

Chapter 4

Leadership for 21st century learning in Singapore's high-performing schools

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This chapter by Clive Dimmock, Dennis Kwek, and Yancy Toh presents a model for developing learning-centred leadership appropriate for the 21st century. The approach is the “school design model”, employing a distinctive “backward mapping” or iterative methodology. It starts with “21st century knowledge and skills” covering global awareness, health literacy, creativity, financial and economic literacy, citizenship, critical thinking and problem-solving, and digital literacy. It then moves to the corresponding teaching, learning and support systems covering curriculum, teaching and pedagogy, assessment and standards, organisational structures, teacher professional development, and culture and environment. Finally, it maps leadership onto this, understood as learning-centred, emphasising leadership of curricula, teaching and learning; distributed thereby empowering teachers and building capacity; and community networked, and so benefiting from the resources of other schools and the community. The chapter applies the model in detail to two case-study schools in Singapore that for more than a decade have practised learning-centred leadership.

Introduction

This chapter presents a model for developing learning-centred leadership appropriate for school improvement and transformation in the 21st century. It applies the model to two schools in Singapore that for more than a decade have practised learning-centred leadership aimed at creating innovative 21st century learning environments. The approach is that of the school design model, employing a distinctive “backward mapping” or iterative methodology.

Applying the model in Singapore is significant for two main reasons. First, Singapore is generally regarded on a range of international indicators as a high-performing Asian school system adhering to traditional methods of pedagogy. Even so, there are schools that have boldly undertaken transformation for more than a decade, convinced of the need to create innovative learning environments built on contemporary notions of school design and leadership. Their motive has been to equip their students with the knowledge and skills thought to be essential for Singapore to maintain its competitive and innovative edge in the global marketplace. Second, previous applications of the school design model have been largely confined to Anglo-American contexts, in particular the USA (Dimmock, 2000), with few examples if any of cross-cultural applications, in Asia and in Singapore specifically.

The context of the Singapore school system

Singapore is a small island republic with a population that has grown from 1.8 million in 1965 to 5.1 million in 2011. It has just over 350 schools, with only about 20 of these independent. Singapore sought independence as a city state on breaking away from Malaysia in 1965, although it had ended a long period of British colonial rule in 1959. Remarkably, Singapore has risen from a third-world to a first-world economy, with a gross domestic product per capita now higher than that of the UK. Singapore's population is urbanised and densely concentrated – hence the relatively small number of schools and their large, uniform size – the average student numbers in primary and secondary schools are a high 1 500 and 1 300, respectively (Barber, Whelan and Clark, 2010). Singapore students have performed at or near the top of international achievement tests in mathematics and science for years, earning it the reputation as one of the best performing systems in the world (Mourshed, Chijoke and Barber, 2010).

The Singapore educational system remains highly centralised and regulated after three decades of reorganisation, consolidation and reform (Gopinathan, 1985; Hogan and Gopinathan, 2008). Over the last five years, there has been a significant but limited shift towards the decentralisation of administrative and pedagogical authority to individual schools. All teachers

are trained at the National Institute of Education (NIE), whose policies and practices, as well as educational research agenda, are closely aligned to the Ministry of Education's (MOE) priorities and schools' needs.

The Ministry of Education's strategic policies since 1997 are indicative of top-down initiatives to create the infrastructure for school change. Such measures have sought to professionalise teachers, promote their professional development, and encourage schools and teachers to adopt more innovative teaching and learning practices. Evidence from a system-wide research programme sponsored by the MOE (Hogan et al., 2013) reveals, however, that despite the policy platform in place to promote innovative school learning environments, teachers' practices and classroom pedagogy in Singapore are still focused principally on the transmission and assessment ("reproduction") of subject-based curriculum knowledge. The research concludes that the instructional system is dominated by traditional forms of pedagogy at the expense of new pedagogies, for a number of reasons including the national high-stakes assessment. Overwhelmingly, teachers in Singapore rely on whole-class forms of lesson organisation, with whole-class lectures and question-and-answer sequences.

A 21st century leadership model

A basic tenet of the design model for schools is that they prepare students with the knowledge, skills and values to enable them to usefully contribute to future society, and to live successful and fulfilled lives. Innovative school learning environments need to reflect evolving trends in society and economy, and especially the workplaces of the future. As David Hargreaves argues, "We should examine the most impressive of today's workplaces and then re-design schools to serve as a preparation for life in the companies of tomorrow's knowledge economy. That would be radical innovation indeed." (2003:3) Transforming schools on such a scale requires more than piecemeal tinkering. It calls for courageous leadership to engineer changes in leader and teacher roles and practices, and institutional cultures and structures. It demands rethinking leadership, and learning-centred leadership in particular, in a more holistic, strategic perspective and with a strong focus on the elements that shape and support innovative 21st century learning environments. It is "strategic" in connecting broader elements that shape the design process itself (especially the aims, goals and outcomes of learning, namely, what are students learning for?) with an understanding of leadership that extends beyond established 20th century institutional models.

A strategic approach to transforming school learning environments as fit-for-purpose for the 21st century is the school design model (see Dimmock, 2000, 2012). It embraces key interconnected elements, such as curriculum

aims and content, assessment systems, learning processes, and teaching practices, as well as structural and technological supports to teaching and learning. At the heart of the model is leadership and its re-conceptualisation; leadership is conceived as the main driving force, orchestrating, implementing, sustaining and scaling up the transformation process in the complex social organisations that are schools. Transformation typically demands sustained leadership over many years, and is anything but smooth and algorithmic.

The school design model has five salient characteristics. First, the model identifies the main elements of a school that are fundamental to its redesign as a 21st century learning environment. Second, it recognises interconnectivity, in that change in one element requires concomitant change in the other elements that functionally inter-relate with it. Third, it is strategic in the sense that, with many changing elements, it is imperative that the process has some order and rationale. Fourth, leadership is the key agency for securing and achieving the school redesign in its completeness, and fundamentally, it is the school design process and the nature of the new learning environments themselves that help to reconceptualise the new leadership that is presaged. Fifth, the model is underpinned by an explicit methodology, known as “backward mapping”.

Backward mapping underpinning the school-design model

Redesigning the complex set of operations involved in delivering a 21st century learning environment with relevant curriculum, and high quality teaching and learning, demands the most robust of models. Such a model needs to show the interconnections between the key elements. It should predict the concomitant changes necessary in interconnected elements in responding to an initial trigger change in a particular key element; and it should generate clear strategies to justify the rationale, as well as the sequence and order in which the elements are redesigned and transformed.

Traditionally, reform strategies begin with policy makers and operate top down, so that by the time they permeate through to teachers in classrooms, the original policy aims are distorted or diffused, and practitioners feel minimal ownership. Elmore (1979-80) thus suggested that reform had more chance of maintaining its integrity if the process was reversed so that policy makers map back from the outcomes and classroom practices they want to see implemented, thinking through the implications for each set of agents at different levels up through the system. “Backward mapping”, for Elmore, is more likely to achieve fidelity to the original policy intention and to win ownership of the practitioners charged with implementation since they have contributed to the policy formation. It is, in this sense, a bottom-up approach.

The principle of backward mapping meets one of Covey's dictums – namely, that successful people “begin with the end in mind” (Covey, 1989). That is, it asks what learning outcomes – knowledge, skills and values – are needed by 21st century learners. When answers to this question are clarified it is possible to rethink the nature of learning environments, beginning with the curriculum. What curriculum content and structure are most likely to achieve the knowledge, skills and values identified for 21st century learners?

Backward mapping further, the next set of questions are: what learning processes, skills and knowledge will enable students to acquire the desired outcomes? How do different student best learn? How do we enable all students to learn? And, what assessment processes are needed to gauge students' achievement of the learning outcomes, whether they be cognitive, affective, moral or physical?

Further steps in the backward-mapping progression are: what pedagogic practices are most supportive of the learning experiences? In what ways do teachers best enable all students to learn? And then, in support of the new learning and teaching arrangements, how are classrooms and organisational and structural arrangements best designed and configured to support these learning environments? Of particular importance here are the timetable, physical layouts, and the role of technology in teaching and learning.

Backward mapping a further stage, achieving many of the above changes in assessment, learning and teaching – known as the “core technology” – are predicated on furthering teachers' professional development to acquire new skills and practices.

Finally, all the foregoing backward-mapping steps implicitly involve leadership in strategising, organising, sustaining and scaling up. The key roles played by leaders centre on how they approach the transformation of their schools to create innovative learning environments, how they provide appropriate support and professional development, and use the available resources represented by society, the community and parents. It is the core technology of teaching and learning that is at the heart of the model and shapes new conceptions of leadership required to deliver it. This process of backward mapping – from learning outcomes through the key interconnected elements of learning, teaching, technology and organisational infrastructure, to leadership – is depicted in Figure 4.1.

The school design model is holistic and comprehensive and the backward-mapping methodology is logical and algorithmic, driven by the aims of achieving consistency of organisational structures and practices, and of synergy. Both the model and the methodology are by nature simplifications and abstractions. Schools undertaking transformation are unlikely to adopt such a holistic model and algorithmic methodology in its pure form as the

basis of their strategy. Over many years, however, school transformations will pass through different phases which, taken together, will include most or all of the elements in the school design model. The change sequence might not be as comprehensive as backward mapping, but the model serves as a heuristic tool by which to assess and evaluate the extent to which schools achieve holistic transformation by following a robust and comprehensive strategy and methodology.

21st century learning outcomes for knowledge-based economies

Figure 4.1 reveals a set of specific knowledge and skills outcomes for 21st century knowledge-based economies. A more globally integrated yet competitive world now places a premium on students having global awareness and literacy. Nation states are concerned about growing income and wealth gaps within their frontiers and declining social mobility, both of which in a globalising world might threaten people's sense of loyalty to, and pride in, their country. These concerns lead to an emphasis on citizenship and life skills. As governments struggle to make state budgets meet growing expectations and aspirations, there is need for better financial and economic literacy, with a view to citizens becoming more financially independent of the state. Likewise, better health education not only results in a more productive labour force, but reduces the state health bill. 21st century workplaces increasingly require their workforces to have innovative and creative skills, critical-thinking and problem-solving capabilities, and to be highly literate in technology and communication.

Curricula and learning experiences that deliver 21st century learning outcomes

Backward mapping from the desired learning outcomes contributes to formulating a curriculum with learning experiences that will help to achieve those outcomes. Hence, as shown in Figure 4.1, alongside the present curriculum emphasis on core subject disciplines (mathematics, sciences, history and so on), there needs to be a greater presence of trans-disciplinary knowledge, enabling the application of knowledge to complex, real-world problems.

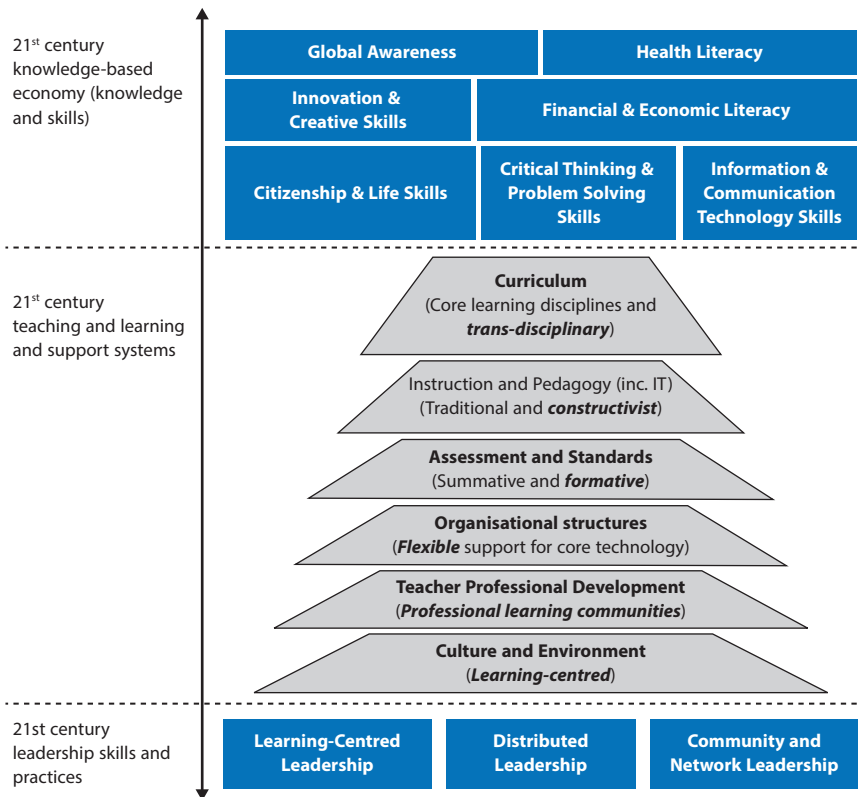
If greater emphasis is placed on learners acquiring the techniques of learning and developing higher-order thinking skills across disciplines in addition to disciplinary learning, then curricula and classroom practices are needed that enable students to:

- learn how to learn and acquire meta-cognitive and thinking skills
- learn co-operatively in teams
- seek and create new knowledge

- cope with ambiguous situations and unpredictable problems
- communicate verbally – the spoken and written word
- be creative, innovative and entrepreneurial
- learn trans-disciplinary as well as disciplinary knowledge.

Two aspects deserve particular emphasis: the importance of holistic education, since it incorporates many of the so-called soft skills essential to 21st century learners (e.g. leadership, team work and citizenship), and the key role of technology as a catalyst (rather than an end in itself) for realising the learning skills listed above, as well as driving changes in pedagogy.

Figure 4.1. The school design model: a framework for 21st century learning leadership



Source: Dimmock, C. and J.W.P Goh (2011).

Such interdisciplinary, integrated and project-based activities provide opportunities for students to experience: 1) independent learning; 2) collaborative work as well as interpersonal communication – oral and written; 3) the integration of knowledge and skills from various disciplines; and 4) the presentation of their views and learning through different modes of communication such as online discussion boards and student weblogs – all of which are essential skills in the twenty-first century. These practices need to be school-wide (across all departments and domains) and school-deep (adopted by all teachers).

Delivering learning experiences and outcomes

If teachers, leaders and organisational structures are to support students to learn in the ways described above, then school-wide and school-deep transformation is required. Teachers and leaders need to model the knowledge, skills and dispositions their students are to acquire (Hargreaves, 2003). While not rejecting traditional forms of teaching altogether as they can be highly effective in certain situations, teachers are challenged to broaden their repertoire of instructional strategies and methods. Not only must they make pedagogical judgments as to which methods to use and when, but they need the knowledge and skills to use such methods effectively (see Dimmock, 2000).

In broadening their pedagogic strategies, teachers embrace student-focused as well as teacher-focused pedagogies, constructivist as well as didactic methods, and forms of individual and group learning as well as whole-class learning. While still experts in their own discipline, they demonstrate epistemological understanding of how their subject connects across domains and with other disciplines. In creating trans-disciplinary and integrated curricula and classroom learning opportunities, teachers need a flexible cognitive capacity that enables them to adopt interdisciplinary practices. Knowledge is seen as more complex and problematic, requiring problem-based learning (PBL) and inquiry-based learning (IBL) approaches. To enable all students to experience successful learning experiences, more individualised approaches are needed.

Technology and 21st century learning environments

Information technology (IT) occupies an increasingly important place in shaping the innovative learning environments of 21st century schools, and it fulfils diverse roles. It enables students of all abilities to acquire knowledge when and where they need it. It also enables them to gain higher-order skills, such as independent learning, team work and problem-solving. In another way, however, it is a powerful tool for teachers, enabling them to adopt a broader range of teaching methods, facilitating student-focused learning, and

extending the boundaries of teaching and learning beyond the classroom. In particular, the use of mobile technologies represent profound technological influences that promise to redefine the ways – when, where and how – in which teaching and learning take place.

For more than a decade, critics of technology in schools have voiced concerns about three main issues: 1) the take-up of IT by teachers who range from enthusiastic adopters to IT illiterates; 2) differential access by students whereby wealthier groups are advantaged; and 3) variable degrees of “embeddedness” across the curriculum as some subjects adopt it whole-heartedly and other subjects less so. While these concerns still exist, considerable progress has been made. Few teachers nowadays can afford to be cynics. The widespread adoption of mobile devices by students (and teachers and society at large), driven by affordability, has led many teachers to keep up to the mark. More especially, any school that denies its students exposure to learning opportunities through IT would be seriously disadvantaging them. IT should still be serving the larger interests of the curriculum, teaching and learning – that is, as a means to an end rather than an end in itself – but its growing influence in the 21st century knowledge-based economy means it has to be understood as a powerful force in its own right.

Wider forms of assessment

Biggs (1999) argues that “constructive alignment” is necessary between the curriculum, pedagogy and assessment. Changes to the curriculum and pedagogy are less likely to be accepted by teachers without concomitant changes to assessment. Teachers need to be convinced that assessment will accurately measure the new curriculum knowledge, skills and values. Many of the 21st century skills are not readily quantifiable through traditional examinations. Hence, new formative and non-quantitative methods of assessment are needed alongside traditional examinations as a gauge of student learning.

Organisational structures for the 21st century

Many past school reforms have foundered on the rigidity of school structures, including the timetable, teachers who are organised into subject departments and guard their independence, and the uniform physical layout of classrooms. The step-wise process of backward mapping through learning outcomes, then the curriculum and pedagogic practices depicted in Figure 4.1 carries instead a strong assumption of flexible organisational structures to enable successful implementation. New curricular, learning and pedagogical practices are presaged on sympathetic changes to organisational structures,

especially to teacher grouping, the timetable and classroom layout (including use of physical space, technology and equipment).

Collaborative cross-disciplinary teams

New forms of collaboration involving teachers from different but related disciplines are required for trans-disciplinary curriculum planning and delivery. Teachers thus engage in the same cognitive processes as their students. Collaborative interdisciplinary teaching teams facilitate problem-based learning and the delivery of integrated curricula. Grouping teachers into core teams of four, say, means that such teams may assume responsibility for delivering the whole curriculum to a cohort of students, moving with their cohort through the school and enabling them to develop a close understanding of their students' learning strengths and weaknesses. Specialist teachers for, say, languages, music and physical education can be brought in by each team.

Greater flexibility in time use

An important pre-requisite for innovation in the school design model is greater timetable flexibility. Problem-based learning and trans-disciplinary study, for example, cannot be undertaken in standard 40-minute lessons. Hence, flexibility of learning time is necessary to free up blocks of curricular time (Dimmock, 2000). Blocked timetabling leaves teachers with curricular discretion, as long as each subject area receives its overall allocated share of time over, say, a month or a term.

Schools could also adopt more flexibility in regard to the school year and school day. In some systems, schools are open for little more than half the days of the year, and typically between the hours of 8.30 and 16.00. There is scope for them to open more days of the year, and extend the school day into the evening, with supervised homework classes, and allowing access to facilities such as the gymnasium and library for extended hours, including weekends.

Reconfiguring the classroom

Embedding innovatory classroom practices will often require reconfiguring the physical layout and use of classroom space. Flexible classroom furniture, for example, affords teachers the ability to change the patterns and clusters of desks which, with wireless technology, enables a range of different classroom settings and an array of teaching methods to be adopted, from whole-class teaching, through group work to individual problem solving. Moving the teacher's desk away from the front symbolises a more student-centred learning approach. Mobile desks with computer nodes or wireless network connections

enable group and individual work to take place with easy access to the Internet for all students. Redesigning and planning classroom physical space is thus essential in promoting a multi-faceted learning environment. Foldable partitions allow for the reconfiguration of space, as does locating flexi-pods near learning courtyards and eco-trails. These and similar conditions pertaining to flexibility and ease of access to technology, equipment and use of space all interconnect to enable new forms of teaching and learning.

All of the above elements in the school design model are, however, dependent on new configurations of teacher professional development, and new forms of leadership for their school-wide and school-deep adoption. Without a concerted effort towards purposeful teacher professional development, and bold and innovative leadership, the direction, goals and alignment of effort required to build sustainable innovative learning environments will fail to materialise (Hargreaves, 2003).

Developing leaders to deliver the new core technology

In schools successfully undertaking transformation journeys – a process often taking a decade or more – the contribution made by outstanding leadership is critical, especially, but not exclusively, by principals. High-performing leaders use their time more effectively to change the important elements of school design to impact student learning outcomes. They are less mired in administration. The leadership required to transform school learning environments can be deduced by backward mapping through the elements of the school design model. Leadership for transforming schools into 21st century learning environments can thus be characterised as: **learning-centred**, emphasising leadership of curricula, teaching and learning; **distributed**, so that leadership empowers teachers and builds the capacity of available human capital; and **community networked**, thereby benefiting from the resources of other schools and the community. (Dimmock, 2000, 2012)

Learning-centred leaders place teaching and learning – and hence teachers and students – at the heart of their leadership of the school. The creation of learning-centred schools requires leadership which is itself a continuing process of learning (MacBeath and Dempster, 2008). Learning-centred leaders possess the knowledge, skills and dispositions to lead their teachers in adopting innovative curricular, pedagogical and assessment practices. They possess the technical and professional knowledge to engage in close professional relationships and influential dialogue and communication with their teacher colleagues. Such leadership focuses on the strategic vision and goals to improve the learning outcomes of the school, as well as the orchestration and organisational operations to implement the transformation process.

While building 21st century learning environments requires learning-centred leadership, it also necessitates a reconfiguration away from principal-centred to distributed leadership (Heck and Hallinger, 2009; Spillane and Diamond, 2007). Schools need to maximise their use of resources through capacity building – including the empowerment of leaders at all levels – flatter structures and more democratic processes. In short, leadership is nurtured among less experienced teacher colleagues by senior leaders, and leadership itself is dispersed and shared at middle and senior levels. Distributing leadership places even greater onus on senior school leaders, especially principals, to orchestrate and secure alignment, consistency and coherence of policy and leadership practices across the school. Flatter structures bring principals and senior leaders into closer functional relationships with classroom teachers.

The third element of contemporary leadership – community networked – is to engage in networking and sharing of resources with other schools and the community. In creating the vision, strategy and practice to underpin the transformation trajectory, leaders need to garner ideas and resources from multiple sources. Such sources may be other schools which have begun their transformation. They may be research literature and case studies to suggest models and frameworks for an evidence-based approach. Or, they may be through the accumulated tacit knowledge of staff experiences of what they have found to work (Guile, 2006). Principals especially need their communities to see the need for whole-school transformation in preparing students for 21st century workplaces. Parents and community members often oppose departures from tradition, especially in relation to teaching, high stakes assessment and discipline. Yet harnessing parental support is a strategic imperative for any principal intent on transforming the school as a learning environment.

All three forms of leadership – learning-centred, distributed and networked – are involved in developing the school's most important resource of all: its own staff. The building of innovative learning environments is dependent on the quality of professional development, and that in turn is reliant on the quality of leadership.

Promoting teacher professional development

Leaders have an important responsibility for teacher professional development that provides the skills, knowledge and values for 21st century classrooms. Transforming curriculum, pedagogy and assessment school-wide and school-deep renders traditional forms of teacher professional development, such as individual teacher attendance on short courses external to the school, largely ineffectual. Professional development is thus re-conceptualised around schools as professional learning communities (PLCs) (Wenger, 1998; Hord, 2008). School leaders, and especially principals, are instrumental in promoting, sustaining and evaluating PLCs as vehicles for teachers to own and implement

the innovations required (Bolam et al., 2005; Louis and Kruse, 1995). In PLCs, all teachers take responsibility for their own professional learning and must engage in peer learning and collaboration. Leaders take responsibility for overseeing the effectiveness of the PLC teams, ensuring that: teacher learning is relevant to the curricular and teaching goals; all teachers are researching and evaluating their practices; all are sharing ideas and working together to research and collect evidence on new improved teaching practices and their implementation; and synergies of adopting new practices are achieved across the school. Primacy is given to promoting shared teacher decision making for adopting evidence-informed practices, whether they are based on peer learning from tacit knowledge or academic research.

Enabling teachers to fully participate in PLC activities requires leaders to invest resources in developing teachers' research and evaluation skills, non-contact time, and provision of tools and templates to make their tasks more manageable. School-wide PLCs are powerful agents for creating learning cultures among teachers. They can also be a key source for leaders' own professional development, in fostering their ability to understand the elements of the school design model and their functional interrelationships, and their capacity to strategise the organisational structures and leadership necessary to deliver new curricula and pedagogies. PLCs offer the opportunity for leadership preparation and development to be more closely aligned with teacher professional development and to be conducted within the school and its network (DuFour and Eaker, 1998).

Leadership *per se* assumes a central role in the development of the intellectual and social capital of the school, and in the deployment of high-leverage strategies to achieve the best learning outcomes. Such leadership activities are vital in building and sustaining a learning-centred school culture.

Case studies of transformation in two schools

The previous section sketched a perspective of learning-centred leadership that derives from a holistic model of school design, the purpose of which is to transform schools into innovative 21st century learning environments. It offers a useful heuristic tool in helping explain and analyse how whole-school transformation takes place in practice; it is applied in this section to two Singapore school case studies.

Case study 1: Fortitude Primary School

Fortitude Primary School (FPS) was founded in the 1940s by a Chinese clan association to provide basic education for the children of immigrants from China. FPS is a government-aided primary school, receiving partial

funding from the government and supplementary funding from private sources. It is typically large, with around 1 900 students and 130 teachers. It has a reputation as a high-performing neighbourhood school.

Evidence of success

FPS has received recognition for its innovative use of technology in changing pedagogical practices from a teacher-centred to a student-centred orientation. It has earned a string of accolades over its decade-long use of technology in education, including as a “Microsoft Worldwide Mentor School” and by the Singapore MOE as a centre of excellence for information technology. Earmarked as one of the 15 “Future Schools” by the government, the school serves as an exemplar for integrating the use of information and communications technology (ICT) into its curriculum, pedagogy and assessment across all levels. Unlike many schools, however, technology has increasingly become a catalyst for driving whole-school transformation rather than propagating piecemeal innovations.

School redesign efforts

FPS has redesigned its learning and teaching through a technology-enhanced curriculum since 2002. The whole-school transformation was a gradual process and continued to gain momentum when the new principal came on board in 2007. The redesign effort predicated on the use of technology and incorporated two aspects of the 21st century school-design model: 1) learning leadership skills and practices, and 2) embedding of teaching and learning skills and support systems. This case study is based on qualitative data emerging from interviews, observations of lessons and meetings, and document analysis (Toh, 2013).

21st century leadership skills and practices

Both the former and current principals have played a vital role in shaping the direction of FPS’s development. Both envisioned ICT as the catalyst to improve the quality of teaching and learning. They saw its value in fostering participatory learning and connecting students to the larger body of knowledge beyond the classroom. They envisioned that by harnessing technology, students would be well-prepared to become future “knowledge workers”. Pedagogically, both principals saw technology as a catalyst for changing teaching practices and transforming classrooms to become student-centred and fundamentally compatible with 21st century learning needs.

A strategic decision was established in 2005 to encourage collective accountability. Decision-making authority was increasingly distributed

through different layers of the hierarchy, especially in terms of deciding on which ICT programmes to embark and scale up. This resulted in the effective empowerment of teachers and middle-level leaders, with wider and greater advocacy of the initiatives, and enhanced the organisation's professional capital to make informed choices. Together with the middle-level leaders and teachers, the principal re-examined the priorities for learning and developed an educational framework that strove to balance students' learning of content knowledge and their acquisition of 21st century competencies and values. Three key elements exemplify the latter – developing students' media literacy skills, fostering social-emotional behaviours and competencies, and building capacity for curriculum leadership. Technology was seen as the nexus to bring all three areas together.

Concomitantly, the senior leadership provided an overarching curriculum framework for the use of ICT that was purposefully aligned with the key thrusts of national educational policies. In 2010 – some 10 years after initial ICT reforms had begun – the principal decided that the school would adopt the “Teaching for Understanding” (TfU) framework of Blythe and Perkins (1998). The framework was seen as a way to distil students' depth of understanding as well as to promote collaborative and self-directed learning, both of which were 21st century skills emphasised by the Ministry of Education. A further framework from literature was adopted to guide staff on teaching strategy, namely, Saphier and Gower's (1997), “Skilful Teacher” model, incorporating the philosophy that technology could cater to the different needs of students.

Over time, capacity-building strategies became increasingly structured and multi-pronged, and discernible in: 1) developing teachers as researchers by leveraging NIE expertise; 2) deepening the innovation culture by promoting learning circles; 3) identifying teachers' professional development needs and devising corresponding plans; and 4) providing mechanisms for reflection through multiple sharing platforms and feedback sessions.

The complexity of ICT-related reform necessitated a concerted effort to change culture, pedagogy, curriculum and assessment. The school could “not walk the journey alone” and so the leadership cemented partnerships with industry and institutes of higher learning. These partners were carefully selected to ensure they added value to the teaching fraternity. For example, in 2009, the school partnered with NIE to set up an in-house research centre. Microsoft Singapore and Microsoft Research Asia joined the alliance in June 2012 to further provide technical expertise. A network of overseas consultants helped to secure additional sponsorship for students' learning tools.

However, as the number of agents and projects increased, so did systemic tensions. These emanated from: 1) research-practice gaps, most apparent in the divergence between espoused and actual use of ICT; 2) ideological chasms,

such as whether technology should be used as an essential and routine tool in classrooms; and 3) school-industry-research incompatibilities between bureaucratic and commercial interests, resulting in frustrating delays and additional development costs. These tensions were collectively debated by the senior- and middle-level leadership. The way ahead was seen in establishing a climate of openness and spirit of innovation; a unifying agenda around the key goals of learning and teaching; alignment of resources (financial, structural, professional, time) to support transformation; opportunities for dialogue sessions with key stakeholders, such as parents, teachers, researchers and the clan association around the rationale and outcomes of the interventions; and the prudent spread of innovations where projects that had obtained proof-of-concept were scaled up systematically, leading to a whole-school programme of transformation.

Learning-centred leadership: juxtaposing this approach against the framework for the 21st-century school-design model outlined earlier in the chapter, both principals can be seen to have displayed learning-centred leadership by prioritising student-centred principles when rationalising the use of technology and setting up mechanisms for teacher reflexivity. The new principal after 2008 declared his strong support for the unifying curriculum and pedagogical framework that underpinned all ICT projects, thus giving continuity and sustainability to the change model under way.

Distributed leadership: leadership became increasingly distributed from early on in the change agenda, evident from the fact that the cognition embodied in the decision-making process was spread throughout the hierarchy and driven by the belief that distributed leadership is the key to the sustainability of innovations.

Community and network leadership: the third element of leadership became increasingly sophisticated through the period of actively establishing strategic partnerships to expand the social capital of the school in congruence with the school-design model. Both principals scanned the environment to understand socio-political trends in order to align the school change agenda with trends in system policy making, assessed the school's contextual readiness for transformation, expended energy to mitigate systemic tensions between stakeholders, and explored sources of funding for scaling up technology-related innovations. All of these required nuanced political acumen and navigation, so emphasising the "political skills" element that is fundamental to community and network leadership encapsulated by the school design model.

Embedding 21st century teaching and learning skills and support systems

School leaders saw the importance of the interconnectedness of innovatory processes of teaching, learning skills and support systems in the successful

embedding of new practices. The time element is emphasised in the frequent references to, and celebrations of, the transformation journey, thereby building “institutional memory” as a form of social capital. FPS has achieved an evolutionary growth trajectory.

Curriculum: recognising that many of the initial ICT projects were ad hoc and of limited impact, FPS started a more integrated mobile learning trail programme in 2005 and has since scaled it up across all levels in the school. Correspondingly, the curriculum advanced from piecemeal projects to whole-school programmes, and these were anchored more in pedagogical research. Further projects with proof of concepts were incorporated into departmental schemes of work; more cross-departmental collaborations sprang up.

Instruction and pedagogy: departing from the predominant use of electronic worksheets in the earlier years, teachers came to a broad consensus on the purpose and place of ICT within a broader student-centred learning approach. Although there was some incongruence between what was espoused and what was actually enacted, a growing majority of teachers were able to adopt constructivist practices in applying ICT.

Assessment and standards: assessment and standards proved especially unresponsive to change. Along with the curriculum and pedagogical frameworks which were established in 2008, emergent attempts were introduced to make formative assessment more varied and just-in-time, and summative assessment more open-ended and aligned with higher order-thinking skills.

Organisational structures: as FPS accelerated its efforts in scaling up successful innovations from 2009, the demand for organisational restructuring became more pronounced. Teacher grouping was reconfigured based on common interests, or facilitated through centralised flagship projects. An additional three periods were created on a fortnightly basis for science. Teachers also utilised the weekly block timetabling of one and a half hours to discuss projects. The infrastructure in computer laboratories was also reconfigured to facilitate collaborative learning, and classrooms were rewired so that students could charge their equipment when needed.

Professional development: over time, teacher professional development became less technically driven by ICT and more broad based to realise the potential of technology in generating new methods of teaching and learning. Abundant opportunities for professional development were provided, with the focus shifting to capacity building through small, customised programmes. Professional development shifted to the wider ramifications of ICT for developing curriculum innovation, implementation issues, instructional strategies, expert views and mentoring strategies.

Culture and environment: a re-culturing process has permeated the entire process of FPS's evolutionary trajectory. Back in 2001, learning circles

were established, which were widened and deepened over time. Every staff member was involved in at least one learning circle. A safe and risk-accepting environment was created with a school ethos of tolerance towards “failure”, and where no teacher was penalised for lagging behind.

FPS’s transformation was based on emergent and iterative feedback along the way. Neither principal had a very precise view of what the transformation would or should be to begin with and instead the trajectory was shaped along the way by multi-level influences and actors. Both principals were guided by the belief that technology, while acting as a powerful catalyst for school transformation, should not supersede pedagogy, and that learning goals should coalesce around the needs of 21st century learners. Through exercising their leadership skills, FPS leaders provided a range of support systems which eventually became better defined through the collective effort of the school community.

Case study 2: Singapore Girls Secondary School

Singapore Girls Secondary School (SGSS) is an independent all-girls secondary school with a highly selective intake. It enjoys greater autonomy than government schools in staff deployment, salaries, finance, management and curriculum. It has a student enrolment of 1 800, mostly from middle and upper income groups, and a teaching staff of 160. In 2004, the school shifted from preparing students for the General Certificate of Education (GCE) O Level examinations to the government-initiated “Integrated Programme” (IP) that provides a seamless six-year education. It is designed to be more flexible, with broader learning experiences and outcomes.

Evidence of success

SGSS is a top-performing school as measured by conventional indicators such as GCE A Level results and has established itself as a leading future-oriented and progressive school by teachers, parents, students and policy makers. In 2012, the school was awarded numerous school excellence and best practice awards.

An NIE evaluation of the school’s IP curriculum showed that whole-school reform to enact IP had been successful. Teaching had shifted from a focus on curriculum coverage to student-centred learning, with high levels of student engagement, personalised learning, dialogic teaching, strong disciplinary practices, meta-cognitive skills, and cognitive and epistemic flexibility. Open-ended, loosely-structured, authentic performance tasks were integrating learning across subjects and engaging students in creative problem-solving. Across a range of pedagogical indicators, SGSS outperformed most secondary schools in Singapore.

21st century leadership skills and practices

Prior to the IP, SGSS was producing academically outstanding students through a traditional focus on examination preparation. In 2001, the principal led the process to rethink its fundamental aims. Discussions around the nature of teaching and learning, disciplines and student identities resulted in an educational vision to develop students who would be “persons, thinkers, leaders and pioneers”. Embedded in this vision was an explicit focus on core 21st century knowledge and skills including global awareness, leadership skills, innovation and entrepreneurship, creative critical thinking, and problem-solving skills.

The principal introduced the other leaders in the school to the “Understanding by Design” (UbD) framework (Wiggins and McTighe, 2005) to help teachers design curriculum maps. By 2004, the leadership team was well prepared to implement an IP design that embedded key vision outcomes. The team recognised that the UbD-driven curriculum had shifted the scale of reform from a piecemeal, department-level innovation to a high-stakes whole-of-school transformation process. The new vision required radical changes to assessment and instructional practices, teacher capacities and school culture in order to teach 21st century knowledge and skills. With the vision as an anchor, the principal guided the school through strategic stages of transformation towards student-centred learning.

The whole-school transition to the IP from 2004 onwards was far-reaching and risky. Many stakeholders, including teachers, were uncertain of the changes. To ensure staff commitment to change and to minimise staff attrition, the principal frequently reassured staff, shared the new vision and stressed that the transformation was crucial for the future of the students. She provided substantial professional and financial support to help staff build their capacities. Leadership capacities were further distributed to empower staff and improve their buy-in. The principal introduced a layer of leaders to manage the transformation process. These “directors” held key organisational responsibilities, with the resulting leadership eventually spread across the principal, deputy principals, directors and department heads. Even so, the principal maintained oversight and control of implementation up to 2008, regarding this as necessary to ensure a continuous, progressive and focused whole-school transformation. It was only after the major transformational processes were completed that more bottom-up opportunities for innovation and leadership were fostered.

To ensure alignment with the new vision and school objectives, the leadership team held numerous conversations with parents, students and alumni. Strong community involvement was established to justify and demonstrate new student-centred teaching and learning to parents and students. Throughout the implementation, continuous feedback was sought from parents

and students. Leadership meetings with other schools shared transformation experiences. Communication and feedback channels were introduced to allow leaders to react to issues, and to adjust the pace and direction of change accordingly. Partnerships with businesses were established to help increase financial revenue and support, and collaborations with research centres helped to boost the research capacities of the school and teachers.

Like the architect overseeing a new building, the principal not only maintained the school vision, but ensured that the transformation trajectory was progressively directed towards achieving that vision. In relation to the school design model, the principal's leadership was aligned to the three forms of leadership.

Learning-centred leadership: the principal drew on research-based resources to help plan and drive forward the transformation. She used her professional, technical and pedagogical knowledge to form close collegial relationships with staff across all levels, encouraged them to become learners through role modelling, and aligned financial, organisational and professional resources to support the school as a learning organisation. Mechanisms for reflection, including platforms for formative feedback, allowed the leadership team to respond rapidly to issues and adjust the pace and direction of change.

Distributed leadership: the principal held the strong belief that top-down leadership was required during key stages of transformation, even as she established new positions to help steer and manage the transformation processes. It was only after the main transformations were completed that she encouraged bottom-up initiatives from those to whom leadership was increasingly distributed.

Community-network leadership: as one of the IP pioneers, the school was unable to depend on the resources and experiences of other schools. Nevertheless, strong engagement and dialogue with stakeholders allowed the sharing of vision and student-centred teaching and learning practices. The school subsequently shared their transformation experiences with other schools, researchers and policy-makers. Partnerships with businesses and research institutes helped to boost the financial and research capacities of the school.

The leaders exhibited an additional leadership role that was arguably essential in the SGSS transformation – a “risk leadership” that helped to manage the uncertainty inherent in the transformation process (Hancock, 2012). They guided the change process intentionally, while adapting to challenges and opportunities. They acted as buffers against uncertainty (especially from stakeholders), constantly focusing on vision-guided outcomes, trying to ensure that the benefits of the transformation outweighed the risks.

Embedding 21st century teaching and learning skills and support systems

SGSS's trajectory of whole-school transformation demonstrates the value of long-term commitment to teleological visions of 21st century knowledge and skills. School leaders recognised that this future orientation should come from a radical transformation of teaching and learning skills and support systems.

Curriculum: curriculum redesign began with intensive study of the UbD framework. The principal hired international consultants to help leaders and teachers understand the new curriculum designs. This was done simultaneously across all departments, with changes led and monitored by department heads. While the curriculum redesign efforts were not uniform across all departments, by 2008 all departments were beginning to move towards interdisciplinary designs and greater curriculum differentiation.

Instruction and pedagogy: as the IP curriculum required student-centred pedagogy and instructional practices, student-centred principles were applied throughout the whole school, with intensive in-house teacher training to enhance pedagogical capacity. Teachers became pedagogical learners in the transformation and by 2008, most teachers employed student-centred pedagogy with a strong emphasis on 21st century skills, knowledge and dispositions. Recently, the school has embarked on 1:1 computing (a laptop for each student) with associated pedagogical innovation.

Assessment and standards: assessment redesign was the second major transformation after curriculum redesign. The leaders recognised that the UbD framework required authentic performance tasks and alternative assessment practices. These were introduced into all departments, again with advice from international consultants. Such practices, tasks and standards were aligned to student-centred learning and the curriculum, with a director having oversight of task designs and curriculum alignment to 21st century knowledge and skills.

Organisational structures: the design and implementation of authentic performance tasks required trans-disciplinary collaboration between departments. There was mandated collaboration time to allow teachers to work across departments to design and align assessment and practices. The school timetable shifted to a two-week schedule to allow longer and more intensive lessons across all subjects. Yet, because the school was in an old building with limited space, flexibility in classroom configurations was restricted (the school is moving to a new campus in a few years' time).

Teacher professional development: multiple professional learning communities (PLCs) were formed to encourage innovative teacher learning. Staff across the school hierarchy worked together to design the curriculum, share practices, and guide whole-school transformation. The principal was

involved in numerous PLCs and workshops. An in-house teachers' academy was formed to provide a compulsory three-year professional development programme for new teachers. Professional growth was encouraged through attachment to other institutions, scholarships, research activities and graduate studies. In 2010, an in-house centre was established in collaboration with NIE to generate school-based research, develop teachers' research capacities, share knowledge with other schools, and continue the commitment to developing and empowering teachers as professionals.

Culture and environment: new organisational capacities and structures contributed to developing the learning culture. The principal felt it was crucial for a learning culture to exist to handle the transformation. The learning culture was increasingly refined to handle insights and understandings gained from school change. Common meta-languages and platforms were developed to make sense of the changes and document new understandings about curriculum, assessment and pedagogy.

In sum, embedding 21st century teaching and learning practices, skills and support systems took place recursively across the sub-systems described above. It was non-linear and networked, with these sub-systems – particularly curriculum, assessment, pedagogy and teacher professional development – constantly referencing the school vision of 21st century knowledge and skills. The learning skills and support systems were driven by the school leaders, especially exercising learning-centred and distributed leadership. The redesign process took over eight years, and was conducted in stages initially – curriculum first, assessment next, pedagogy after – with subsequent systems developing concurrently. Under the second principal, the transformation process has continued as the school constantly seeks innovative ways to equip students with a growing range of 21st century knowledge, skills and dispositions.

Comparing transformation trajectories and leadership

Despite one being a primary school in the government system and the other a secondary school with greater independence, the case studies share similarities in their transformations. First, both embraced and committed to long-term visions of future schooling to benefit their students and society at large. They recognised that the *status quo* with its traditional transmission model, although useful in achieving narrow academic high-stakes outcomes, is no longer tenable for educating and preparing students for the 21st century. Second, both schools centred their redesign trajectories on curriculum, assessment and teaching strategies for personalised, student-centred learning through technological and pedagogical innovations. Third, each school recognised the necessity of distributing leadership, albeit through different routes: with SGSS it evolved cautiously, top-down from the principal; in

FPS, it was more bottom-up and organic. Fourth, leadership in both schools recognised the dependence of transformation on teacher buy-in and enhanced professionalism and professional development. Enhanced professional practice was driven in both schools by a model of teacher-driven research and learning. Fifth, both schools displayed a willingness to communicate with and involve key stakeholders, and to seek ideas and resources, as well as share them with other schools.

There are also important differences between the schools. Each had different drivers of change, and in the pace and scaling of joined-up innovation. Transformation in SGSS was driven by the decision to introduce the new IP curriculum, requiring more radical and joined-up rethinking of learning, teaching and assessment. Transformation in FPS, on the other hand, was largely driven by the desire to harness new technology for teaching and learning. Connectivity between the broader elements of the school design model – such as teacher professional development and whole-curricular change – have been achieved more recently.

Distributed leadership in FPS was more hybrid from the start, being a mix of top-down and bottom-up approaches, while leadership in SGSS was more top-down especially initially, moving more slowly towards a top-down/bottom-up mix.

FPS leveraged social and corporate contacts to build its organisational capital to become a technology-rich environment, while this was less a feature for SGSS, possibly because of its greater financial independence.

Teacher professional learning communities (PLCs) in SGSS were initiated by the principal, who was directly involved to ensure direction, continuity and accountability. Professional learning communities were more emergent and informal in FPS, even in the early years of transformation when teachers were encouraged to form their own learning circles, and have latterly become more decentralised and customised to meet teachers' wishes for professional development in smaller, "hands-on" sessions.

While curricular change in both schools was about 21st century knowledge and skills, SGSS focused on innovation and creative skills, citizenship and life skills, critical thinking, problem-solving skills and global awareness, while the cornerstone for FPS was using communication technology skills as levers to achieve new learning goals.

Leadership of the change process in both cases can be summarised by referencing the school design model. The SGSS principal demonstrated awareness of the multiple interconnected elements, but the process evolved in response to the challenges of innovation and transformation with each new opportunity for change that arose. As the change gathered momentum, many of the elements began to change concurrently rather than in sequence.

The principal adjusted her focus and energy to particular areas of change as circumstances dictated, according to what she thought was imperative in order to initiate, sustain and scale up the innovation. Leadership of FPS, in contrast, demonstrated no prior master plan or strategy: early innovations tended to be discrete and small scale, but with time became more comprehensive and connected. By 2010, with a new principal in place, a coherent overall vision had evolved, with large stakeholder involvement forming a “collective intelligence”. Throughout, however, the change process was governed by two core ideas – student welfare at the heart of all reform, and technology harnessed to improve teaching and learning.

Conclusion

Using the school design model and understanding the transformational journeys of the two Singapore case-study schools enables us to draw the following conclusions. First, the onus for school transformation lies primarily with the individual school and its leadership, particularly the principal. This is apparent even in traditionally centralised systems of control such as Singapore, where the MOE policy framework supports school-level initiatives aimed at creating 21st century learning environments. More generally across the globe, there is an increasing recognition of the need for school leadership to be reforming and a corresponding discouragement of principals to be over-dependent on central administrations. Second, it is not the case that only poorly performing schools look to transform themselves into 21st century learning environments as a means of regeneration. Indeed the two Singapore schools are in their different ways both highly successful according to traditional indicators such as public examination and test results. Rather, it is their unwillingness to be complacent that has propelled them to keep ahead of the competition and of the “education game”. Third, with the school design model offering comprehensiveness in its elements, including leadership, and a methodology, which together provide the essential components of transformation towards innovative learning environments, the model is generic in accommodating and embracing the different and unique reform paths of individual schools.

One of us (Dimmock, 2000) has elsewhere argued that the basic tenets or principles of school redesign are generic. Any school undertaking transformation of its learning environment must inevitably give consideration to the same common elements covered by the school design model. Successful transformation implies:

- Identifying and maximising the main drivers for change.
- Recognising the elements (captured in the school design model) and their interdependence, with leadership ensuring strong strategic alignment and functional interrelationship between them.

- Sequencing the implementation of redesigned elements in ways that achieve alignment, coherence and synergy – as reflected in backward and iterative mapping.

An obvious starting point is the envisioning of the learning outcomes (knowledge, skills, and values) and the types of graduates aimed at, together with the motivations for so doing. Other key elements concern the processes considered most likely to achieve the outcomes, such as new configurations of curriculum, pedagogy, assessment and technology, supporting structures such as timetable, student and teacher grouping, and finally, leadership that is learner-centred, distributed and networked. Transformation that is “school-wide” and “school-deep” involves all of these elements and sees them as functionally interconnected, thus achieving embeddedness, sustainability and scalability. In reality, many schools undergoing reform will be on a trajectory that is as yet incomplete and partial in terms of the school design model. They may be working to a generic model similar or akin to the school design model, but have only reached an intermediate stage of redesigning some of the elements. Or, more problematical still, they may periodically implement separate piecemeal innovations without a design model to engineer synergistic, operational and logical connections between the key elements.

Leadership is an integral and main component of the school design model. Three salient aspects of leadership that come to the fore emanate from the very characteristics of 21st century learning environments. That is, through backward and iterative mapping, the question implicitly posed is: given the requirements and features of a 21st century learning environment, what forms of leadership are necessary? This turns upside down the conventional thinking which first asks, “What type of leadership is needed going forward?” and then, “What teaching and learning methods will leaders promote?” The three forms of leadership derived from the backward-mapping/iterative methodology – learning-centred, distributed, and community networked – are not meant to be exclusive, but they are highlighted as the three mainstays of leadership for whole-school transformation. As the two Singaporean case-study schools reveal, a premium is also placed on capacity to strategise, political acumen, risk-taking and boldness – all are invaluable characteristics for transforming 21st century schools.

The pace and sequence in which the elements are transformed, the emphases given to particular elements, and the styles and patterns of leadership, will all differ as each transforming school follows its own trajectory. Activating the model necessarily introduces the uniqueness of each school and every system, reflecting their own cultural norms, patterns of governance and leadership; school type, aims, size and intake; resource availability; degree of teacher professionalism; and, not least, the starting point from which each school and system takes off. It will also reflect the main drivers of the

transformation. Cultural norms in particular will shape variance in patterns and styles of leadership in the transformation process: “distributed leadership”, for example, will normally assume different configurations in Asian hierarchical societies than in Anglo-Saxon social organisations (Dimmock, 2012).

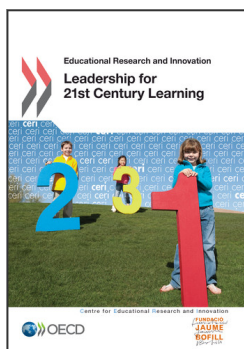
Hence, schools will engineer their transformations towards 21st century learning environments in diverse ways in the decades to come, in line with greater school discretion over implementation and increasingly professionalised teachers and leaders. This leads to the conclusion that the model *per se* is transferable and has high validity, even though the drivers, processes, and emphases involved in operationalising it will vary according to the particular contexts of each school system. This is all to the good – the last thing needed from transformed 21st century education systems is standardisation, conformity and convergence.

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