Chapter 15
Adaptivities in the Singapore Education System: From Great to Excellent

David Hung, Shu-Shing Lee, and Kenneth Y.T. Lim

Introduction

Singapore has consistently achieved high student performances on national and international assessments. In 2010, the McKinsey report on how the world's most improved school systems keep getting better evaluated Singapore as a 'great' system on a four-point scale – 'poor', 'fair', 'great', and 'excellent' (Mourshed, Chijioke, & Barber, 2010). The report identified that for Singapore to progress, quality teaching and learning practices are key leverages. Thus, for Singapore to transform towards 'excellent', the system needs to cater to twenty-first century goals while maintaining TIMMS and PISA test scores achieved in recent years (OECD, 2010; Olson, Martin, & Mullis, 2008).

Twenty-first century literacies have always been a goal the Singapore education system aspires towards. Singapore believes that research in local classrooms can inform the complexity of this change process at multiple levels of the education system. Over the last 7 years, educational research managed by the Office of Education (OER)[1] in the National Institute of Education (NIE) has involved various studies capturing baseline data of teaching and learning in schools, interventions that aim to change pedagogy and learning practices, and blue-sky experiments on novel ideas.

This chapter aims to discuss how educational research invested in the school system has yielded research studies and findings that may inform how Singapore might shift from 'great' to 'excellent'. The chapter also postulates that a shift towards 'excellent' requires the education system to be adaptive in different ways at various levels of the system and yet be aligned towards a shared vision. In this way,

[1] The Office of Education Research is responsible for awarding funds and managing educational research in the National Institute of Education, NTU, Singapore.

D. Hung • S.-S. Lee (✉) • K.Y.T. Lim
National Institute of Education, Nanyang Technological University, Singapore, Singapore
e-mail: shushing.lee@nie.edu.sg

D. Hung et al. (eds.), *Adaptivity as a Transformative Disposition: For Learning in the 21st Century*, Springer Education Innovation Book Series,
DOI 10.1007/978-981-4560-17-7_15,

small pockets of pedagogical innovation spread across the system and enable change and adaptivity. The system as a whole transforms through a long and gradual process that is informed by educational research.

Constructing Our Stance on Systems Change and Adaptivity

Systems Are Nested and Interconnected

Mizikaci (2009) has asserted that all systems are nested within other systems. From a systems perspective, the education system has within itself smaller sub-systems that are, for example, related to classrooms, schools, families, and social welfare.

Bronfenbrenner's (1979) framework on ecologies is a useful lens to conceptually analyse the Singapore education system because it perceives an environment as comprising multiple layers that are nested within each other and have resulting impact on the next level. Using this framework, education systems can be organised into five nested sub-systems that co-influence each other:

- The *chronosystem* refers to the patterning of environmental events and transitions over the life course, as well as sociohistorical circumstances. As an example of sociohistorical circumstances, consider how the opportunities for women to pursue a career have increased during the last 30 years (Santrock, 2008). For the purposes of this book, we use chronosystem to refer to cultural dimensions – such as move towards articulating a distinct East Asian pedagogy – which have influenced the development of Singapore's education landscape.
- The *macrosystem* characterises Singapore by comparing its pedagogies and practices with other high-performing education systems, such as Finland and Shanghai.
- The *exosystem* relates to education policies that Singapore as a system enacts. Examples of education policies are *Thinking Schools, Learning Nation* and *Teach Less, Learn More*.
- The *mesosystem* concerns contextual dimensions related to students' daily activities, for example, family and peer influences as well as the school environment, learning spaces within the school, and the school's leadership.
- The *microsystem* focuses on the kinds of pedagogies and practices that happen in classrooms, such as, how pedagogies impact student motivation and how pedagogical practices are enacted in classrooms.

Aligning the System Towards a Shared Vision

System components interact with each other and the effects of these interactions are felt throughout the system. Each sub-system adapts within its parameters, with other sub-systems, and they co-influence each other on a system-wide level.

Thus, it is important to understand the interplay between the educational system and different drivers of change, such as research studies that intervene in classrooms, parent groups, and shifts in funding policies (Lemke & Sabelli, 2008).

Given the nested and integrated nature of the system, there needs to be an integrated view of values across and within the subsystems. All levels of a system – however they are defined – should be coordinated and interconnected. A coherent, integrated system occurs when all components or parts of the system are connected to each other to achieve a common purpose or shared values (Mizikaci, 2009). Work at each level has to be mutually reinforcing with respect to the purpose and shared values of that system or sub-system. In the context of education systems, the shared values could be educational equity, inclusiveness, and embracing diversity. Work at each subsystem needs to reinforce and make shared values explicit to the community.

Activities as Means to Achieving Shared Values

Activities provide services, establish standards, or engage in events and tasks that produce outcomes related to system-wide goals and values (Hmelo-Silver & Pfeffer, 2004). Activities can be structured differently, with different goals and intentions, at various sub-systems. Ideally, activities at different levels should coordinate and adapt over time to achieve system-wide goals. However, this may not always happen.

Many studies adopting Activity Theory as analysis discuss how tensions arise across sub-systems. In an activity system, individuals perform different roles and functions that are coordinated by norms and rules. Contradictions happen when norms and rules are not aligned. This, in turn, inhibits the achievement of system goals and values (Engestrom, 2000; Murphy & Rodriguez-Manzanares, 2008; Yamagata-Lynch & Haudenschild, 2006).

Implied in Activity Theory is the importance of the capacity to work in teams and collaborate with others to achieve goals and outcomes. Consistent with this, experiences of top-education systems suggest that teachers are important individuals. The performance and quality of an education system cannot supersede the quality of its teachers (McKinsey & Company, 2007). Top-education systems engage in various activities to keep the quality and capacities of teachers relatively high. Top-education systems attract the 'right' people to be teachers. These systems recruit teachers from the top percentile of each graduating cohort. There is a limit to the number of teachers enrolled in teacher education courses to maintain the quality of training. Rigorous selection criteria and attractive salaries elevate the status of the teaching profession because cultural perceptions play a role in attracting talented people to be teachers. At the same time, teachers are urged to participate in professional learning communities (PLCs) and communities of practices (CoPs) to dialogue, reflect, and improve on their practices. Teachers are encouraged to conduct research about their practices and introduce evidence-based innovations in classrooms to enhance learning experiences. Insights generated from research can be channelled to enhance teacher education and professional development courses.

Roles and Professional Accountability

Systems are composed of actors working at multiple levels. Through activities, actors in sub-systems partake in their respective roles and work towards the shared goals and visions of the larger system. Systems literature indicates that cooperation, coordination, and collaboration are pivotal in the successful functioning of systems (Cohen, 2008). It is also equally important to foster relationships and mutuality at all levels.

As the system adapts to accomplish shared goals and values – in an ideal situation – the system needs to maintain accountability and ensure that goals at sub-systems are also achieved. However, some times, sub-systems may have many defined key performance indicators (KPIs) and these may not necessarily sum up to the overall system accountabilities and indicators. Over-doing or narrowly defined KPIs at one level may consequently cause more damage at the next level of the system. Actors should not over emphasise quantifiable performance indicators at the expense of implicit values. It is important to engage in activities that are meaningful rather than looking out for observable outcomes.

Figure 15.1 summarises issues depicted in the literature review which are related to system adaptivity and change. To reiterate, we see systems as deconstructed into three major components: shared values, activities, and professional accountability. Shared values are the common beliefs about the goals and purpose held by members in the system. Activities are organised to achieve these goals and build capacity of individuals in the system; they also develop collective or group capacities to enact and perform activities. Accountability refers to the professionalism and responsibilities needed by every member of the system.

The literature on systems adaptivity and change emphasises that the systems environment is in a state of constant and discontinuous change (Stevens & Cox, 2008). Begun, Zimmerman, and Dooley (2003) claim that complex adaptive systems provide multiple and creative pathways for action. Adaptive systems put in place structures that allow the system to be more adaptive. In the subsequent sections, the chapter analyses educational research at each sub-system in order to characterise adaptivity at various levels. Insights from research are discussed to inform structures needed at different sub-systems to enable change to happen. Such an evidence-based approach towards change suggests that educational research at various sub-systems may spread across the entire system to enable gradual systemic change and adaptivity.

Research Interventions Classified Within Bronfenbrenner's Framework

Approximately 200 research proposals, funded research projects, and their respective publications on a range of domains – all of which were carefully reviewed based on strict criteria by local and international experts before they were awarded

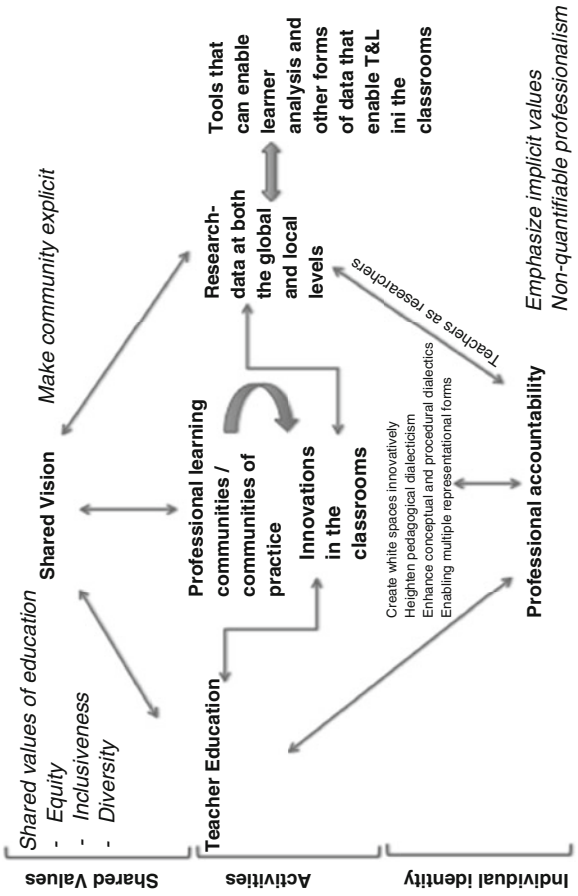


Fig. 15.1 Adaptivities in the system

grants – have been categorised according to the five levels of Bronfenbrenner's (1979) framework to derive a set of research themes and findings which spread across the education system in Singapore. Educational research at various levels generates insights on how to transform and adapt the system for the future.

Chronosystem

Findings and analysis in the chronosystem aim to trace the historical developments and adaptivites of the Singapore education system from the nation's independence to the current context.

In the early years (1959–1978), Singapore went through a *survival* phase. The key focus then was to develop every child's basic literacy and numeracy skills (Goh & Gopinathan, 2008; Mourshed et al., 2010). At the end of this phase, Singapore achieved near universal primary education but there was high-educational wastage (Goh & Gopinathan, 2008; Mourshed et al., 2010).

Consequently, the *efficiency* phase (1979–1996) focused on reducing performance variation by streaming students into different academic tracks based on their aptitudes. Teaching practices became highly prescriptive and textbook-bound, and examination-driven. This phase proved highly effective as teachers developed sophisticated abilities to teach to the test. This phenomenon became a double-edged sword. On one hand, students managed to achieve relatively high academic standards. However, when schools became overly effective in examination-smart strategies, students may not develop twenty-first literacies that are widely emphasised today.

As the Singapore education system continued to develop, central control by the Ministry of Education (MOE) gradually decreased. In 1997, Singapore went into the *ability* phase and launched a vision for *Thinking Schools, Learning Nation* (TSLN). This vision gave teachers and schools greater flexibility and autonomy in the ways they taught and managed students, to help every child reach maximum potential. The ability phase focused on creating a responsive education system that kept the best of the old while adapting to new changes as needed by providing more academic pathways for different student profiles (Goh & Gopinathan, 2008; Mourshed et al., 2010). For example, brighter students could join the Integrated Programme that spans 6 years, where they can proceed from secondary school to junior college education without taking the GCE 'O'-level examination.

In 2012, the MOE announced a new phase – a student-centric, values-driven education – where students are to be grounded in sound and ethical character with dispositions, such as adaptability and resilience to face twenty-first century challenges. This is not to imply that abilities in the academics have been de-emphasised, but that MOE is signalling a need to shift education towards twenty-first century values and dispositions.

Over the last 40 years, the Singapore education system has evolved into one with distinctive streams for different abilities as well as many pathways and ladders to move from one trajectory to another (see Appendix 15.1). From a macrosystems perspective, Singapore's education system is adaptive and constantly changing. MOE has invested heavily to enable flexibility for students to switch pathways from academic to vocational tracks and vice versa. All learning pathways provide opportunities for students to graduate from universities.

Tracing the evolution of the education system in Singapore is important because the context of the latter differs from that of, say, Finland. An education system should be aligned with global and local contexts to maintain its competitive edge and relevance. One factor inherit in our local context is East Asian values. Giving a good education to children is an implicit and innate desire for most families as it is seen as a route to advance up the social economic ladder. East Asian pedagogies also differ philosophically from Western ones in that discipline and diligence, including that of rote learning, seems reasonable. A large class size seems undesirable to Western education; and while deeper analysis and observations show that Asian teachers value student thinking and participation, their definitions of student-centred experiences differ from the West (Mok, 2006).

In other words, education in Singapore needs to be adaptive in ways which preserve its local East Asian values and balance that with Western education styles that emphasise creativity, entrepreneurship, and innovation. The system needs to constantly adapt and reflect on how these seemingly diametrical constructs are achievable in our students.

Macrosystem

Research at the macrosystem focuses on how Singapore's evolution and achievements compare with other systems. Findings from TIMMS and PISA show the average baseline literacy in Singapore is above average when compared to other systems, except for those at the lowest tenth percentile of each cohort, which is Singapore's Normal (Technical) students (OECD, 2011). Researchers have analysed Singapore's data in TMISS and PISA to identify factors that predict students' academic and non-academic outcomes and compared it with other successful systems (Kaur, 2010; Lee, 2010). This kind of research is important because it compels the Singapore education system to adapt, improve, and understand reasons for why some factors work or otherwise. Building on these findings, MOE is seeking ways to close achievement gaps between the higher achieving and lower achieving students. There is an also greater cognisance of system structures needed to cater for those lagging behind in their academic performances.

Another area of research aims to analyse Singapore's teacher education practices and compare it with other countries. These comparisons surface factors in teacher education that influence high student achievements (Wong, 2006, 2009). Findings

about teacher education in other countries enable teacher educators in Singapore to gain insights and identify areas for improvement. In Singapore, the system fosters teacher professionalism through leadership supports for PLCs and other forms such as CoPs (Hung, Shaari, & Lyna, 2012). The structures that underpin PLCs and CoPs are less formal. Thus, teachers become more adaptive and experimental with pedagogies.

Exosystem

Research in the exosystem examines how education policies are enacted to assess how the education system is transforming. The MOE has initiated numerous policies and generic observations suggest that it is not easy to translate policies into classroom practices. School leadership is needed to ensure policies get enacted as intended (Silver, 2011). Generally, the education system needs to move towards student-centred learning. However, there is a lack of policies that support deep enactment of self-directed and collaborative learning practices. Policies are needed to develop content and pedagogical knowledge and an action–learning process to enact such learning practices. Policymakers need to change their mind-sets about teacher–researcher partnerships as an integral culture to evolving practices and policies.

Another theme of research shows that student-led pedagogies can be more efficacious if teachers work collaboratively with an accompanying PLC or with researchers as co-designers/co-researchers. Teachers contribute insights from a practitioner perspective while researchers equip teachers with research skills to consistently refine their own teaching practices (Fang & Lee, 2010).

On the surface, research findings suggest that the system is rather rigid to new policy initiatives. When teachers perceive numerous top–down policies, they typically find ways to cope and stay convicted to their beliefs of preparing students for examinations. Research on policy enactments ought to understand that teachers need time and supporting processes to enable the translation of policies into classroom practices.

Mesosystem

Research at the mesosystem attempt to illustrate adaptivities in three areas: (1) distributing leadership to enable changes in teaching and learning practices, (2) adapting instructional practices to the needs of students, and (3) learning from specialised schools to offer different learning opportunities.

Findings suggest that leadership from principals and heads of departments is critical to support and reward teachers as they adapt school culture, curricular design, and classroom practices (Taylor, Kwek, & Foo, 2011). Generally, changes

in teaching and learning practices happen when there is school-wide support from administrators, curricular leaders, teachers, and students (*ReEd* [Research in Education], 2011i). Decentralised leadership empowers teachers to design their own curricula and develop expertise to manage student-led interactions. PLCs play a key role in this change process. They are platforms for teachers to build capacities by sharing best practices, addressing issues, and reflecting their experiences with peers (Dimmock, 2010).

Preliminary evidence also suggests that adapting teaching and learning practices to diverse student needs is a complex issue. To level up students in the bottom percentile, teachers need to develop the expertise to adapt their practices accordingly to students with special needs, slower development, and those who are gifted in non-academic ways. School leadership should understand the struggles of teachers in specific areas, such as special needs, and support teacher professional development (Lim, Wong, & Cohen, 2011).

Findings from specialised schools show that building partnerships with various communities can offer adaptive opportunities for students to learn in authentic environments (Shaari, Hung, & Lee, 2011). For example, the School Of The Arts has links with the arts community and the Singapore Sports School partners with sports councils and federations to carry out their curricular. These links enable students to tinker and experiment with practitioners to develop other talents and dispositions.

These findings also suggest that mainstream schools need to explore ways to build links between schools and communities so students can learn in authentic situations. Investigations are needed to explore how such links enable the integration of main curricula with co-curricular activities to support self-directed learning, adaptivity, and collaboration. Links between schools and communities as well as bridges between main curricula and co-curricula may be possible levers to cultivate teaching practices that develop and recognise talents that go beyond the academics.

Microsystem

Research at the microsystem suggests that to enhance students' learning experiences, particularly for low-achieving students, it is important to adapt towards student-centred pedagogies that balance explicit knowledge with tacit experiences. Empirical evidence suggests that if teachers begin with students' ideas or get students to solve real-life problems first and bring in scaffolds later, students' understandings could be better developed than if teacher-led instruction is assumed from the start (Kapur, 2008). Similarly, the order of learning abstract concepts first followed by practicum need not be followed strictly. It is more important for students to experience variations in ideas and solutions to different problems in order to develop deep understandings through exploration and inquiry (*ReEd*, 2011h, 2011k).

Teachers and researchers can work together to create opportunities for inquiry-based learning and knowledge building by engaging students in critical thinking and productive interactions with peers (*ReEd*, 2011a). In this kind of research, teachers become facilitators – engaging students in problem solving and knowledge discovery through hands-on activities. Accordingly, students begin to take ownership of their learning (Fan, 2010; *ReEd*, 2011c, 2011d, 2011e). In other instances, researchers use technologies and virtual environments to facilitate knowledge creation through peer interactions (*ReEd*, 2011f, 2011j) or enable knowledge building through role-playing and first person's perspectives (*ReEd*, 2011b, 2011g). These kinds of knowledge construction emphasise 'learning by doing' and appropriate new ways of seeing meanings.

The preceding examples of research interventions at the classroom reveal that pedagogical innovations are possible. Sustaining pedagogical innovations in classrooms require teachers to be adaptive to new partnerships, pedagogies, technologies, and ideas. Teachers need to change their mind-sets and believe that student-led learning is a process they want to enact.

Discussion

In this section, insights from research spread across Singapore's education system are discussed in relation to systems' adaptivity and change. The discussion attempts to highlight that systemic change is an evolutionary process, in which research plays a participatory role. Four dialectical interactions are emphasised to further enable adaptivity and change within Singapore's education system:

1. Goals of an Adaptive Education System for the twenty-first century;
2. Adaptivity between Actors and the Meaning-making Process;
3. Interplays between System Goals and Activities, and Actor Accountabilities; and
4. Interplays between Learning Experiences in Formal and Informal Contexts.

Goals of an Adaptive Education System for the Twenty-First Century

If Singapore desires to be an 'excellent' education system, adaptivities at all subsystems and a movement towards twenty-first century teaching and learning goals are encouraged. These twenty-first century goals with insights from Barber and Mourshed (2009) can be conceived along the following dimensions:

- *Students* are equipped with twenty-first century skills that go beyond conceptual knowledge to include twenty-first century literacies, values, and dispositions. Diverse learners are given equal access to high-quality education.

- *Quality teachers* are well-informed about what constitutes learning, 'How learning occurs', and 'How to make it work for diverse learners'. Teachers constantly improve their practices by reflecting and dialoguing with themselves and peers.
- *Leaders* provide teachers with resources and supports to learn about student-centred pedagogies and provide teachers with the autonomy to adapt teaching and learning for different students.
- *The system* consistently benchmarks itself with other systems. Structures and organisation are put in place to adapt, manage change, and engage stakeholders in the change process. The system is cognisant of its uniqueness and context when closing gaps and enacting policies to achieve high-quality learners.

Adaptivity Between Actors and the Meaning-Making Process

Appropriate interventions at various sub-systems seem to be key activities that propel the education system towards twenty-first century goals. Baseline research on existing teaching and learning practices show that teacher talk still pervades in Singapore's classrooms (Hogan & colleagues, 2009). Dynamic two-directional interactions between teachers and students are needed to enact student-centred pedagogies and enable students to construct deeper understandings. Findings from student-centred pedagogies at the microsystem have shown that such heightened adaptivities between teachers and students can be achieved. These kinds of interactions reflect the first kind of interplays and adaptivities that occur at the teacher–student level.

A movement towards student-centred pedagogies needs a paradigm shift in the assumptions, culture, and practice of teaching and learning. Teachers need to be actors of change and function as adaptive experts (Bransford, Brown, & Cocking, 2000). Teachers can no longer be routine experts who help students excel in examinations. They need to be adaptive in helping students develop deeper understandings and twenty-first century literacies. Teachers can enhance students' meaning-making processes by encouraging increased interplays between: (1) procedural and conceptual knowledge, and (2) multiple forms of representations and their respective meanings. Our findings have shown that when learners are exposed to content knowledge in various forms instead of just one representation, understandings can be enhanced.

Analyses of research presented in this chapter suggest that teachers need to heighten their capacities in terms of their understandings of student-centred pedagogies and how to enact practices that are appropriate for their schools' contexts and goals. When school leaders show explicit support to teachers and are in constant dialogue (interplay) with their teachers' experimentations and learning of student-centred pedagogies, intended goals can be better achieved. Similarly, when teachers participate in PLCs and CoPs and when they construct artefacts, such as

conference papers, teachers' learning and understandings of student-centred pedagogies become more engaged because there is interplay between conceptual and practical understandings.

Interplays Between System Goals and Activities, and Actor Accountabilities

Whilst MOE drives policy for change, teachers on the ground know that 'teaching to the test' is pivotal both to school rankings and to give students an advantage in school placements. Although MOE has embarked on school rankings with multiple criteria beyond the academics, it is important to recognise that cultural changes through the system would take years.

From our findings at the exosystem level, we know that policy-to-practice translations have been less than ideal in adaptivity terms. Policy translations from MOE to teachers need much more dialogue compared to the current situations. Teachers need structures and support and capacity building in order to enact twenty-first century learning and policy intents. Twenty-first century literacies are not identical to explicit knowledge, which schools and teachers are used to enacting. Twenty-first century competencies are process-inclined more than content- or product-inclined. They cannot be 'tested' in traditional examinations.

Our research at the microsystem level shows that teachers need to be closely guided in partnerships with researchers or possibly master teachers who possess the expertise, to encourage them to experiment on new pedagogies and continue to maintain order in classrooms. Importantly, teachers need to be supported in their efforts by evidence and data because innovations may in the short term produce less than ideal results but typically benefit in the longer term. Thus, student data on twenty-first century learning as a complement to the typical test scores is critical. Teachers could work with researchers and master teachers to develop teacher competencies in data collection and analysis. It is increasingly important to invest in teacher-support tools to aid in data collection, aggregation, analysis, and interpretations so teachers can make timely and appropriate decisions in classrooms. Teachers also need to know that their principals are supportive of their capacity building endeavours.

Movement towards twenty-first century goals can be further enhanced if various stakeholders (such as, teachers, school leaders, policymakers) go through the process of learning and arrive at a consensus that student-centred pedagogies are indeed needed to prepare learners for the future. Stakeholders need to be deeply convicted that there should be inclusiveness and equity in education for all learners – gifted or otherwise. Stakeholders should have the professional accountability to provide diverse students with quality learning experiences.

Continuous dialoguing on shared vision and values is also needed in the system – in schools, professional society meetings, and others – to bring alignments in

the second kind of interplays between system goals, activities, and personal accountabilities. Alignments will occur when parties involved in the system see their roles as they perform in the various activities in smaller parts that lead to the collective whole. This is possible only when stakeholders make sense of their roles and identities with reference to the shared goals and values. The important emphasis is the shared understandings of the collective. Teachers, school leaders, and policy-makers have to make explicit their values through dialogue, actions which they engage in, and allow the community to provide feedback in the interplay of personal goals and system goals.

Interplays Between Learning Experiences in Formal and Informal Contexts

The third kind of interplay is the interaction between formal actions, activities, and goals in relation to implicit and less formal (or informal) ones. When the stakes are high, individuals do not innovate, experiment, or take risks. Teachers, students, and perhaps the system need to design for activities where people can innovate in less formal settings in order to develop a culture for innovations.

In schools, students participate in co-curricular activities. These are less formal activities where students can tinker and experiment. Teachers too need to be involved in professional activities and societies where they can try out new ideas, put ideas forth to the community without fearing failures or that the activities may have negative influences on their yearly performance appraisals. Consequently, teachers can begin to engage in actions with outcomes that may not be measureable explicitly. Teachers participate in these activities because they are motivated by the positive influences it has on their profession and community.

In Finland, there is a culture of trust amongst the community that schools and teachers will do their best to help students experience holistic learning. It is their duty as professionals to adapt their practices and ensure learning goals are met (Kupiainen, Hautamäki, & Karjalainen, 2009; Sahlberg, 2007). There should be ways to reward the contributions of teachers to the educational community at large and not just at the individual school level.

This also means that an overemphasis of achievements at the respective school level can have less than intended consequences at the larger and systems level. Professionally informed teachers think not just at their local levels, but draw implications at the community- and systems-levels. The community of teachers will know through word of mouth about the quality work of certain teachers and find ways to recognise and reward them for the good work. The interplay between the explicit and implicit motivations can be productive when teachers who develop motivations and bring these beliefs to the formal, and vice versa. We reckon that when the three kinds of interplay: (1) teachers and the meaning-making process,

(2) goals of the system, activities, and teacher accountabilities, and (3) teachers learning in formal and informal contexts – occur over time and the culture for innovation continues, the heightening of the teaching profession occurs. Thus, adaptivity is an integral aspect for the capacity building of teachers and their professionalism.

Interplays Between Local Systems and International Benchmarks

The fourth kind of interplay is the constant benchmarking of local systems' goals and performances with international standards. Studies that make comparisons across systems have made transparent data about other systems (Webb, Vulliamy, & Hamalainen, 2004; Yeom & Ginsburg, 2007). Such studies enable interplays between different systems. Consequently, education systems can benchmark themselves against international counterparts, learn from others, and motivate reforms for further improvement. Figure 15.2 shows the four dialectical interplays discussed above that enable adaptivities within Singapore's education system.

For example in Finland and South Korea, the teaching profession is highly desired and coveted in the society (Webb et al., 2004; Yeom & Ginsburg, 2007). Teachers' sense of professionalism, including that of teachers' competencies in disciplinary understandings, are also of high quality. Similarly there ought to be a strong sense of professionalism and accountability towards the shared values in Singapore's education system. Teachers need to be professionally aligned to the shared (and changing) values espoused in the education system. They need to be involved in activities which are aligned with the goals of the system, and be accountable to these intentions – explicit or otherwise.

Conclusion

Education systems are accountable to many stakeholders. If innovations and interventions are not sufficiently novel, it becomes hard for education systems to transform. How can this dilemma be addressed? This chapter suggests that transformations through a sufficiently long and gradual participatory process may be key. Small pockets of pedagogical interventions need to be spread across the system. A longitudinal orientation to interventions is needed in which small interventions are progressively made, and in which processes and supporting structures are available to evolve the education system. In the meantime, the system should continue to afford for the collection of data with regards the success of levelling up. Ultimately, it is the enlightened teacher and school leader who would enact the transformation and adaptation process. Clear standards and goals have to be articulated. Teachers need to go through the enactment and embodiment of shared values which are aligned to

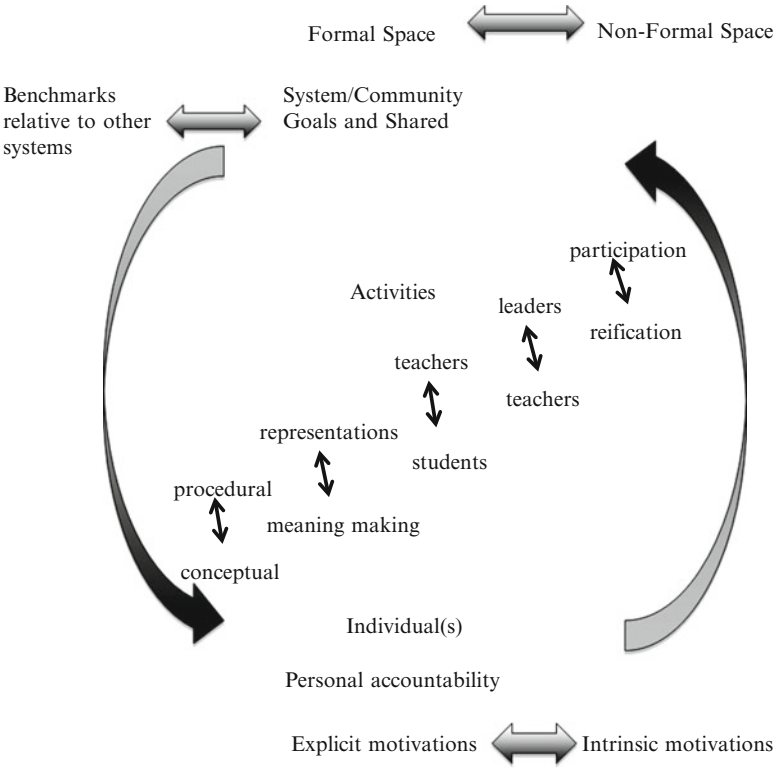
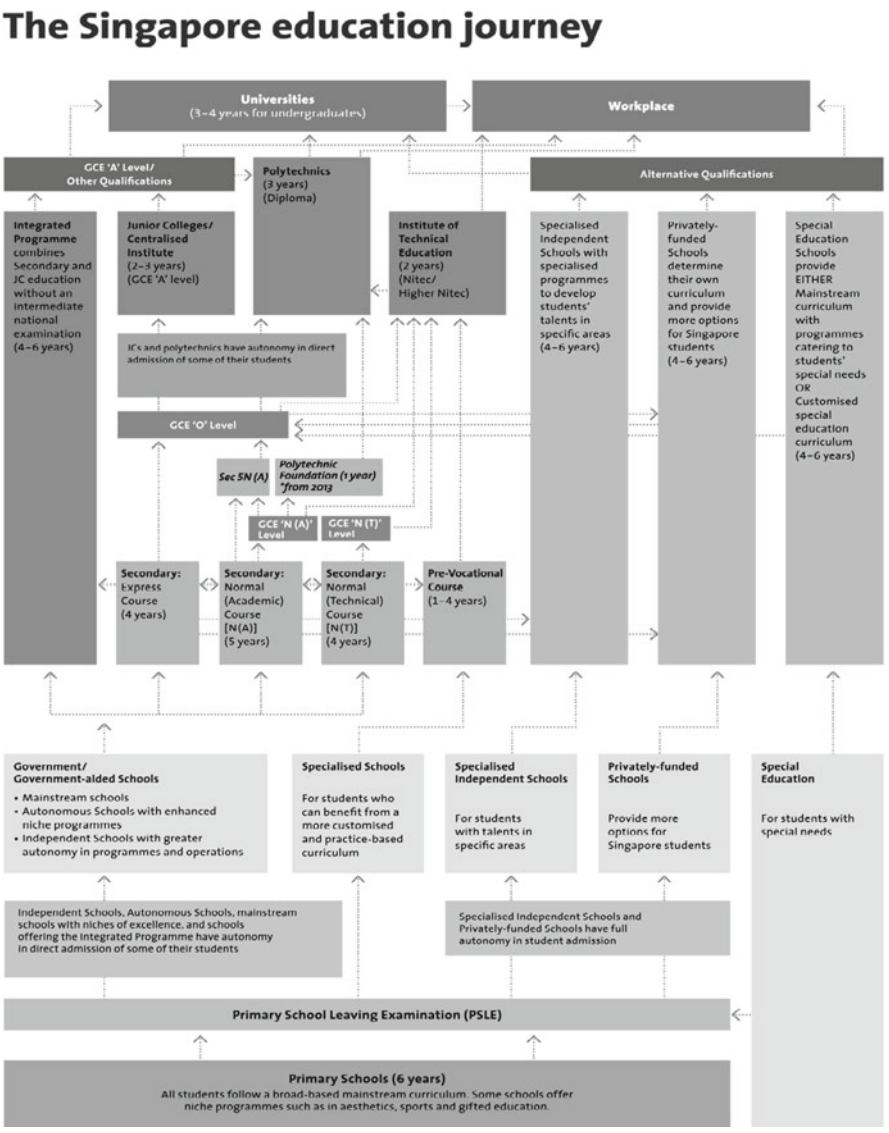


Fig. 15.2 Interplays in the system necessary for adaptivities

the goals of the system. Teachers need to have a heightened sense of professionalism and this in turn acts as a social impetus for their individual identity and accountability.

Singapore has become a great education system in a relatively short period of time. This significant progress stems from the efficiency phase where the key focus was to optimise education policies and practices towards academic performances. To evolve into an excellent system, a paradigm shift consistent with a values-driven education that MOE espouses is needed. A values-driven education emphasises beliefs, professionalism, tacit experiences, and implicit performance indicators. It is a paradigm where trust and mutual sociality is valued and intrinsic motivations abound for the well-being of students and their all rounded achievements. In other words, a culture of diversity, trust, and respect needs to develop within the education system where education professionals do their best to safeguard the learning interests of students. With continued investment in research and levelling up teacher capacity to adapt pedagogies for different learning orientations, a truly learner-centric and values-driven education can be achieved, in which equity, inclusiveness, and diversity are valued and embraced.

Appendix 15.1. The Singapore Education Journey (Ministry of Education, Singapore, 2012).



References

Barber, M., & Mourshed, M. (2009). *Shaping the future: How good education systems can become great in the decade ahead*. London: McKinsey & Company.

Bransford, J. D., Brown, A. L., & Cocking, R. R. (2000). *How people learn: Brain, mind, experience, and school* (expanded edition). Washington, DC: National Academy Press.

Bronfenbrenner, U. (1979). *The ecology of human development: Experiments by nature and design*. Cambridge, MA: Harvard University Press.

Begun, J. W., Zimmerman, B., & Dooley, K. J. (2003). Health care organizations as complex adaptive systems. In S. S. Mick & M. E. Wyttenbach (Eds.), *Advances in health care organization theory* (pp. 253–288). San Francisco: Jossey-Bass.

Cohen, E. (2008, October). *Breaking the cycle: Addressing children's exposure to violence.* Paper presented at the Public Health without Borders: American Public Health Association Annual Meeting and Expo, San Diego, California, USA.

Dimmock, C. (2010). Leadership and its relationship with teaching and learning. *SingTeach, 23*. Singapore: Office of Education Research, National Institute of Education, NTU & Marshall Cavendish.

Engestrom, Y. (2000). Activity theory as a framework for analyzing and redesigning work. *Ergonomics, 43*(7), 960–974.

Fan, L. H. (2010). *Integrating new assessment strategies into Mathematics classrooms* (Research Brief No. 10-003). Singapore: Office of Education Research, National Institute of Education, NTU.

Fang, Y., & Lee, C. K. (2010). *Lesson study and instructional improvement in Singapore* (Research Brief No. 10-001). Singapore: Office of Education Research, National Institute of Education, NTU.

Goh, C. B., & Gopinathan, S. (2008). The development of education in Singapore since 1965. In S. K. Lee, C. B. Goh, B. Fredriksen, & J. P. Tan (Eds.), *Toward a better future: Education and training for economic development in Singapore since 1965* (pp. 12–38). Washington, DC: The World Bank.

Hmelo-Silver, C. E., & Pfeffer, M. G. (2004). Comparing expert and novice understanding of a complex system from the perspective of structures, behaviors, and functions. *Cognitive Science, 28*, 127–138.

Hogan, D., & colleagues. (2009, August). *Ministry of Education research seminar: Office of Education Research/National Institute of Education presentation to Ministry of Education*. Presentation presented in Singapore.

Hung, D., Shaari, I., & Lyna. (2012). How learning takes place in communities of practice: Complementing the emergence with the systems' perspective. *Celebrating Learning through Active Research (CLEAR).*

Kapur, M. (2008). Productive failure. *Cognition and Instruction, 26*, 379–424.

Kaur, B. (2010). *In-depth analysis of Singapore's TIMSS 2007 data* (Report synopsis). Singapore: Office of Education Research, National Institute of Education, NTU. Retrieved from http://www.nie.edu.sg/files/cics/OER_0210_BK.pdf

Kupiainen, S., Hautamäki, J., & Karjalainen, T. (2009). *The Finnish education system and PISA*. Helsinki, Finland: Ministry of Education Publications.

Lee, J. (2010). *Students' academic and non-academic outcomes: An international perspective from PISA 2009 study* (Report synopsis). Singapore: Office of Education Research, National Institute of Education, NTU. Retrieved from http://www.nie.edu.sg/files/cics/OER%201410%20JYL_01.pdf

Lemke, J. L., & Sabelli, N. H. (2008). Complete systems and educational change: Towards a new research agenda. *Educational Philosophy and Theory, 40*(1), 118–129.

Lim, S. M., Wong, M. E., & Cohen, L. (2011). *Exploring the emerging identities of special needs officers in Singapore primary and secondary schools* (Research Brief No. 11-003). Singapore: Office of Education Research, National Institute of Education, NTU.

McKinsey & Company. (2007). *How the world's best-performing school systems come out on top*. Retrieved from http://mckinseyonsociety.com/downloads/reports/Education/How_the_Worlds_Best_Performing_french.pdf

Ministry of Education, Singapore. (2012). *Education in Singapore*. Retrieved from http://www.moe.gov.sg/about/files/moe-corporate-brochure.pdf

Mizikaci, F. (2009). A systems approach to program evaluation model for quality in higher education. *Quality Assurance in Education, 14*(1), 37–53.

Mok, I. A. C. (2006). Shedding light on the East Asian Learner Paradox: Reconstructing student-centeredness in a Shanghai classroom. *Asia Pacific Journal of Education, 26*(2), 131–142.

Mourshed, M., Chijioke, C., & Barber, M. (2010). *Education: How the world's most improved school systems keep getting better*. London: McKinsey & Company.

Murphy, E., & Rodriguez-Manzanares, M. A. (2008). Using activity theory and its principle of contradictions to guide research in educational technology. *Australasian Journal of Educational Technology, 24*(4), 442–457.

OECD. (2010). *What students know and can do: Student performance in reading, mathematics and science. Vol. 1. PISA Results 2009*. Paris: Author.

OECD. (2011). *Lessons from PISA for the United States: Strong performers and successful reformers in education*. Paris: Author.

Olson, J. F., Martin, M. O., & Mullis, I. V. S. (Eds.). (2008). *TIMSS 2007 technical report*. Chestnut Hills, MA: TIMSS & PIRLS International.

ReEd [Research in Education]. (2011a). *A critical resource for web-based teaching* (Vol. 1, 9). Retrieved from http://www.nie.edu.sg/files/oer/OER-NIE-ReEd1_Final%20for%20Web.pdf

ReEd [Research in Education]. (2011b). *Breathing a second life into geography teaching* (Vol. 2, 8). Retrieved from http://www.nie.edu.sg/files/oer/OER-NIE-ReEd2_Final%20for%20Web.pdf

ReEd [Research in Education]. (2011c). *Do you really know science inquiry?* (Vol. 3, 4). Retrieved from http://www.nie.edu.sg/files/oer/OER-NIE-ReEd3_Final%20for%20Web.pdf

ReEd [Research in Education]. (2011d). *Everyone can solve math problems with confidence* (Vol. 1, 8). Retrieved from http://www.nie.edu.sg/files/oer/OER-NIE-ReEd1_Final%20for%20Web.pdf

ReEd [Research in Education]. (2011e). *Learning physics by inquiry* (Vol. 2, 7). Retrieved from http://www.nie.edu.sg/files/oer/OER-NIE-ReEd2_Final%20for%20Web.pdf

ReEd [Research in Education]. (2011f). *Networking in the classroom* (Vol. 2, 4). Retrieved from http://www.nie.edu.sg/files/oer/OER-NIE-ReEd2_Final%20for%20Web.pdf

ReEd [Research in Education]. (2011g). *Online games take learning to the next level* (Vol. 1, 5). Retrieved from http://www.nie.edu.sg/files/oer/OER-NIE-ReEd1_Final%20for%20Web.pdf

ReEd [Research in Education]. (2011h). *Productive failure in math* (Vol. 2, 3). Retrieved from http://www.nie.edu.sg/files/oer/OER-NIE-ReEd2_Final%20for%20Web.pdf

ReEd [Research in Education]. (2011i). *Teaching and learning get a makeover* (Vol. 1, 6). Retrieved from http://www.nie.edu.sg/files/oer/OER-NIE-ReEd1_Final%20for%20Web.pdf

ReEd [Research in Education]. (2011j). *Transforming classroom culture* (Vol. 2, 6). Retrieved from http://www.nie.edu.sg/files/oer/OER-NIE-ReEd2_Final%20for%20Web.pdf

ReEd [Research in Education]. (2011k). *When kids' ideas come first* (Vol. 2, 5). Retrieved from http://www.nie.edu.sg/files/oer/OER-NIE-ReEd2_Final%20for%20Web.pdf

Sahlberg, P. (2007). Education policies for raising student learning: The Finnish approach. *Journal of Education Policy, 22*(2), 147–171.

Santrock, W. J. (2008). *Life-span development* (11th ed.). New York: McGraw Hill.

Shaari, I., Hung, W. L. D., & Lee, S. S. (2011). *Formal and informal relationships: Critical success factors*. Manuscript submitted for publication.

Silver, R. E. (2011). *Curriculum implementation in early primary schooling in Singapore* (Research Brief No. 11-004). Singapore: Office of Education Research, National Institute of Education, NTU.

Stevens, I., & Cox, P. (2008). Complexity theory: Developing new understandings of child protection in field settings and in residential child care. *British Journal of Social Work, 38*(7), 1320–1336.

Taylor, P. G., Kwek, D., & Foo, A. (2011). *A study of the Raffles Programme at the Raffles Girls' School, Singapore* (Research Brief No 11-002). Singapore: Office of Education Research, National Institute of Education, NTU.

Webb, R., Vulliamy, G., & Hamalainen, S. (2004). A comparative analysis of primary teacher professionalism in England and Finland. *Comparative Education, 40*(1), 8–107.

Wong, K. Y. (2006). *TEDS-M: Teacher education and development study in Mathematics* [RB12-002] (NIE Research Brief Series). Singapore: National Institute of Education, NTU. Retrieved from http://www.nie.edu.sg/files/oer/NIE_research_brief_12-002.pdf

Wong, K. Y. (2009). *Identification of unique and promising practices in mathematics and science teacher preparation among APEC economies: Singapore participation.* Retrieved from the National Institute of Education website: http://www.nie.edu.sg/research-projects/identification-unique-and-promising-practices-mathematics-and-science-teacher-prep

Yamagata-Lynch, L. C., & Haudenschild, M. (2006, April). *Using activity theory to identify contradictions and tensions in teacher professional development.* Paper presented at the Annual Meeting of the American Educational Research Association.

Yeom, M., & Ginsburg, M. (2007). Professionalism and the reform of teachers and teacher education in the Republic of Korea and the United States of America. *Asia Pacific Education Review, 8*(2), 298–310.