; the Government of the United Kingdom's Newton Fund which is supporting research in a range of middle-income Asian countries; and the European Union funded disaster resilience focused Advancing Skill Creation to Enhance Transformation program in Sri Lanka, Thailand, and Bangladesh.

In summary, there is good knowledge available on the features of effective research capacity building. Policy makers should ensure that good practice is being used and specifically that systems and structures are built so that capacity building efforts become self-sustaining.

B. Policy and Regulation for Research Quality

The section above discusses efforts to build the knowledge, skills and attitudes required for research quality. Such efforts can be complemented by policies and regulations that incentivizes good practice and disincentivizes bad practice. Many Asian countries have been plagued by reports of a widespread culture of plagiarism (Mathews 2015 and Misra et al. 2017). Plagiarism is clearly unethical, but it is also detrimental to innovation; if the academic culture enables researchers to copy ideas from others, the skills needed to come up with new ideas will not be fostered. There are signs that governments and institutions are strengthening regulations to address the problem; however, it is yet to be seen if this will prove effective (Nisha and Bakhshi 2015, Haq 2018, and Zuo 2019). Tackling plagiarism will be critical to countries' long-term research success: plagiarism, if not detected, may enable researchers to achieve short-term gains in terms of research publications but it will have a highly negative impact on the longer-term potential of research to feed into innovation.

Incentives that promote good academic practice are just as important as those that punish bad behavior. In particular, there have been calls for hiring and promotion practices to focus more on researchers' impact and contribution to society rather than focusing so strongly on impact factors of publications (Moher et al. 2018).

C. International Collaboration

One approach to increasing research quality is to engage in more international research collaborations. Academic papers with authors from two or more countries are cited significantly more frequently than those authored by authors from the same country (Adams 2013, Glänzel and Lange 2002 and Van Raan 1998) and the quality of research outputs is highly correlated with measures of international collaboration (Wagner et al. 2018).

Figure 9 shows the total research publication output, field weighted citation impact, and proportion of publications with authors from two or more territories for a range of Asia and Pacific economies for the periods 2004–2008 and 2014–2018. For most countries, there has been an upward trend in terms of all three metrics. We cannot conclude that the relationship between international collaboration and quality is causal. In fact, it would make logical sense for the relationship to flow in both directions with more

internationally collaborative research driving quality and higher quality attracting additional international collaborators. Nevertheless, opening up to international collaboration does appear to be a promising policy strategy to improve research quality.

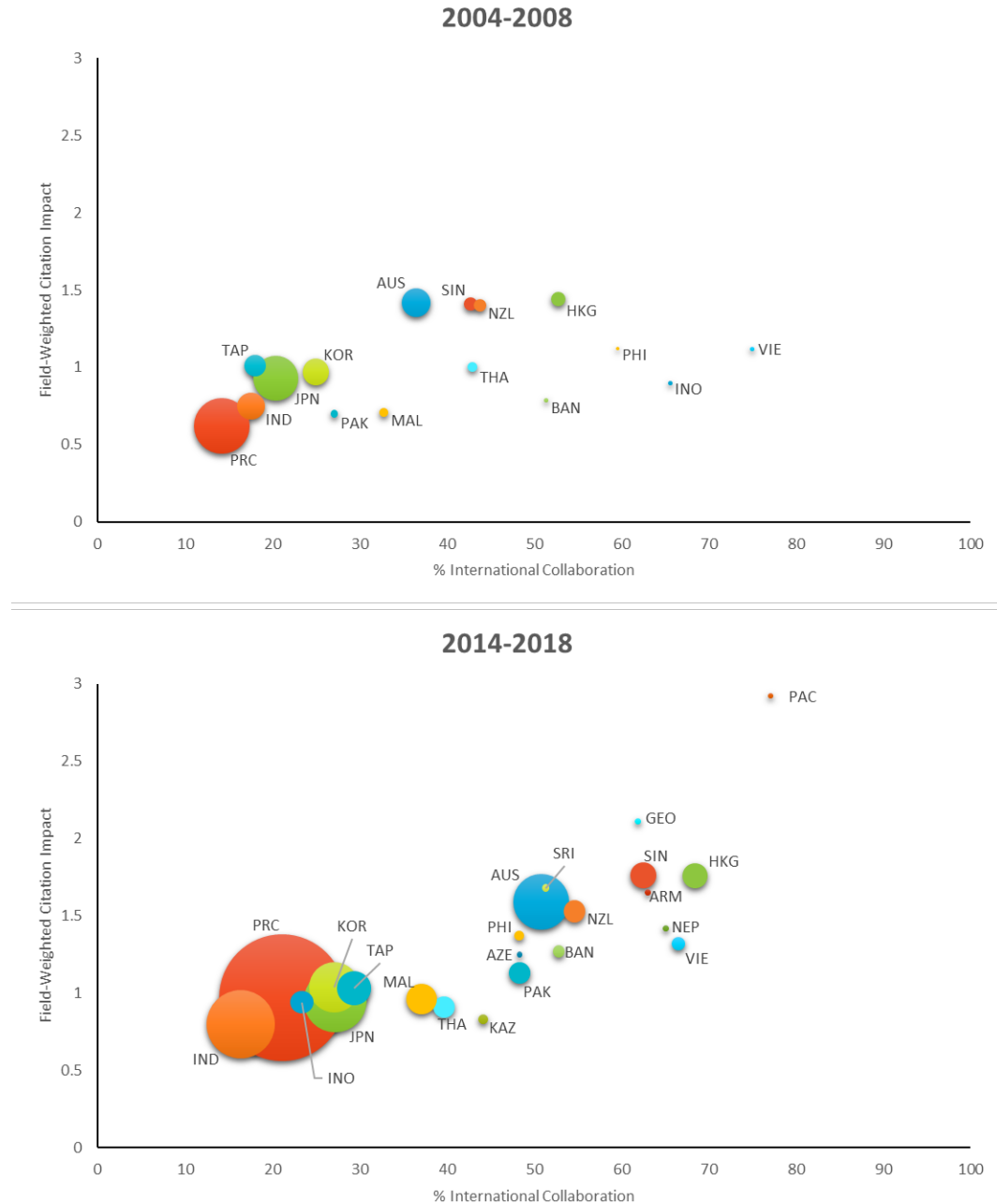
A number of Asian countries are actively attempting to boost research quality by promoting, incentivizing and facilitating the flow and exchange of ideas, knowledge and talent. The PRC has instituted a range of schemes designed to increase international research collaboration. For example:

- (i) The “Thousand Talents Plan” was designed to attract up to 1,000 foreign academics and entrepreneurs to work on short- or long-term contracts over the following 10 years to help improve research and innovation (Government of the PRC 2010).
- (ii) The Chinese Academy of Sciences (CAS) offers a package of international fellowships to support highly qualified international scientists and postgraduate students to work and study at CAS institutions (Chinese Academy of Sciences 2016).
- (iii) Visa policies throughout the country have been adjusted to allow researchers to visit to work and some research-intensive areas offer long-term visa options and even permanent residency to attract foreign research talent (China Briefing 2018).

Malaysia has also placed a strong emphasis on internationalizing their higher education sector. They aim to become an International higher education hub and, given the importance that research rankings play in universities’ prestige, improving research quality is a growing priority (British Council 2018). They have a strong focus on regional collaboration – for example they supported the establishment of the UNESCO International Science, Technology and Innovation Centre for South-South Cooperation in Kuala Lumpur (UNESCO 2008) and they are one of the founding members of the ASEAN International Mobility for Students (AIMS) program (SEAMEO 2019).

In the Philippines, the government has initiated the Joint Delivery of Programs in Niche Subject Areas (JDPN) to build the capacity (including research capacity) of its local higher education institutions through international collaboration (Ilieva et al. 2020). The program was developed by the Philippines Commission for Higher Education together with the British Council, through consultation with Philippine higher education institutions. Research identified that most institutions aimed to strengthen their capacity and research collaborations through the internationalization of higher education. Many of the collaborative postgraduate programs have resulted in joint research publications between the United Kingdom and the Philippines.

Figure 9: Publications, Impact Factors, and International Collaboration



Note: The size of the bubble indicates the average number of publications produced per year over the time window indicated. As a reference, the average number of publications produced by the People's Republic of China for 2004–2008 is 244,435 while the average number per year for New Zealand for the same time period is 11,929. Countries were included in the graph if they produced an average of 1,000 publications or more per year. For this reason, not all countries represented in the 2014–2018 graph are shown in the 2004–2008 graph. The publications of all Pacific islands were aggregated and they are labeled 'PAC' in the 2018 graph.

Source: Asian Development Bank and British Council analysis of data from SciVal® database, Elsevier B.V., <http://www.scival.com> (downloaded on 22/01/20).

D. Measuring Research Quality

One caveat to the above discussion is that it relies on journal impact factors as a measure of research quality, which is far from an ideal proxy. Journal impact factors measure how frequently cited papers are. Field-weighted citation impacts factors attempt to normalize impact factors across different subject areas. However, even these have major drawbacks. The first issue is that impact factors massively favor publications written in English, which is likely to skew the results for many Asian countries (González-Alcaide et al. 2012 and Moed 2002). This is also likely to be a confounding factor in the association between quality and international collaborations, since international teams are more likely to publish in English. In addition, the widespread use of impact factors can lead to ‘gaming’ (for example excessive self-citation to increase impact factors) and can drive academics to focus more on research that is likely to be accepted to a high-impact journal, rather than focusing on research most likely to have real-world applications (Macdonald and Kam 2007).

There have been sustained calls for alternative metrics to the impact factor for many years (Wouters et al. 2019). Some alternatives have been established which make more use of webpage downloads or mentions in newspapers (PLOS Medicine Editors 2006). One novel approach to assessing research quality of universities (not of research papers) has been initiated by the Times Higher Education (THE), which now produces an Impact Assessment of universities based on their alignment to the Sustainable Development Goals (THE 2019). In other words, THE explicitly aims to rank universities based on their impact on society, rather than just on their publication record. At present, it is unclear whether any of these alternative approaches—or indeed new approaches yet to be developed—will affect the dominance of impact factors.

VI. CATALYZE INNOVATION BY MIXING SKILLSETS AND CREATING ENABLING ENVIRONMENTS

As set out in previous sections, the most important way that the education system can drive innovation is by building innovative human capital, and universities can also contribute by driving high-quality research. If these two factors are in place, innovation is likely to occur. In these circumstances, it is possible to further catalyze innovation by supporting initiatives that bring together people with different skillsets and by ensuring the environment enables innovation.

A. University-Industry Linkages

Probably the most well known approach to university-industry linkages is the development of a science or industrial park linked to one or more universities (Box 1). In many cases, policy makers assume that these developments will lead to direct commercialization of university-derived knowledge or technology. The model to which they almost universally aspire is Silicon Valley, with its vibrant community of start-up companies (MacDonald and Deng 2004). However, this aim is very rarely achieved; evidence from a vast range of science parks suggests that direct flow of ‘new to the world’ knowledge or technology from universities to new firms is extremely rare (Bakouros et al. 2002, Chan and Lau 2005, Corrocher et al. 2019, Malairaja and Zawdie 2008, Motohashi 2013, and Quintas et al. 1992). In fact, the evidence on whether science parks have a positive impact on innovation at all is extremely mixed; some studies report that science park location has a positive impact on a firms’ innovation (Fukugawa 2006, Lamperti et al. 2017, and Yang et al. 2009) but others report no impact (Liberati et al. 2016, Lindelöf and Löfsten 2003, and Westhead 1997). Low and middle-income countries have been particularly keen to support science parks in the hope that it will stimulate economic growth but, in most cases, they have failed to achieve their intended impacts (Rodríguez-Pose, and Hardy 2014).

A number of more recent studies have attempted to bring more clarity to discussions by investigating under what circumstances science parks might have positive impacts on firm innovation. For example, two recent studies suggest that while science parks are not good at triggering *de novo* innovation within firms, they can sustain innovation in firms that already have a good degree of innovative capacity (Corrocher 2019 and Ubeda et al. 2019).

Based on the evidence, there are some important lessons for policy makers. First, as discussed in the previous section, commercially viable innovation requires research excellence; building a science park around a university with mediocre standard of research output is unlikely to drive innovation (MacDonald and Deng 2004 and Newman 2014). Therefore, before assuming a science park will enable innovation, universities need to make a sober assessment of their research prowess.

A second important policy lesson is that firms do benefit significantly from linkages with universities—but they generally benefit more from the human capital coming from universities than from the technology or knowledge outputs (Audretsch 2014, Audretsch and Lehmann 2006, and Oketch et al. 2014). That is because having more people with higher educational levels increases the absorptive capacity of firms for innovative ideas (Di Gropello and Tandon 2011). Therefore, it is critical that

Box 1: Zhangjiang High-Tech Industrial Development Zone: University–Industry linkages

The Zhangjiang High-Tech Industrial Development Zone comprises 22 industrial parks and is located in Shanghai, People’s Republic of China. It was founded in 1991 and now hosts 20 universities and research institutes, as well as around 600,000 firms. In economic terms, Zhangjiang is highly successful—it accounts for 8.3% of the total industrial output value of Shanghai despite only taking up 1.2% of the land area. It is also generating an impressive and rapidly growing rate of patents and many new products and business models emerge from the park. The park has undergone a great deal of evolution since it was first established. In the early years, the focus was on developing infrastructure and attracting firms to locate there. Over time, through a series of reform efforts, attention has turned to strengthening university–industry linkages to drive innovation and technology transfer.

In common with most other industrial zones and science parks, the direct commercialization of research outputs coming from public research institutions and universities is rare and has not been the main focus of innovative activity. Instead, most of the innovation in Zhangjiang occurs within firms and the research centers they have established and is mainly adaptive innovation rather than ‘new to the world’ innovation. In recent years, there have been growing efforts to support networking between public and private research institutions, albeit with the understanding that commercially relevant innovation is most likely to occur when enterprises take the lead and draw on talent and knowledge from public universities and research centers.

Policy makers in Zhangjiang have recognized that human capital is a key driver of innovation and are proactively supporting policies to boost talent. One constraint to the attraction of talent has been the household registration system that restricts interregional and urban-to-rural migration. As partial compensation for this, authorities have relaxed immigration restrictions in order to attract more foreign talent to the area. In addition, they have strengthened efforts to develop in-house innovative capacity, for example by offering joint training to graduate students between universities and firms.

Conscious that commercialization of new knowledge and technology will only occur if the standard of research is outstanding, Zhangjiang research institutions have invested in high-quality research in frontier fields such as photonic science, energy technology, brain-like intelligence, and nanotechnology and have achieved world-leading status in a range of fields.

In addition to high-quality research, technology transfer will only occur if academics are incentivized and supported to commercialize new knowledge. Policy makers have therefore also focused on the enabling environment for innovation that surrounds and supports the university–industry nexus. Reforms include improvements to the intellectual property regulations to clarify ownership and incentivize innovation; introduction of innovative financing models; and comprehensive support services for firms and research institutions.

universities, whether in a science park or not, develop innovation capabilities. Science park-located firms can benefit from the proximity of potential higher-quality staff who, once hired, are able to drive within-firm innovation. Approaches which help to develop the right kind of skills amongst students are likely to be important to the success of science parks. One way to achieve this is to develop schemes that allow students to spend some of their time working and learning within firms.

B. Policy Environment

Policies, at both national and institutional levels, can have important impacts on the transfer of knowledge and technology from the university sector. In the United States, the Bayh-Dole Act, which allows universities and research institutions to retain ownership of new inventions, has been credited with increasing the number of patents from academic institutions twentyfold, although others dispute the size of its impact (Hemel and Ouellette 2017). As a result of its (perceived) success in driving technology transfer, at least 24 other countries have instituted similar pieces of legislation (GTIPA 2019).

Policies at national and institutional levels that secure ownership of intellectual property for researchers and reduce the bureaucratic barriers to transfer of knowledge are generally good for innovation (Guerrero and Urbano 2019). Nevertheless, many policies which have successfully driven innovation in one context fail to do the same elsewhere due to different contexts. Analysis of the evidence once again shows the importance of getting the foundations right before assuming that policy levers can be used to drive innovation (Mowery and Sampat 2004). Policy makers need to focus first on developing good quality human capital and strong research quality before regulations related to property rights are likely to have significant impacts on innovation.

VII. CONCLUSIONS AND POLICY RECOMMENDATIONS

The main conclusion from this brief is that the education system can be used to drive more innovative societies but that policy makers will need to ensure that they get the basics right first. In particular, there is no way to ‘leap-frog’ over good quality education. The five recommendations set out in this paper are summarized below and a brief overview of metrics that countries could use to benchmark their progress can be found in Appendix 2.

- (i) Policy makers who wish to drive innovation need to start by measuring learning to see if they are developing the human capital which is vital for innovation. If learning outcomes are low, they need to grapple with this problem first.
- (ii) Educators will need to employ approaches which develop innovative capabilities. There is much to be learnt from education systems in other countries, but transplanting approaches wholesale from elsewhere rarely works. Instead, policy makers will need to develop and promote teaching approaches that are locally owned and driven.
- (iii) Innovation relies on mixtures of skills within and between individuals. Therefore, policy makers should ensure the school system has a broad-based curriculum including

subjects drawn from science, technology and mathematics, social sciences, humanities and arts. Beyond school education, there is a need for flexible post-secondary education that evolves according to industry needs.

- (iv) The majority of private sector innovation occurs within firms and relies on the quality of human capital firms can attract. In addition, innovation can flow from universities to firms, but this generally only occurs if universities are producing world-leading research. Therefore, if technology transfer is an aim, policy makers need to focus on interventions to improve research quality.
- (v) In countries that are already performing well in developing innovative human capital and where high-quality research is being generated, there may be benefits to supporting additional interventions to catalyze innovation. The aims should be to mix people with different skill sets and outlooks and to ensure the policy environment incentivizes innovation.

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APPENDIX 1: TEACHING PRACTICE STUDIES

An extensive literature search was carried out to identify studies which had utilized classroom observation (either direct or via video recordings) to understand teaching practice. The quality and representativeness of these studies varied considerably. Some studies used a nationally representative sample of schools, trained observers extensively in observation techniques and verified that there were high levels of inter-rater reliability. On the other hand, some studies focussed on a small number of schools which may not be nationally representative and used ill-defined approaches to gather data on practice. Below we present the evidence that we were able to obtain for a range of Asian and Pacific economies along with some comments on the reliability and generalisability.

Afghanistan

Teaching practice in Afghanistan appears to be generally poor quality and highly teacher-centered. This conclusion is based on a single high-quality study which used a nationally representative sample.

The teaching practice study by Molina et al. (2018c) investigated 200 primary schools across 21 provinces, of which 170 constitute a nationally representative sample of public schools and the remaining 30 are community-based education schools managed by nongovernment organizations. The authors used the Systems Approach for Better Education Results (SABER) Service Delivery Tool and the Classroom Assessment Scoring System (CLASS).

Overall, the study revealed generally low quality of teaching and highly teacher-centered approaches. Some key observations from the study include:

“...general pedagogical knowledge, the ability to assess and respond to students’ learning, and, the institution of a monitoring system to measure what students know are poor across teachers in Afghanistan. Inside the classroom, many teachers deploy some of the teaching practices identified in the literature as promoting learning, but few (less than two in ten) apply the full set of beneficial skills— structuring, planning, asking questions, creating a positive environment and providing constructive feedback—in their lessons.”

“Teachers struggle both to read and understand a factual text (average score of 40%), and translate this information into teaching”

“Few teachers demonstrated an ability to assess student learning and respond to that assessment”

“Half of the teachers explained the topic of the lesson at the start and summarized what was learned at the end, and around 15% of lessons seemed unplanned to the observers.”

“During their lessons, many teachers asked questions that required students to recall information or to practice what was learned, but significantly fewer asked questions that required higher-order skills, encouraged students to apply what was learned to different contexts, or be creative.”

“Afghanistan classrooms mostly struggled with low levels of Instructional Support. Teachers did not usually make use of a variety of instructional methods, displayed low levels of content understanding, and were not likely to deliver high-quality feedback to their students. The area where teachers struggled the most was in providing students with opportunities to think and apply what was learned in a new problem. More than 90% of the teachers received the lowest score on this practice.”

Australia

Australia has a long history of constructivist-inspired educational reform and, the available evidence suggests that this has resulted in relatively learner-centered approaches to teaching. Australia scored in the middle range in the 2018 PISA tests suggesting that teaching practices are somewhat effective but could be improved.

Two high-quality cross-national studies of teaching practice in 2000-2003 included Australia. The results from these studies suggested that Australian teaching used significantly more learner-centered approaches than many countries in the Asian/Pacific region.

Aldrige et al. (2000) gathered qualitative data from observations in 50 secondary level science classrooms in Australia and compared practice with classrooms in Taipei, China. Some key quotes include:

“Observations in both countries confirmed that, in most cases, students in Australia indeed have more opportunities to discuss ideas and explain their learning to peers than students in [Taipei, China], where science classes tend to be more teacher-centred with fewer opportunities for student negotiation.”

“...reduced competition in Australian schools allows teachers more time for classroom activities which include opportunities for students’ negotiation. Many of the science classes that were observed in Australia moved away from the teacher-centred lesson that was so prominent in [Taipei, China] and

included various group activities that provided the opportunities for students to be involved in negotiation at different levels. ”

“There does not appear to be the same depth of content that is expected to be covered in Australia and this would appear to allow teachers more time for alternative teaching methods (such as library research) and more opportunities to invite students to share control with the teacher, including the articulation of learning goals and the design of learning activities.”

Australia is also one of the seven countries included in the comparative study by Hiebert et al. (2003).

The study is about teaching mathematics among Grade 8 students using the 1998-2000 Third International Mathematics and Science Study (TIMSS) Video Study. This method investigates the teaching practices in eighth-grade mathematics and science among various countries as well as teacher questionnaires. The filmed lessons collected were obtained across a full school year sampling. However, it should be taken note that the sample was not chosen to represent systematically the curriculum of each country. Some key quotes include:

“In all the participating countries, eighth-grade mathematics was taught predominantly through solving problems {...}. Apparently, this is the common currency of mathematics teachers in these countries. Some readers might regard this as an obvious finding, but the extent to which working on problems provides the prevalent instructional activity in countries around the world has not been documented previously.”

“Using a generous criterion, alternative solution methods were presented for 17 percent of the mathematics problems per lesson in Japan, a higher percentage than found in Australia, the Czech Republic, and [Hong Kong, China].”

“Lessons taught by mathematics teachers in Australia and the United States retained the making connections focus of problems less often than lessons in the other countries.”

Research by Tao et al. (2013) investigated the teaching and learning approaches in science lessons among Chinese and Australian elementary students. One objective of this research was to seek how these approaches have been influenced by different cultural contexts. The methodology employed was multi-comparative case study of six Grade 6 science teachers, three in each country, through classroom observations, teacher interviews and student questionnaire. Some key quotes include:

“Group work was a common feature in the lessons observed in high and medium socioeconomic case studies in both China and Australia... in Australia worked in pairs to discuss dependent and

independent variables, this lesson did not involve the students in conducting practical work or solving problems in groups.”

“...student presentations of work were evident in two of the observed lessons in Australia, {...} but not in any of the lessons in Chinese schools.”

Bangladesh

The evidence on teaching practice in Bangladesh is somewhat limited; there is one large but relatively old study and a number of more recent studies with small sample sizes which may not be nationally representative. Having said that, the findings from all these studies are consistent in describing a highly teacher-centered approach. Based on this it appears that teaching practice is likely to be highly teacher-centered but further research using nationally representative samples and rigorous methods to minimise bias in data collection would be valuable.

A research report by the government of Bangladesh on the English in Action program (2009) focused on the classroom observations of English lessons in primary and secondary schools in Bangladesh. The sampling included 252 classrooms for both primary and secondary levels. Classroom environment and teachers’ professional background and experience were observed. One key quote is:

“The pedagogic approach adopted in most lessons observed did not encourage a communicative approach to learning English. Throughout the lessons, teaching from the blackboard or front of the class was the predominant pedagogic approach. As the lesson progressed, teachers tended to read from the textbook, ask closed questions or move around the classroom monitoring and facilitating students as they worked individually. All other pedagogic activities were observed in less than 10% of classes at each of the times sampled.”

The teaching practice review by Haider and Chowdhury (2012) investigated the classroom practices, particularly on English Language teaching in secondary schools in Bangladesh. The methodology employed were classroom observations and teachers’ interviews through a sample of eight secondary schools and sixteen lessons, in which two lessons of Grade 9 in each school, and sixteen teachers. Some key quotes include:

“... it was observed that pair works and group works were not practiced in most of the classes for most of the times.”

“While talking to the teachers, it was revealed that they prefer sticking to the teacher-centered approach of teaching as it gives them “command” over the students’ learning. Moreover, some

teachers are with the belief that a teacher centered classroom enables them to complete a lesson smoothly and in time. It is clear from the finding that no one has ever challenged their authority or raised any questions about their established practice. Now when they are invited to consider exploratory learning or interpretive learning, they find a mismatch between their old practice and what is now being suggested.”

“Most teachers held the view that traditionally, learners in Bangladeshi schools are the passive receivers of knowledge and the learners believe that they have nothing much to do, as their teacher is responsible for doing everything. According to the teachers, in a culture like this, the learners feel shy and reluctant to speak out. Moreover, some teachers admit the fact that learners are not encouraged by teachers to ask questions and they always feel insecure and helpless about making mistakes. Therefore, learners prefer it to keep silent and listening to their teachers most of the time.”

“While responding to the question about dealing with students’ errors, majority of the teachers said that they do not have enough time to give constructive feedback to the learners. It is also evident from classroom observation that the teachers of Bangladesh have neither the skills nor the patience of correcting their students’ errors gently. By doing this, they are causing serious damages to the very spirits of a communicative classroom.”

The study by Rahman (2018) examined the various classroom assessment practices used by teachers of the secondary schools in Bangladesh. The sample included 30 science teachers from six schools in Dhaka city, in which 5 teachers were randomly selected. The methodology used was lesson observation protocol with pre and post observation interviews. Each teacher’s science class was observed following the protocol. Some key quotes include:

“...most of the teachers used only lecture method in their teaching learning activities.”

“... most of the teachers didn’t encourage students to talk and share ideas about science in the classroom.”

“The classroom questions are basically focused on very specific responses and encourage rote learning; even students’ didn’t get enough time for thinking and answering the questions.”

The study by Rahman and Sarker (2019) was about teachers’ classroom practices on English writing lessons among primary level students in Bangladesh. The sampling used were five teachers in five government primary schools which are randomly selected. The methodology employed was a classroom observation, where three lessons of each of the five teachers were observed. The authors also used a lesson observation and interview protocols as main instruments. One key quote is:

“Teachers used traditional teaching-learning methods emphasizing students’ rote learning and used Bangla as a medium of instruction. The study also found teachers’ challenges like large class size, extra workload, and lack of teaching aids. in developing students writing skill at the elementary level.”

Bhutan

Only one study was identified for Bhutan which suggests that in the schools sampled teaching practice was highly teacher-centered.

The teachers’ pedagogy study by Sherab and Dorji (2013) studied the teaching practices of primary schools in western Bhutan. The sampling covered 18 schools with levels from pre-primary to class VI with 36 teachers. The authors used teaching observations and interviews as methodology of this study. Some key quotes include:

“...teacher dominated lessons generally prevail in the primary classrooms with detrimental student learning outcomes”

“Data from this study also revealed that over eighty percent of the teachers interviewed supported the importance of student-centred teaching and learning. On the other hand, the class observations found that many of the lessons observed conformed to semi-student-centred and teacher-centred methods.”

“Findings from this study suggest that Bhutanese classrooms still need a major shift in this paradigm. The notion of teacher being the source of all knowledge for a student is still apparently prevalent in the minds of both teachers and students.”

Brunei Darussalam

Only one study which used a small sample size was identified for Brunei Darussalam. This study identified highly-teacher centered approaches in the schools sampled.

The study of Shahrill and Clarke (2014) investigated the teaching practice among the secondary level (Year 8) students. The authors adapted the Learner’s Perspective Study (LPS) approach, which is a classroom study of video recorded lesson sequences, in this case, four Mathematics classrooms and four teachers. This data collection approach involved videotaping a considerable number of consecutive lessons for each teacher, using a three-camera mechanism: Teacher camera, Student camera, and Whole Class camera. Some key quotes include:

“...during the public interaction segments of the mathematics lessons; students were busy copying the notes written on the whiteboard whilst the teacher was discussing or explaining to the whole class, the teachers were not dialoguing with the students, the students were passive, the teachers did most of the talking in the classroom, when the teachers did ask students mathematical questions or whether students understood the topic (that was given in the video recorded lessons), the students typically gave chorused answers (of a few words) or a short reply of “yes” or “no”, and in many cases, teacher questions were almost always rhetorical.”

“...independent student learning was almost non-existent.”

“In these four Brunei classrooms that we studied, the lessons were so rushed (except for 1 teacher), the teachers did most of the talking and when teachers and students do interact, it almost always involved faster-paced exchanges between them.”

“In the Brunei classrooms, faster-paced ‘back and forth’ verbal public exchanges between teachers and students were common. The fast pace of mathematics lesson instruction in the classrooms of the novice teachers was possibly the main reason for these portrayals of classroom activities. But for the experienced teacher {...}, although he had a relaxed attitude on the instructional delivery of his lesson, he also preferred to firstly, conduct his lesson according to his students’ learning pace and secondly, to try to encourage wider student participation.”

“The similar emerging issues are the prevalence of commonly frequented occurrence of students’ questioning behaviour in their classrooms albeit in private conversation moments rather than during the public discussions, and the perceived typicality by two of the teachers in the acceptance of chorused responses by the students. But the issue with chorused answering will only continue to exist when teachers persist in asking their students questions that are of low cognitive level.”

“Rather than asking questions or participating in classroom discussions during the public interaction segments, all four teachers indicated that their students preferred to interact with them during the private conversation moments of the lessons.”

Cambodia

The classroom observation evidence on teaching practice in Cambodia is relatively strong with two large, nationally representative studies as well as one smaller study. The findings of all these studies paints a consistent picture of highly teacher-centered approaches. They also demonstrate that subject level knowledge amongst teachers was insufficient. PISA results indicate relatively ineffective development of learning outcomes.

The teaching practice report by Benveniste et al. (2008) covered primary and secondary levels particularly 210 primary schools—approximately 6,500 students from 23 provinces and 150 lower secondary schools from 16 out of 24 provinces in Cambodia. The authors used the Cambodia Education Sector Support Project (CESSP) survey that collects information on school activities, performance characteristics, environment, and actual classroom observations. With the classroom observation, the report borrowed the strategy from the time-on-task and time segment studies by Bloom (1964) and Stallings and Kaskowitz (1974). A key quote is:

“Lower secondary school teachers prepare inadequately for class. Only half of lower secondary school teachers had lesson plans readily available on the day of an announced visit. Class time is mostly exclusively devoted to instruction or recitation. The time spent in applied individual or group work is low. Overall, classes tend to be highly structured with limited opportunities for interaction or creative thinking. Teachers tend to dominate the time-on-task through frontal instruction or asking questions.”

A World Bank report by Tandon and Fukao (2015) investigated the teaching quality and recommended policy reforms in Cambodia. The methodology employed were classroom observation, assessments of pedagogical content knowledge (PCK), and teacher and school director surveys, enlightening on the aspect of teachers’ training, professional capacity and teacher quality. For the teacher quality, the authors used the World Bank’s Systems Approach for Better Education Results (SABER) to conduct the teacher policy analysis. The teacher surveys were carried out in 2012 to 2013, covering 150 primary schools in all 24 provinces. Some key quotes include:

“Despite adequate facilities and positive perceptions of school environments, most of Cambodia’s teacher trainers have failed to provide sufficient content mastery and student-centered pedagogy. “...dictating lessons with little feedback or applied activities, or having students copy off the board for extended periods, suggests low-quality instruction.”

“Many also lack the skills to diagnose students’ mistakes and to propose solutions, raising concerns about eventual effectiveness in the classroom.”

“Mathematics knowledge is low—teachers answered only about half of the grades 6 and 9 mathematics items correctly. And the lack of lesson plans and student- initiated questions is a concern. Class time could also be used more efficiently, with less dead time or time off task.”

The study by Sokha and Prudente (2012) examined the learning and teaching beliefs of 13 lower secondary Biology teachers and used classroom observation to assess whether these were translated

into practice. They found that teachers expressed support for learner-centered approaches but continued to use highly teacher-centered approaches in the classroom. A key quote is:

Although teachers believed in learner centeredness, the translation of beliefs into their teaching practices was not generally observed.

Fiji

One study focussing on a small number of schools was found for Fiji. This study reported a mix of learner-centered and teacher-centered approaches. It is unclear how generalizable these findings are.

This chapter by Koya (2015) in the UNESCO report about the pedagogical practices in Fiji schools investigated three primary schools and five secondary schools in 2013. It employed a mixed-methods approach such as document and policy analysis, questionnaires, classroom observations, talanoa (an informal means of communicating in Samoa, Tonga and Fiji indigenous contexts) and an indigenous dialogic research instrument. Some key quotes include:

“Positive observations included effective management of spaces through colourful and creative classrooms, well-planned, -managed and -delivered lessons, a wide variety of activities, well-designed guided-learning activities for slower students, general abilities-focused tasks, code-switching and bilingual teaching to enhance understanding, development of own resources, and the effective use of positive reinforcement in some cases.”

“...very large numbers of students in small classrooms, which inhibited movement and group work; students coming late to class; lack of resources, text books and science equipment; language levels posing difficulty for students; poor time-management; note taking and lecture-style lessons; and predominant use of negative reinforcement. There was some concern about some teachers being too friendly and lax in their handling of disruptive students and, in one instance, of a teacher not being prepared. Yet another teacher was reported as having been distracted by non-teaching duties and having left the classroom, leaving students to their own devices.”

“Overall, the study found that the prevailing pedagogical practice among participant teachers is a mix of teacher-centred and student-centred approaches. There is an understanding among teachers of the relationship between content-knowledge focused lessons, in which teacher-talk and passive learning is sometimes necessary, and skills- and inquiry-based learning situations. However, understanding *and practice were not necessarily aligned.*”

Hong Kong, China

There is one high-quality, nationally representative, but rather old, study of teaching practice in Hong Kong, China as well as two smaller, more recent studies. These studies, along with the results from PISA, suggest that teaching in Hong Kong, China is effective in achieving learning outcomes using mainly teacher-centered approaches.

One of the seven countries included in the comparative study by Hiebert et al. (2003) is Hong Kong, China. The study is about teaching mathematics among Grade 8 students using the 1998-2000 Third International Mathematics and Science Study (TIMSS) Video Study. This method investigates the teaching practices in eighth-grade mathematics and science among various countries as well as teacher questionnaires. The filmed lessons collected were obtained across a full school year sampling. However, it should be taken note that the sample was not chosen to represent systematically the curriculum of each country. Some key quotes include:

“In all the participating countries, eighth-grade mathematics was taught predominantly through solving problems {...}. Apparently, this is the common currency of mathematics teachers in these countries. Some readers might regard this as an obvious finding, but the extent to which working on problems provides the prevalent instructional activity in countries around the world has not been documented previously.”

“...[Hong Kong, China] and Japan emphasized new content, with Japan focusing on introducing the new content and [Hong Kong, China] focusing on practicing the new content.”

“...no differences were found on the percentage of mathematics problems per lesson that involved proofs among the Czech Republic, [Hong Kong, China], and Switzerland”

“Using a generous criterion, alternative solution methods were presented for 17 percent of the mathematics problems per lesson in Japan, a higher percentage than found in Australia, the Czech Republic, and [Hong Kong, China].”

The research by Li, Rao, and Tse (2012) investigated how Western ideas were used or translated into teaching practices through case studies of Hong Kong, China; Shenzhen; and Singapore primary schools. The methodology employed is classroom observation and teacher surveys, covering 18 early childhood classrooms. The survey was about teaching practices and how they manifest these inside the classrooms and towards the students. Stratified random sampling was used to identify the kindergarten classes (4-year olds and 5-year olds) from the three primary schools catering to middle-class societies that are representative of the three locations. Some key quotes include:

“Whole-class teaching was the most frequently used mode in [Hong Kong, China] (54.9%){...}Some instructional time was spent on large-group (8–15 students) teaching in [Hong Kong, China] (14.5% {...}), but very little time was spent on individual and paired teaching.

“Teacher-directed explicit instruction was the prevailing teaching strategy in the Chinese classrooms ([Hong Kong, China]: 59.8%...”

“Strategic questioning of group children was frequently observed in [Hong Kong, China]; individual interactions and feedback were also preferred.”

The classroom interaction study by Yiqi (2012) was focused on the enhancement of critical thinking skills among secondary level students in Hong Kong, China. The methodology used was classroom observation and audio recordings of second year of senior high school classroom with 44 students participating.

Some key quotes include:

“...it can be shown that the face-to-face classroom interaction has provided a knowledge basis for students’ development of critical thinking. Although such a process seems to be co-constructed by both the teacher and the students, the teacher remains the main distributor of content knowledge. In this sense, the offline classroom interaction tends to be teacher-centered.”

“...with the traditional initiation response feedback (IRF) pattern and long feedbacks and explanations, the interactions tend to be rather teacher-centered.”

“... students can obtain basic facts and content knowledge from the teacher, which serves as the basis for development of higher order thinking.”

India

India is a huge country with a great deal of decentralisation in education provision. Therefore, evidence from one state may not necessarily reflect the situation in another. Three large, high quality studies of classroom practice were identified which together provide evidence on Andhra Pradesh, Madhya Pradesh, Uttar Pradesh, Bihar and Tamil Nadu. These studies present a picture of largely teacher-centered approaches but with examples of interactive approaches being introduced in some cases. The activities described in the studies suggest a focus on the lower levels of Bloom’s taxonomy of learning, i.e., remembering and understanding but there was little indication of activities related to higher order thinking. It is not clear to what extent these findings can be generalised to other Indian states. Nationally representative data (ASER 2018) reveals low learning levels across India suggesting that teaching practices are on average relatively ineffective in supporting learning.

The report by Sankar and Linden (2014) is about the kind of teaching that exists in the primary school levels in India. The authors investigated 100 government schools each in the states of Andhra Pradesh, Madhya Pradesh, and Uttar Pradesh during 2006-2007. Private schools were selected from each neighborhood of every fifth government school. In each state, 1,680 classrooms were observed using the Stallings Snapshot Observation Schedule (SOS) method. Some key quotes include:

“Teachers were engaging children in student-centric, higher order activities for around 24 percent of the classroom observation time on average. However, a fifth of the classrooms observed were devoid of any student-centered tasks of teaching-learning.”

“Overall, the largest proportion of time was spent on activities that were teacher-centric. Traditional teaching activities accounted for over 40 percent of overall classroom time and more than 50 percent of all teaching time within the observed classrooms.”

“Teacher-centric methods with no materials or only the blackboard were observed three-quarters of the time.”

“Within student-centric activities, more observations using Teaching Learning Materials (TLM) or innovative methods were found in classrooms in government schools.”

The teaching performance study by Sinha et al. (2016) investigated elementary level education in 400 schools in Bihar with more than 2,000 teachers tracked during three visits to each school. The study used a variety of methods, including teacher surveys; classroom and school observations; and an assessment of teachers’ subject matter knowledge, ability to communicate, and ability to learn from children’s work. Some key quotes include:

“...teaching in Bihar’s elementary schools is carried out in a traditional way. Students sit in rows and work individually. There is hardly any group work. The observations of classroom interactions in both grades—Class IV and Class VI—indicate that the teaching was almost entirely driven by textbook content. Most teachers were observed to be reading from the textbook (89 percent) and asking oral questions to students from the textbook (67 percent) or asking students to recite (49 percent).”

“Fifty-seven percent of teachers were observed writing on the blackboard—usually content from the textbook—and in 44 percent of the classes, students were asked to write (in their notebooks or slates). Hardly any material other than textbooks were used—either by teachers or students.”

The World Bank Report (2016) discussed what is happening inside Indian secondary levels classrooms in the states of Madhya Pradesh and Tamil Nadu. The study investigated 150 schools where Language and

Mathematics classes for class 10 in each school. In case it was not possible to survey class 10, class 9 was observed in that school using the Stallings tool, SOS log, student questionnaire, school and teacher questionnaire, and teacher understanding student knowledge questionnaire. Some key quotes include:

“Overall, almost 89 percent of teachers’ time was spent on instructional activities. However, there is significant difference in Madhya Pradesh and Tamil Nadu on how time is being spent in the classroom.”

“There are important differences in the way instructional time is used across subjects. Teachers are spending more time on ‘Discussion’ and ‘Reading Aloud’ in Language than in Mathematics classrooms. ‘Assignment/class work’ and ‘Copying’ activities take up a higher proportion of class time in Mathematics classrooms than in Language classrooms.”

“While teachers were able to identify errors made by students correctly for some of the questions of lower class levels, there were cases where most teachers missed fundamental conceptual errors made by students.”

Indonesia

Evidence on teaching practice in Indonesia is scarce. Two studies which provide some insights were identified—one study focussed on student teachers while the other study observed teaching practice after an in-service teacher training intervention. The findings from these two studies may not be generalizable to the general population. Having said that, it is unlikely that the subjects in these two studies are using less learner-centered approaches than the general population and therefore the findings could be seen as a ‘best case scenario’. The results from the studies suggest that whole-class teaching approaches remain prevalent but that some more interactive approaches were being introduced – particularly by the new student teachers. The activities described in the studies suggest a focus on the lower levels of Bloom’s taxonomy of learning, i.e., remembering and understanding but there was little indication of activities related to higher order thinking. Results from the PISA tests suggest that teaching is relatively ineffective in developing learning outcomes.

The teaching study by Azkiyah and Mukminin (2017) investigated the teaching quality amongst student teachers in Indonesia. The authors used a mixed-method design through classroom observation and questionnaire for students. The sample included 199 students of three different schools. Some key quotes include:

“Nevertheless, the student teachers started to introduce group work although they had to learn how to maximise students’ work in the group. It was apparent that only several students seriously worked in their groups”

“...the student teachers raised questions to lead the discussion during the lesson. This activity was even observed in the very beginning of the lesson. The student teachers, for instance, raised some questions to discuss students’ homework and or to review previous materials. However, the questions did not promote students’ critical thinking. The questions raised, for instance, were related to who, what, when, and where, the answers to which could be easily found in the text. Questions concerning why and how, which are expected to encourage students’ critical thinking, were not really introduced.”

The paper by Harjanto et al. (2017) was about the impact of a program on improving teacher quality and student learning. The sampling included 193 in-service teachers in 350 schools across provinces in Indonesia namely North Sumatera, Riau, and Jambi. The authors employed an explanatory mixed-methods evaluation through a survey, interviews, and observations. The intervention was the community-based teacher professional development program. Some key quotes include:

“...teachers had started to apply only a few components of AICEPL (Active, Innovative, Creative, Effective, and Pleasant Learning) but still tended to use more traditional direct teaching methods.”

“...when asked in the pre-observation interview what they planned to do, lecturing was still the most dominant teaching style and the expected learning outcomes were mostly lower order thinking—remembering and understanding.”

“The post-classroom observation interviews found that the most teachers thought that they carried out their lesson plans well...only a few teachers {...} felt that the teaching objectives were not achieved. These teachers said that students had difficulties understanding the lessons and need more assistance to grasp the whole concept.”

“When observed during their class session, teachers demonstrated more teacher-centred approaches, and correspondingly, students also reported more teacher-centred behaviours.”

“More than half of the observed teachers were seen to have failed to engage their students actively in the teaching and learning process.

“...teachers’ knowledge of student active learning is in need of improvement, particularly in the areas of encouraging higher-order thinking skills and student-centred learning.”

“As the teachers themselves reported, teachers seemed to have attempted applying active learning principles in their classrooms by engaging their students in group-work...confirmed by the classroom

observation and their students' opinions...However, the dominant learning processes in the classrooms still tended to be teacher-directed rather than student initiated."

Japan

Teaching practice in Japan has been the focus of international attention based on the high results it obtains in international tests and on a seminal study from 1999 which revealed teaching approaches to Mathematics which were significantly more focussed on problem solving than those employed in other countries. Perhaps surprisingly then, there is a paucity of studies published in English since the 1999 study which examine teaching practice in Japan. The 1999 study suggests a teaching approach which is exceptionally strong in fostering higher order thinking skills and which generally uses whole-class teaching approach.

One of the seven countries included in the comparative study by Hiebert et al. (2003) is Japan. The study is about teaching mathematics among Grade 8 students using the 1998-2000 Third International Mathematics and Science Study (TIMSS) Video Study. This method investigates the teaching practices in eighth-grade mathematics and science among various countries as well as teacher questionnaires. The sample of the Japanese lessons were collected over a four-month period via the TIMSS 1995 video study (Stigler et al. 1999). There was no evidence that the sampling done was not representative of the teaching practices at that time even if it is not ideal (since lessons are not drawn across the full school year). *Some key quotes include:*

"In all the participating countries, eighth-grade mathematics was taught predominantly through solving problems {...}. Apparently, this is the common currency of mathematics teachers in these countries. Some readers might regard this as an obvious finding, but the extent to which working on problems provides the prevalent instructional activity in countries around the world has not been documented previously."

"Japanese eighth-grade mathematics lessons focused on presenting new content through solving a few problems, mostly as a whole class, with each problem requiring a considerable length of time."

"...on average, Japanese eighth-grade mathematics lessons were characterized by devoting lesson time to solving relatively few problems and spending a relatively long time on each one."

"Applications—problems that ask students to decide how to use procedures rather than just execute them—were a feature of eighth-grade mathematics problems in Japanese lessons (74 percent of problems per lesson) to a greater degree than in all the other countries except Switzerland."

Malaysia

Evidence on teaching practice in Malaysia is limited. Two small-sample studies were identified which used classroom observation in primary schools. In addition, there is a study of training practices within a teacher-training college. Although this latter cannot be taken as evidence of what practices teachers go on use in the classroom, we can be somewhat confident that if practices are not even being introduced to pre-service teachers then they will not be implemented once they begin practicing. The overall picture based on these studies is of mainly teacher-centered approaches but with signs that some more interactive approaches are being introduced. The fact that even in the teacher training college it was rare to see teachers encouraging critical evaluation suggests that this practice may be relatively rare amongst teachers – although this would need to be tested with actual classroom observation studies. Malaysia scores in the low range for the PISA test although it does perform significantly better than some of its South-East Asian neighbours. This suggests that teaching is more effective in Malaysia than in some nearby countries but that there is still a great deal of room for improvement.

The instructional practices in teaching paper by Sidhu and Fook (2010) examined the primary level language lessons in the state of Selangor. The authors used classroom observations and interviews to assess five Teaching English as a Second Language (TESL) teachers in five randomly selected schools. In each school, one TESL teacher is randomly selected and was observed four times. Some key quotes include:

“...teachers spent a lot of time on individual comprehension work with little emphasis given to comprehension instruction and higher order thinking skills. The integration of literary elements in the literature classrooms was also minimal and teachers lacked creativity as far as organizing learning tasks were concerned.”

“Where instructional practices were concerned, all five respondents were able to articulate what constituted good teaching practice. All agreed that teaching has to be student-centred. Teachers A, B and C admitted that their classrooms were not student-centred as their students were very weak in English and it was difficult to get their students to participate in classroom discussions. Hence, they were aware that their classrooms were indeed teacher-centred. All the respondents were aware of the importance of pre, while and post reading activities.”

The study on teachers and implementation of new curriculum by Hardman and A-Rahman (2014) examined the teaching practices and curriculum reforms in primary schools in Malaysia. The authors

employed a purposive sampling of eight English teachers from a cohort of over 100 teachers attending three-day in-service training in Malaka with class of 35 students each on average. These teachers were selected based from years of teaching experience (7 years) and had taught both the old and new English curricula. The methodology used is a mixed-method approach composing of teacher interviews, lesson observations, systematic analysis of recorded lessons, and discourse analysis of lesson transcripts. Some key quotes include:

“Lesson observation notes recording timeline activities across all 32 lessons showed teachers spent relatively little of the lesson time interacting with pupils: on average it occupied 25% of the time. Lessons normally started with action-based classroom activities such as songs and games followed by teacher-fronted talk and by individual seat work based on tasks taken from the chalkboard or textbook {...} no collaborative group work was observed in any of the classes.”

“Individual seat work on average occupied 31% of the lesson time, often ending with teacher supervision of the class or the marking of work with little teacher–pupil interaction taking place. It was also rare for teachers to share the learning objectives with the pupils and to use a discussion to draw the whole class together at the end of the lesson to summarise, consolidate and extend what had been covered, and direct pupils to the next stage of learning.”

A study by Ong et al. 2018 examined the teaching practice of lecturers in a teacher training institute in Malaysia. A total of 20 lessons taught by 13 lecturers were observed. While this study does not give information on actual practice in school classrooms, it provides useful triangulation by revealing what new teachers are being taught about pedagogical practice. Some key quotes include:

“...it was a prevalent practice for students to do small group presentations (#3, frequency, $f = 11$), to complete a problem solving activity (#1, $f = 10$), to assign students into small discussion groups (#2, $f = 8$), and subsequently to present their work in class (#6, $f = 10$). Additionally, it was observed that the teaching and learning did provide students the opportunity to discuss real-life situations related to the topics at hand (#10, $f = 7$). Nevertheless, there was a scarcity from the observed practices which foster critical evaluation such as critically evaluating the work or ideas of their peers (#7, $f = 5$), challenging the ideas proffered by their lecturers or by their peers (#8, $f = 1$), and debating on an issue (#4, $f = 1$).”

“...lecturers fell short of fostering intellectual excitement in terms of having students to compare theories and concepts which are relevant to the lesson at hand (#11, $f = 5$) and providing students with the opportunity to ask higher order thinking questions (#12, $f = 5$).”

New Zealand

Evidence from New Zealand’s Education Review Office and from a single study focusing on technology teaching suggest that group work and interactive teaching are commonplace in New Zealand classrooms. There appears to also be good practice in stimulating higher order learning although this continues to be the focus of attention for policy makers. The PISA 2018 results suggest that teaching is effective in developing learning outcomes.

New Zealand’s Education Review Office carries out evaluations of schools using various methods including classroom observations. Reports from ERO demonstrate that, in at least some New Zealand schools, interactive practice goes much further than just approaches within the classrooms with students being active participants in the planning of teaching and learning. For example, in a report on what drives learning in secondary schools (ERO 2018) it is stated:

“In some cases, the school made good use of these reflections: responses and information gathered from students were acted on by teachers to improve their delivery and to improve aspects of the school. Students were able to contribute to course planning, to their own progress and pathways and, in some cases, to designing their own assessments, because they knew what was expected and were encouraged to have a say in decisions affecting them.”

A report from ERO on the integration of Key Competencies into teaching practice (ERO 2019) used classroom observation along with interviews to understand how well teaching was building competencies including ‘thinking’ and ‘participating and contributing’. The report concludes that most schools are integrating the use of the Key Competencies to enhance well-being and learning. Examples were provided of good practice from schools which encourages critical engagement, using a variety of thinking tools and being self-directed learning.

A study by Almutairi (2019) on technology teaching in primary schools in New Zealand (in comparison to practice in Saudi Arabia) carried out classroom observation in a single primary school. A key quote is:

“The study’s findings also indicated that the teachers implemented a variety of teaching methods and that problem-based learning, enquiry learning, discussion, designing and student self-assessment, together with collaborative and individual learning, were key strategies implemented for technology education in New Zealand class-rooms”

People's Republic of China

The People's Republic of China (PRC) is another huge Asian country. Its education system is more centralised than is the case in India (Bingman 2010) but still, caution must be observed in generalising evidence on education practice from one region to the rest of the country. Although no large, nationally representative studies of teaching practice were identified, there are a number of small studies which give fairly consistent results. Overall, the evidence suggests that mainly whole-class instruction approaches are used but that there are signs of more interactive approaches being introduced. There are also mixed reports on the use of strategies to develop higher order thinking skills. Encouragingly, one study which looked at schools which were part of the first phase of roll out of a major curriculum reform, demonstrated that teachers in the reform school showed enhanced skills in development of higher order thinking skills. Four provinces in the PRC took part in the recent round of PISA testing and scored higher than any other country. This demonstrates that teaching approaches, at least in those provinces, is highly effective in developing learning outcomes.

The pilot study by Coflan et al. (2018) covered the primary and junior secondary schools in Guangdong, PRC. The methodology used was the Classroom Assessment Scoring System (CLASS) tool in which classroom observation were implemented on a sample of 36 teachers in three counties across Guangdong namely Dianbai, Lianjiang, and Wuhua. Each county had four schools observed, two primary schools and two junior secondary schools; one of each rural and one of each urban. There were no qualitative descriptions of teaching however the teachers scored low on enquiry and regard for student perspective.

The psychometric evidence-based study by Hu et al. (2016) investigated a sample (through stratified random sampling) of 180 kindergarten classrooms across three municipalities in Guangdong. The sampling selection was based on quality classifications based on current governmental rating and funding source of the schools. The study used the Classroom Assessment Scoring System (CLASS) tool. Some key quotes include:

“...whole-group instruction is the most prevalent form of teaching/activities... [this] usually focuses on academic learning tasks... instead of... concept development, creativity and language advancement... The limited academic activities that they are engaged in usually focus on repetition, recitation, and memorization...”

“...Chinese kindergarten teachers lack the relevant knowledge and strategies to enhance the children's critical thinking skills and creativity through play and routine activities.”

A study on teaching practice by Li and Ni (2011) investigated primary mathematics school level of a city in the PRC. The sampling included matched groups of 33 teachers from an area which had not yet introduced new curriculum and 25 teachers from area which had introduced new curriculum. Each teacher was filmed for 3 of his or her classes within a 3-day period. The authors used their own coding system based on previous studies of Mathematics teaching. Some key quotes include:

“...77% of the instructional tasks in the non-reform group, compared to 50% of the tasks in the reform group, were those involving memorization or procedures without connections.”

“...students in reform classroom had more opportunities to discuss and evaluate different ideas and to pose questions.”

“...reform teachers used a significantly higher proportion of instructional tasks with high cognitive demands, when compared to the teachers of the classrooms using the conventional curriculum.”

“...often ‘discussion’ appeared to be meaningful but was sometimes little more than teacher-centered questions and answers.”

A study by Yan (2012) explored secondary school teaching practice. It is an in-depth case study of three teachers (representative of early, middle and late career stages) in a single school triangulated with additional observations and interviews with other secondary school teachers. The authors used a three-level coding system via various kinds of data such as the interview transcripts, classroom observation notes, and field-notes. The three levels are open coding, axial coding, and selective coding where data was organized by clustering and generating conceptual categories of responses and units to come up with themes and subthemes. Some key quotes include:

“There emerged a high level of endorsement of... the proposed philosophy of developing students’ autonomy, collaboration and inquiry learning...”

“... however {...} teachers’ classrooms displayed major features of ‘three Ts’: teacher-centred, textbook-centred, and test-centred”

“The teacher talked to the whole class, and if any interactions occurred, they were generally between the teacher and one student. The class was generally quiet. Most of the time students kept on looking at their textbooks with little eye contact with the teacher and with each other.”

The research by Tao et al. (2013) investigated the teaching and learning approaches in science lessons among Chinese (Hunan) and Australian elementary students. One objective of this research was to explore how these approaches have been influenced by different cultural contexts. The methodology employed was multi-comparative case study of six Grade 6 science teachers, three in each country,

through classroom observations, teacher interviews and student questionnaire. Some key quotes include:

“...participating Chinese students reported a greater proportion of their science lessons involved activities such as reading textbooks and memorizing facts, activities that are consistent with Confucian educational culture.”

“Group work was a common feature in the lessons observed in high and medium socioeconomic case studies in both the PRC and Australia...students in worked in small groups to conduct an experiment on the expansion and contraction of air.”

“...only lesson that did not involve small group work at all was the lesson observed in the Chinese low socioeconomic case study where students worked almost the entire lesson either individually or as a whole class.”

“...students in the Chinese high and medium socioeconomic case studies chanted important facts at the end of their lessons on the expansion and contraction of air and magnetism...”

“According to the Chinese Grade 6 students, the three most frequent activities they participated in during science class were writing or giving an explanation of what they were learning, reading books about science, and watching the teacher conduct a science experiment.”

The research by Li, Rao, and Tse (2012) investigated how Western ideas were used or translated into teaching practices through case studies of Hong Kong, China; Shenzhen; and Singapore primary schools. The methodology employed is classroom observation and teacher surveys, covering 18 early childhood classrooms. The survey was about teaching practices and how they manifest these inside the classrooms and towards the students. Stratified random sampling was used to identify the kindergarten classes (4-year olds and 5-year olds) from the three primary schools catering to middle-class societies that are representative of the three locations. Some key quotes focused in Shenzhen include:

“Whole-class teaching was the most frequently used mode in {...} Shenzhen (68.6%); Some instructional time was spent on large-group (8–15 students) teaching in {...} Shenzhen (9.3%) {...}, but very little time was spent on individual and paired teaching.”

“Teacher-directed explicit instruction was the prevailing teaching strategy in the Chinese classrooms {...} Shenzhen: 63.5%...”

“...Shenzhen teachers were very comfortably conducting direct teaching.”

“...the Listen-and-Play approach, the shared-reading approach, and theme-based integrated teaching were used in Shenzhen.”

Philippines

Two high quality studies of primary school teaching practice were identified for the Philippines; one covered the entire country and the other only the Mindanao region. Both studies reveal a highly teacher-centered approach using mainly whole-class teaching and showing little evidence of development of higher order thinking skills. The recent PISA test results demonstrate that teaching in the Philippines is relatively ineffective in developing learning outcomes.

The World Bank report by Molina et al. (2018) on teaching practices covered 45 public primary schools across the Mindanao region. The methodology used is Teach Classroom Observation Tool, in which 24 observers were trained and certified to investigate the teaching practices of 140 teachers. They observed classes in Mathematics, English, and Science among grades 1, 2, and 3 students. Some key quotes include:

“Teachers provide superficial thinking tasks (61%){...} rather than tasks that require students to analyze content at a higher level (19%)... Most teachers do not encourage students to identify and synthesize relevant information, analyze problems, or evaluate solutions... they provide few or no opportunities for students to make choices and take on meaningful roles, rarely promote student efforts or encourage goal-setting, have either a negative or neutral attitude toward student challenges, and do not foster a collaborative classroom environment...”

“...teachers score around the medium range in facilitating the lesson, checking for understanding, and providing feedback; however, they are less likely to encourage students to think critically.”

“Mindanao teachers are poor at promoting student autonomy, fostering perseverance, and at promoting social and collaborative skills.”

The United States Agency for International Development report by Pouezevara et al. (2014) discussed reading assessment results in the early grades of elementary education and implementation of the Mother Tongue-Based Multilingual Education (MTB-MLE). Early Grade Reading Assessment (EGRA) tool, one of the instruments used in this report, is a criterion-referenced measure and is implemented orally. The authors also used teacher survey and a classroom observation tool. The instruments employed used a nationally representative sample in Grade 3 comprising 6 regions with 2,400 students and regionally representative sample in Grade 1, comprising of 1 region with 500 students. Some key quotes include:

“Teachers were predominantly using teacher-centered, whole class instruction. Students participate in turn, when asked either to read something out loud or to answer a question.”

“...in only 10% of the observed lessons were students engaged regularly in productive speaking, listening, and/or writing activities.”

Republic of Korea

Two studies using relatively large, but not necessarily nationally representative, samples of secondary school teaching were identified. The studies suggest an approach characterised by whole-class teaching with relatively little interaction but with relatively strong cultivation of higher-order thinking skills. High scores in the PISA test suggest teaching is generally effective in developing learning outcomes.

The research study by Campbell et al. (2010) investigated the teaching practice to secondary level students (Grade 9 to 12) between Korean and American science classrooms. The authors conducted classroom observations using the Reformed Teaching Observation Protocol with data from 66 science classrooms, 26 from Republic of Korea and 40 from the United States of America. Each teacher was observed within one class period. This data sampling was reported to be a convenience sample because the sources were taken from the places where American and Korean researchers were based. However, this data was reported to be informative since it was obtained prior to any intervention or development. Some key quotes include:

“...teacher-dominated classrooms in Korea may inhibit teaching and learning framed by constructivism.”

“...little consideration for students’ prior knowledge in how lessons were designed, little science process emphasized that might empower students to explore and create ideas based on concrete experiences, and little emphasis on communication occurring among students in either country.”

“...the lack of opportunities for students to share with peers is cause for concern in that it deprives students from negotiating and constructing knowledge with others and their community at the time they are learning science.”

The teaching practice study by Grift et al. (2017) assessed the teachers in secondary schools between the Republic of Korea and the Netherlands. Particularly for Korean schools, a sample of 375 teachers were observed. These teachers taught 25 different subjects. The authors used six observation scales from reviewed educational effectiveness studies, then implemented a multigroup confirmatory factor analysis. Some key quotes include:

“The 375 South Korean teachers perform significantly better than the Dutch teachers on “teaching learning strategies” and almost significantly on “differentiating instruction.”

“...South Korean students have access to teachers with more advanced teaching skills with regard to teaching students how they should learn and better differentiating their instruction to meet the distinct needs of their students.”

“Dutch teachers significantly ($<.001$) outperform South Korean teachers with regard to organizing ‘intensive and activating teaching’ (Cohen’s $\delta = .21$).”

Singapore

Two studies of primary school practice, both with small sample-sizes, were identified for Singapore. Both studies suggest that teacher-centered approaches were prevalent but there are some suggestions that learner-centred approaches (i.e., more interactive approaches and stimulation of higher-order thinking) were emerging. PISA results demonstrate that Singaporean teachers are highly effective in developing learning outcomes.

The article by Curdt-Christiansen and Silver (2012) focussed on lower primary schools in Singapore. The study examined teaching and classroom practices and explored instructional organizational patterns and participation lesson structures against traditional cultural beliefs. Data and methodology employed were lesson observations in primary 1 (7–8 years and primary 2 (8–9 years) English classrooms, 10 lessons for primary 1 and 10 for primary 2 and a coding scheme that maps participation structures and various details of the learning environment. Some key quotes include:

“Whole-class teacher-fronted participation patterns predominated”

“...peer work was used quite infrequently.”

“The overall environment was not highly conducive to social and conversational interactions, with interaction encouraged in only 53.3% of participation patterns while 46.8% of all participation patterns tended to discourage interaction.”

“Consistent with the predominance of whole-class teacher-fronted structures, the most frequently occurring activity was ‘classroom management’ – in which the teacher actively managed student behaviour and work – 28% of all activities. The second most frequent activity was ‘giving instructions’ (15%). Taken together, these indicate that 43% of all activities were teacher-focused, management and procedure-oriented.”

“...teachers did little overall to encourage independent learning. Similar low results were found for promoting collaboration or stimulating creativity. The situation was even less encouraging when it came to promoting problem solving. Over 90% of the total observed participation patterns indicated that teachers rarely, if ever, promoted this learning skill.”

The research by Li, Rao, and Tse (2012) investigated how Western ideas were used or translated into teaching practices through case studies of Hong Kong, China; Shenzhen; and Singapore primary schools. The methodology employed is classroom observation and teacher surveys, covering 18 early childhood classrooms. The survey was about teaching practices and how they manifest these inside the classrooms and towards the students. Stratified random sampling was used to identify the kindergarten classes (4-year olds and 5-year olds) from the three primary schools catering to middle-class societies that are representative of the three locations. Some key quotes focused in Singapore include:

“Whole-class teaching was the most frequently used mode in {...} Singapore (91.1%);”

“Teacher-directed explicit instruction was the prevailing teaching strategy in the Chinese classrooms {...} Singapore: 73.5%).”

“In Singapore, two kindergartens used the theme-based approach and one was trying the project approach to promote emergent literacy.”

“...Singapore teachers used SAIL (Story Approach to Integrated Learning), the story approach, and the project approach...”

“It was found that the theme-based approach, whole language approach, project approach, and TPR approach were widely used in Singapore;”

“...the Singapore teacher was leading a project to conduct some emergent literacy activities, although it was transformed into a teacher-directed learning activity.”

Taipei, China

Evidence on teaching practice in Taipei, China is scarce. Two studies were identified both of which describe mainly whole-class teaching approaches. Results from the 2018 PISA test indicate that teaching in Taipei, China is effective in developing learning outcomes.

The cross-national study of secondary level science classrooms by Aldrige et al. (2000) explored 1,879 students from 50 classes in Taipei, China. The authors used the Constructivist Learning Environment Survey (CLES) and qualitative data such as classroom observations and interviews with teachers and students. Some key quotes include:

“Observations in both countries confirmed that, in most cases, students in Australia indeed have more opportunities to discuss ideas and explain their learning to peers than students in [Taipei, China], where science classes tend to be more teacher-centred with fewer opportunities for student negotiation.”

“...classes in [Taipei,China] tend to be teacher-centred to enable them to cover the content of the textbook. Time constraints allow few diversions and fewer opportunities for students to exercise control over what they learn.”

“Teaching in [Taipei,China] is often centred on developing academic ability as efficiently as possible and diversions from teacher-centred methods can be viewed as off-task by parents and students. The competitive nature of the education system in [Taipei,China] often forces teachers to use more teacher-centred methods, thus providing few opportunities for activities which include student negotiation. In addition, it was felt that, in terms of academic achievement, teaching methods which are not teacher-centred could be less effective. “

A study by Liaw (2012) examined the teaching practices and beliefs of student teachers.

“Pronunciation practice and activities or games where students could speak English were also mentioned by the majority of participants. However, of all the participants, only [one] created a classroom atmosphere that directly reflected this belief.”

Thailand

Only one study with a small, non-nationally representative sample was found focussing on Thailand. This study reported mainly teacher-centered approaches however it is unclear how generalizable these findings are. Results from the 2018 PISA test suggest that teaching in Thailand is relatively ineffective in developing learning outcomes.

The teaching practice study by Tayjasanant and Barnard (2010) investigated secondary level schools. The authors used the Classroom observation tool to assess eight teachers (purposive sample) in two Thai secondary schools, one in public sector, the other a private language school. The two secondary schools were picked due to differences in terms of size, administration, curricula, reputation, and teaching styles. Some key quotes include:

“In general, the teachers in both schools espoused the idea of student-centered learning.”

“In both schools the proportion of teacher-talking time (TTT) far exceeded that of the students {...} Not only did the teacher’s talk dominate the lessons, but the type of questions they asked suggested little opportunity for students to use English extensively.”

“In the private school, only one teacher asked a few open-ended questions, such as ‘Why do you think that the owner of the room is a writer?’, ‘In which part of the world do you think the house is located?’ ‘Why do you think that this house is in England?’ and so on. Despite the teachers’ general

endorsement of child-centered learning, the very high proportion of such questions is not indicative of a student-centered approach in either school, as both the questions and the responses are directed by the teacher, and those responses are, by their nature, extremely limited in extent.”

Viet Nam

One large study of teaching practice in kindergartens and primary schools as well as two smaller studies focussing on secondary school teaching were identified. These studies suggest a mainly teacher-centered approach.

The teacher quality study by Hoang et al. (2018) investigated classroom engagement and teacher-student interactions in Vietnamese primary schools. This study used the Classroom Assessment Scoring System (CLASS) tool on a sample of 1474 kindergarten children and 60 teachers from 12 primary schools in three cities. Some key quotes include:

“...due to many and fast-paced activities in one teaching session, the teachers in the study were afraid of running out of time, which caused the teachers to ignore students’ ideas or fail to help students who did not have a strong understanding of the lessons.”

“...the study has demonstrated that Vietnam had teacher-centred teaching style and large class size...”

The paper by Cao (2018) focused on teaching instruction competencies for developing higher-order skills such as critical thinking and creativity in teaching Mathematics to secondary level students. The author used a survey covering 3 provinces in Vietnam namely Thai Nguyen, Quang Ninh, and Bac Giang with 60 participating teachers. In addition to the methodology, the author reviewed the teachers’ answers through the questionnaires and classroom observations and activities. Some key quotes include:

“...there are only 18.3 % of them, who regularly implement instruction for developing higher -order thinking skills for secondary students. In addition, 15.1% of the surveyed teachers never implement instruction for developing higher-order thinking skills for secondary students.”

“The survey results showed that teachers’ capacity in using questions were not proportional with their knowledge of Maths. Although they could in-depth understand the knowledge of Maths, they did not usually give any questions for their students that probe reason and evidence.”

“...teachers more frequently asked their students repeated concepts, formulas, and theorems; they often asked students distinguished concepts, gave examples, explained concepts and theorems; sometimes they wanted their students to apply concepts, formulas, and theorems in new situations.

In addition, they rarely asked questions that students must give their perspectives and viewpoints or look for consequences of concepts, formulas, or theorems.”

The study by Pham and Roberts (2012) investigated the classroom performance evaluation of secondary school teachers in Viet Nam. The sampling utilized were 34 participants where 10 are evaluators and 24 are teachers from various school aspects such as rural areas, towns, and cities. The methodology employed are interviews and classroom observations.

“While most teaching strategies match the requirements of the instructional guidelines, not all the teaching methods will hold students’ attention.”

“...memorization or performing lab experiments method may not interest the student as much as the ‘inviting students to enter the world of the subject matter’ method...”

APPENDIX 2: METRICS TO BENCHMARK PROGRESS

Recommendation	Potential Metrics	Comments
1: Focus first on basic skills	<p>(iv) International standardized learning tests such as PISA, TIMMS, Early-Grade Reading Assessment (EGRA)</p> <p>(v) Composite datasets which attempt to compare learning outcome data across multiple countries drawing on a range of datasets. These include the World Bank Learning Poverty Dataset and Altinok et al. (2018).</p>	<p>The availability of learning outcome data has improved massively in recent years. There is still room for improvement to ensure that learning outcomes are measured at different levels of schooling, for different geographical areas within countries and that data is disaggregated by gender, by disability status and by displacement (because of fragility or conflict) status. Nevertheless, there is sufficient data available at this stage to know that many Asian and Pacific countries have a severe learning crisis.</p>
2: Shift teaching practice to develop innovation capabilities	<p>(vi) Data from classroom observations has been gathered using a range of different tools including CLASStm (Pianta et al. 2008), TEACH (Molina et al. 2018) and Stallings (World Bank 2015).</p>	<p>Little is known about the comparability of results from classroom observation studies across countries so benchmarking is not possible currently .</p> <p>As discussed in paper, self-reported practice of teachers or reports from students on teachers' practice are unlikely to provide accurate assessment. To properly bench-mark teaching practice, cross-country classroom observation studies would be required.</p>
3: Optimize the mix of skills	<p>(vii) Curricula reviews</p> <p>(viii) Standardized testing for language, mathematics, science, and digital skills</p>	<p>A tool kit for measuring breadth of learning opportunities was developed (Anderson et al. 2018), but data on this is not being systematically gathered. Standardized testing exists for a narrow range of subjects.</p>

4: Drive research quality	<p>(ix) Average field-weighted citation impact factors</p> <p>(x) THE Impact ranking of universities</p>	<p>Impact factors can be calculated for all countries however, as discussed in the paper, these are by no means a perfect proxy for research quality.</p> <p>The Impact Rankings may provide a better proxy for research quality for developing countries, but may not capture high-tech research and innovation.</p>
5: Catalyze innovation by mixing skillsets and creating enabling environments	<p>(xi) Innovation linkages indicator of Business Sophistication pillar of the Global Innovation Index (Cornell University, INSEAD, and WIPO 2019)</p> <p>(xii) US Chamber International IP Index (Pugatch et al. 2018)</p>	<p>Data exists in the Global Innovation Index on innovation linkages however, as the authors themselves acknowledge, it is unclear whether the data they have is a good proxy for success in this area. In part this is because, as discussed in the paper, many university-industry linkage schemes do little to drive innovation. Therefore, it may be more appropriate to use a more qualitative assessment to measure whether a range of schemes to mix skill sets are in place and whether they are genuinely driving innovation.</p> <p>Indices of innovation policy such as the US Chamber International IP Index are available. Again, these metrics should be interpreted cautiously since, as discussed in the paper, a policy which works well to stimulate innovation in one context may not be effective in another context if the foundational conditions are not present.</p>

Source: Authors.