David Hung
Shu-Shing Lee
Yancy Toh
Azilawati Jamaludin
Longkai Wu   *Editors*

Innovations in Educational Change

Cultivating Ecologies for Schools

Springer

Education Innovation Series

Series Editor

Wing On Lee
School of Education
Zhengzhou University
Zhengzhou, China

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The audience of the edited volumes and monographs published in this series includes researchers, policy makers, practitioners and students in the fields of education and teacher education, and public policies related to learning and human resources.

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David Hung • Shu-Shing Lee • Yancy Toh
Azilawati Jamaludin • Longkai Wu
Editors

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Editors
David Hung
Nanyang Technological University
National Institute of Education
Singapore, Singapore

Yancy Toh
Nanyang Technological University
National Institute of Education
Singapore, Singapore

Longkai Wu
Nanyang Technological University
National Institute of Education
Singapore, Singapore

Shu-Shing Lee
Nanyang Technological University
National Institute of Education
Singapore, Singapore

Azilawati Jamaludin
Nanyang Technological University
National Institute of Education
Singapore, Singapore

Series Editor's Foreword

Centralisation and/or decentralisation, in educational policymaking, educational administration, and educational management, has been an issue of debate for a long time. The debate is giving advantage to decentralisation, which is represented in various forms such as self-managing schools, self-transforming schools, school-based management, school autonomy in management, total quality management, learning organisation, shared and distributive leadership, etc. and the emergence of the concept of governance in place of governing. Education policymaking, administration, and management philosophies being increasingly influenced by decentralisation concepts notwithstanding, decentralisation is also criticised for its disadvantages and weaknesses, such as its potential of becoming loose in management, lack of coordination and clearly defined responsibility, and the relatively high costs of communication and slow decision-making, especially in a "flat" organisation.

The specific contribution of this book is its exploration of an ecological model that will combine the "tight" and "loose" management, as well as the "top-down" and "bottom-up" decision-making and communication process. Needless to say, the significance of middle management comes to place immediately as the "in-between" lubricator; and their bridging functions are essential to bring about mutual understanding among the various sectors within an organisation.

Apart from the complementary functions, the ecological model of management has a lot more to offer, such as culture building and holistic perspectives for all staff in the organisation, and both of these are important elements for a sustainable management model. Further, the ecological model as advocated in this book provides a lens for innovation diffusion, which is also an essential concern for the sustainability of successful organisation innovations.

In addition, the strength of this collection of works comes from its case study analyses that unfold the communication and management processes of the ecological approach, and communication is essential for bottom-up voices to be heard and top-down decisions to be implemented. The chapters were not only written with conceptual and theoretical rigours but also with lessons drawn from the experience of implementation. And this is a specific contribution of the research agenda of

NIE's Centre for Research in Pedagogy and Practice (CRPP), trying to look for research findings on practice and implementation.

I would like to congratulate the editors and authors of this book for their success in advancing the agenda of ecological leadership, as demonstrated in the multiple perspectives of examining the various aspects and dimensions of this new angle of looking at leadership in this volume.

Distinguished Professor   Wing On Lee
Director, International and Comparative Citizenship
Education Research Centre
Director, Central Plains Education Development Research Centre
Zhengzhou University
Zhengzhou, China

Foreword

New forms of schooling are needed to ensure education systems remain relevant for the twenty-first century. Yet, the pace of educational reforms lags behind rapid global developments. While market-driven innovations gain momentum because they can be created with careful considerations relating to values and fit with contemporary contexts, the rigid demands of schooling, such as subject compartmentalising, institutional routines, timetabling, and exams, limit the agility of educational innovations. Educational change is also challenging, requiring grit, will, and risk-taking from stakeholders throughout the education system if implementation is to be successful and sustained.

Diffusing innovations for educational change is a complex and non-linear process. This book foregrounds an ecological perspective that is needful to understand the possibilities and complexities of spreading and sustaining educational innovations. The case studies show that cultivating ecologies for innovation and change is possible by leveraging affordances and resources across the education system to create new contexts, synergies, and capacities. Few books operationalise the nuances and interactions of innovation and change across multiple levels of the education ecology – from the micro (classroom), meso (organisation/school), exo (partners), macro (policy), and chrono (time scales) levels. This book provides a unique, ecological lens to explicate the dynamic tensions and intricacies of how the chronological, systems, school, and learner's views shape innovation and change. Collectively, the case studies provide a multiplicity of insights that discuss the complexity of cultivating ecologies for innovations in holistic ways.

As we move towards new forms of schooling, collaborations and synergies continue to be strong features for nurturing ecologies that not only emphasise individual school improvement but also collective and continuous improvements involving whole education systems. This endeavour requires diverse stakeholders to synergise and broker differences towards a collective goal as well as generate and share

knowledge across ecological boundaries. This book is both insightful and timely given that the principles of collaboration, synergy, and complexity are key for educational innovation and change in the twenty-first century.

Director of Policy, Scotland   Christopher Chapman
Founding Director of the Robert Owen Centre
for Educational Change
University of Glasgow
Glasgow, Scotland

Preface

Innovations in Educational Change: Cultivating Ecologies for Schools

Despite efforts to transform schools, there continues to be gaps between what students learn in schools and what is needed in the workforce. This situation known as the "education crisis" is further fueled by difficulties schools face to keep up with expectations to foster twenty-first-century learning dispositions and student-centred learning (Hargreaves & Shirley, 2012).

Educational reforms and innovations have been introduced to bridge this gap. Yet, the process of diffusing innovations is inherently complex. Even when pedagogical reforms for student-centred learning are initiated in schools, inertia and resistance can curtail change efforts. Piecemeal efforts may also impede deep-seated transformations or result in lethal mutations during the uptake of innovations.

This book explores the imperatives of educational reforms and locates the role of schools in growing, diffusing, and sustaining changes in Singapore's context together with international case studies from the United Kingdom, the United States, and Israel. The case studies explore dialectical relationships between structure, people, and culture. Each education context harbours unique characteristics. Scholars, such as Elmore (2016), Peurach and Glazer (2012), and Shirley (2017), emphasise that seamless transfer and replication of explicit knowledge cannot be assumed. Spreading educational innovations and reforms is not just concerned about accelerating and replicating explicit knowledge. It is a complex process that is shaped by multiple nuances. Educational innovations and reforms need to pay attention to tacit knowledge and conditions of transfer which may be ambiguous and challenging with overlapping social dimensions and evolving teaching and learning contexts.

This book aligns with scholars, such as Elmore (2016), Peurach and Glazer (2012), and Shirley (2017), in taking a critical view where spreading educational innovations is not a simplistic, straightforward process of replicating explicit knowledge or best practices. This book contributes by proposing an ecological perspective

to unpack intertwining issues related to spreading innovations – such as developing teacher capacity, school leadership, and culture building – and its relation to education systems. The ecological view embraces the complementary roles of top-down and bottom-up approaches as well as qualitative and quantitative dimensions to understand the intricacies of educational innovations and reforms (Hung, Lee, & Wu, 2015). We postulate that the way to embrace complexities within the education system and yet sustain the "spread" and "growth" of educational innovations is to create new ecologies. An ecological perspective consolidates and attends to the dynamic tensions in order to understand the rich interplay of policy- and school-level influences that contextualise school innovations. An ecological perspective also acknowledges the rhizomatic nature of spreading educational innovations which involves multiple interplays, trajectories, implementations, and adaptations to influence the sustainability and ownership of change (Jamaludin & Hung, 2016). The multiple voices and views presented in this book enable impediments and affordances of innovation diffusion to be discussed holistically, which is an integral caveat for nurturing a sustainable ecology that allows innovations to grow.

A prominent example of an ecological framework often cited by scholars of the ecological paradigm is Bronfenbrenner's (1979, 1993) model of human development. Informed by his insights, we map out the nested context of ecological systems that shape the diffusion of innovations across schools (see Fig. 1). We adapt Bronfenbrenner's (1979, 1993) model to define ecological dimensions as nested subsystems at the micro (classroom), meso (organisation/school), exo (partners),

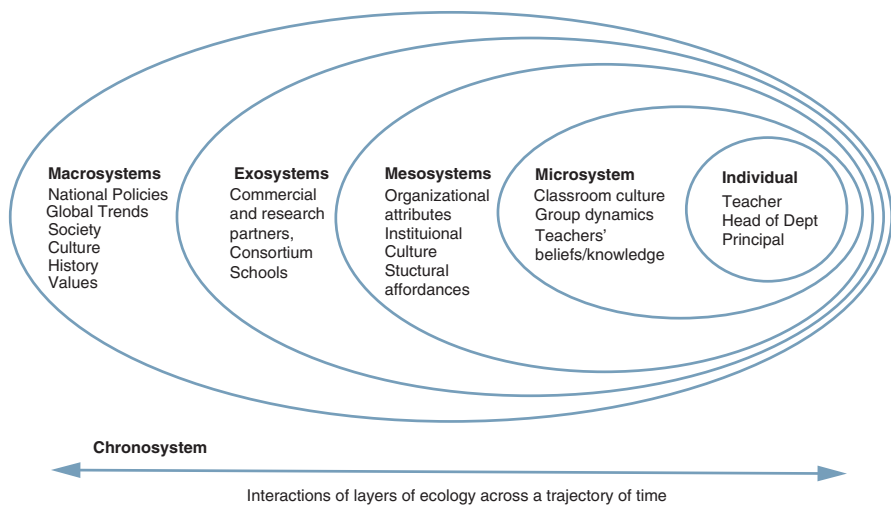**Fig. 1** Ecological sub-systems that shape the diffusion of innovations in education contexts. (From "Ecological Leadership: Going beyond system leadership for diffusing school-based innovations in the crucible of change for 21st century learning" by Y. Toh, A. Jamaludin, D. Hung, & P. M-H. Chua, 2014, *Asia-Pacific Education Researcher, 23*(4), pp. 835–850. Copyright [2014] by A. Jamaludin. Reprinted with permission)

macro (policy), and chrono (time scales) levels with interplays and synergies that face the spread and sustainability of educational innovations.

From an ecological perspective, innovation diffusion in education is about schools leveraging affordances and resources in the larger education system. While most education systems are predominately centralised or decentralised, an ecological perspective argues that both top-down (centralised) and bottom-up (decentralised) efforts are needed for creating new contexts, synergies, and impetus for diffusing innovations and developing the sociality that sustains change. Elmore (2016) describes the complexity of innovation diffusion in education which is shaped by micro and macro contexts as well as the unique social-cultural differences across these contexts. This suggests that innovation diffusion is neither top-down or bottom-up because neither of these approaches may adequately acknowledge the contextual differences between micro and macro contexts that shape the spreading and sustaining of innovations. Instead, innovation diffusion may involve both top-down and bottom-up approaches in complementary ways. However, the extent and contributions of top-down and bottom-up approaches may be evolving depending on the level of the education ecology in which the innovation foregrounds. For example, innovation and change that foreground the chronological view may have a larger portion of top-down efforts as compared to bottom-up efforts.

Through such efforts, new contexts are formed where sociocultural affordances, technological infrastructure, and leadership aspects are coupled to sustain innovations, develop teacher capacities, and enact student-centred practices for the twenty-first century. Sustaining innovation is about developing understandings of how to adapt innovations for diverse contexts (Elmore, 2016; Jamaludin & Hung, 2016) and yet continuing to align change imperatives at the system, district, and school levels and throughout the interlocking phases of planning, implementation, and integration (Fullan, 2006).

In this book, we explore tenets, stakeholders, and interactions of innovation and change at different levels of the education ecology to highlight the chronological, systems, school, as well as classroom and learner's views. These views are elaborated in the following:

1. Innovation and change from the chronological view

   (a) Explications of the chronological trajectory of centralised and decentralised education systems.
   (b) Considerations of how these trajectories shape policies, historical and social-cultural dimensions, as well as the need to consider top-down and bottom-up efforts to create macro contexts for innovation and change.

2. Innovation and change from the systems view

   (a) Policies that enable partnerships with communities of practice and stakeholders, at the macro- and exo-system levels to drive and spread innovation in schools.
   (b) Frameworks that organise different types of educational innovations and the varying roles communities of practice play in diffusing new practices.

   (c) Understandings of communities of practices and stakeholders in helping
       schools develop deep understandings of innovations and seek alignments
       between policy and practice.

3. Innovation and change from the school view

   (a) Tenets related to mesosystems where schools' orientation to teacher learning
       sets school's conditions, leadership perspective, and culture create support-
       ive ecologies for innovations.
   (b) School leaders' roles which include making sense of innovations, creating
       metaphors as well as school-level structures to operationalise innovations.

4. Innovation and change from the classroom and learner's view

   (a) Microsystem/classroom understandings of how teachers implement innova-
       tions in classrooms and its impact on students.
   (b) Insights of how schools provide opportunities for learners to engage in inno-
       vations in informal contexts to develop sustained interests and dispositions
       for learning in classroom contexts.
   (c) The implementation, diffusion, and sustainability of innovations require
       interactions across different levels of the ecology.

Accordingly, the book chapters will be organised to the above four major levels
of analyses.

Structure and Outline

The book is divided into four major parts. All chapters embrace the ecological view
where the complementary nature of top-down and bottom-up approaches to innova-
tion and change evolves according to the different levels of analyses. In the first
part, we describe the historical trajectories and orientations of education systems
which set the background for the ways innovation and change are implemented. The
intent is to highlight that although education systems may be predominately central-
ised and/or decentralised, top-down and bottom-up efforts work in synergies to
enable innovation and change. The second part relates to system-level policies and
structural relationships, such as communities and partnerships, which are mecha-
nisms that attempt to enable bottom-up efforts that drive the spread and sustainabil-
ity of innovations in schools. The third part provides schools' views of how school
leaders make sense of innovations and policies to create cultures of innovations as
well as school-level structures and processes to implement and spread innovative
practices while remaining cognisant of system-level policy directives. The fourth
part provides understandings of how teachers and learners engage in innovations
and change with diverse stakeholders that are in line with policies.

Part I: Innovation and Change from the Chronological View

In Part I, chapters foreground the chronological view by illustrating how the historical context of education systems, such as whether it adopts a centralisation and/or decentralisation stance, shapes the ways innovation and change unfold in schools.

Chapter 1 by Chua, Toh, He, Jamaludin, and Hung introduces the concept of centralised-decentralisation. This concept enables an education system, such as Singapore, to achieve synergies as well as optimise the diffusion and sustainability of innovations. The chapter argues that centralised-decentralisation may not be a concept unique to the Singapore education system. Yet, there are indigenous understandings and implementations of the concept that is nuanced to Singapore. In Singapore, centralised-decentralisation is deployed pervasively across all levels of the education system. This chapter shows how centralised-decentralisation is an ingrained disposition and a way of thinking for policymakers, researchers, school leaders, and teachers in Singapore.

Chapter 2 illustrates a case that is situated in a decentralised education system, such as the United Kingdom. In this chapter, Brown, Husbands, and Woods describe the transformation of schooling for a district and unpack several linked factors and efforts that are carefully coordinated to facilitate change. This case study exemplifies that even though the district is situated within a decentralised education context, coordinated top-down efforts such as political leadership and generous resourcing are needed to complement teachers' professional leadership to enable sustained change.

Part II: Innovation and Change from the Systems View

In Part II of the book, authors discuss how system-level policies, frameworks, and communities create leverages, partnerships, and synergies that influence innovation and change in schools.

Zohar in Chap. 3 unpacks a system-level model that develops senior instructional leaders' capacities to infuse higher-order thinking across the curriculum in Israeli schools. In this chapter, capacity building becomes a key leverage to drive innovation and change in the curriculum. The chapter highlights how top-down efforts for innovations coupled with substantial degrees of autonomy are meaningful for building senior instructional leaders' capacities to bridge gaps between policy and practice.

Chapter 4 describes a system-level approach to promote a culture of innovation and reflective practice and spread technology-mediated educational innovations across Singapore schools. Lim, Kwan, and Poh describe this approach as a top-down initiative driven by the Ministry of Education (MOE, Singapore) to enable bottom-up diffusion by communities of practices and teacher champions. While

communities of practices and teacher champions are often seen as bottom-up drivers, this chapter illustrates how system-level efforts can be designed for more concerted use of communities and teacher champions as leverages for innovation diffusion and change.

Chapter 5 delves into a classification framework where Shaari, Hung, and Osman unpack educational innovations according to its characteristics, namely, adaptability, technicality, accessibility, relevance, and change. The classification framework accounts for the operational aspects of innovations in the Singapore context by considering teachers' views and existing infrastructures to situate ways innovations can leverage system-wide communities of practice to facilitate diffusion within schools and/or at the school district levels.

Chapter 6 unpacks the partnership involving a lead specialist from the Ministry of Education, Singapore, and schools. In this chapter, Teo illustrates the contributions of her rich understandings of policies and practice to align, adapt, and spread an innovation according to school's needs. The chapter also describes how the lead specialist engages with teachers to codesign, cocreate, and use evidences to create school-level practices, structures, and processes that sustain the innovation while remaining cognisant of policies and other educational directives.

Part III: Innovation and Change from the School View

In Part III, chapters discuss the ways school leaders interpret and negotiate understandings of policies with teachers, the representations that school leaders use to describe innovation approaches to teachers, the schools' orientation to teacher learning, as well as the structures and processes that schools establish to create an ecology and culture towards innovations.

In Chap. 7, Spillane and Anderson examine how school leaders in the United States make sense of system-level policies and negotiate meanings with teachers to shift classroom practices. The chapter discusses the social tactics that school leaders plan to gather teachers' cooperation and integrate innovations into existing practice. Findings illuminate the role of school leaders in making synergies between policy at the system level and practices at the school and classroom levels.

Chapter 8 by Pedder and Opfer provides insights from the United Kingdom which illustrate that a key aspect of cultivating ecologies for innovations is to focus on schools' orientation to teacher learning. Pedder and Opfer stress that a supportive ecology is one where relationships between schools' orientation to teacher learning are aligned with the values teachers place on those practices.

Chapter 9 describes tenets of change related to the structures and processes that a Singapore school creates to develop capacities and build an ecology and a culture that encourages teachers to engage in ICT-mediated innovations. Lee, Seow, and Hung provide insights on synergies across multiple levels of the education system (such as school district and policy) that facilitate the spreading of innovations within and across schools.

Huang in Chap. 10 describes the metaphors that school leaders in Singapore use to explain and rationalise innovation diffusion approaches to teachers. The chapter provides empirical understandings of how school leaders rationalise innovation diffusion including the factors and reasons for why they integrate top-down and bottom-up approaches to spread innovations and enable change.

Part IV: Innovation and Change from the Classroom and Learner's View

Part IV focuses on teacher's and learner's views of how innovations in classroom and informal contexts shape learning experiences.

Lim, Song, and Kho describe in Chap. 11 how teachers implement innovations in classrooms so as to get students to generate questions, clarify conceptual doubts, and learn from each other. The authors emphasise that implementing, diffusing, and sustaining the innovation require enabling conditions and synergies across the education ecology at the school, district, and policy levels.

In Chap. 12, Tan describes how schools provide opportunities for the learner to engage in innovations and interest-driven learning in informal learning contexts. These opportunities enable the learner to experience interactions with communities to develop understandings and dispositions for learning that can be diffused and transformed to formal classroom contexts.

Finally, Chap. 13 concludes the book by synthesising all chapters and unpacking three tenets (calibrating top-down and bottom-up approaches, collaboration in networks, and leadership) for building new innovation diffusion and change contexts. This chapter integrates the book by emphasising the need to suit local contexts and the dynamic synergies within and across subsystems in the education ecology. The chapter also elaborates on the need for schools to come together in partnerships to cocreate understandings and the role of all stakeholders in leading efforts through top-down and bottom-up efforts to create a nurturing ecology for innovations and self-improving school systems.

A highly centralised approach to the propagation of innovation tends to eschew school voices and thus falls into the entrapment of supplanting innovations in inhospitable environments. A highly decentralised approach, on the other hand, may not be aligned with national goals and diffuse resources which could be channeled elsewhere to address more pressing priorities. As either way does not bode well for the well-being of the innovation ecology, this book attempts to provide insights by showcasing how innovation diffusion can occur through combinations of top-down and bottom-up efforts or centralised and decentralised approaches.

This book acknowledges that historical contexts may have implications on the synergies of top-down and bottom-up approaches for innovation and change. Unlike case studies from Israel, the United Kingdom, and the United States which embrace a centralisation or decentralisation stance, Singapore in comparison is a relatively

small education system where centralised-decentralisation is an ingrained way of thinking that is imbued throughout the education community (Ng, 2017). This contextual backdrop seems to directly align with the ecological perspective proposed in this book where multiple ideas related to innovation and change are unpacked as case studies at different levels of analyses. We hope these case studies from Singapore provide understandings for readers to adapt for their own contexts.

It is also our hope that through the various case studies and perspectives in this book, researchers, policymakers, school leaders, and teacher-practitioners glean insights into the thinking and culture that underpin sustainable innovations. As we move into the twenty-first century, student-centred learning, creating new ecologies, cultures, and approaches to reform and sustain classroom practices is key so that education systems remain malleable and relevant for our students and contexts.

Singapore, Singapore   David Hung
                                                                            Shu-Shing Lee
                                                                              Yancy Toh
                                                                       Azilawati Jamaludin
                                                                             Longkai Wu

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About Editors

David Hung is Dean of Education Research at the National Institute of Education, Singapore. He has served as Contributing Editor and Associate Editor for several well-read international academic publications in the learning sciences field and appointed as journal reviewer for various well-established international academic journals. His research interests are in learning and instructional technologies; constructivism, in particular, social constructivism; social cultural orientations to cognition; and communities of practice.

Shu-Shing Lee is a Research Scientist at the Centre for Research in Pedagogy and Practice, National Institute of Education, Singapore. Her research interests include teacher learning as well as understanding contextual factors and leverages for spreading and sustaining ICT-mediated educational innovations. Shu-Shing has published book chapters and journal papers and served as a reviewer for Social Sciences Citation Indexed journals. She is coeditor of the book *Adaptivity as a Transformative Disposition: For Learning in the 21st Century*.

Yancy Toh was a Research Scientist at the Centre for Research in Pedagogy and Practice, National Institute of Education, Singapore. Her research interests include leadership studies, school reforms, innovation diffusion, complex systems, and seamless learning. She is particularly interested in examining the systemic influences that impinge on a school's capacity to sustain technology-enabled pedagogical innovations for student-centred learning.

Azilawati Jamaludin is an Assistant Profession at the Curriculum, Teaching and Learning Academic Group, National Institute of Education, Singapore. Her research interests include progressive pedagogies, reform pedagogies, institutional innovations, gamification, game-based interactivity, immersive environments, argumentative knowledge construction, trans-contextual learning, embodiment, embodied knowing, embodied subjectivities, trajectories of *becoming,* and construction of self.

Longkai Wu is a Research Scientist at the Centre for Research in Pedagogy and Practice, National Institute of Education, Singapore. His current research focuses on the design and implementation of technology-enhanced learning activities in classrooms that help students develop deeper understandings. Dr. Wu has published his research work on classroom inquiry and computational thinking at several international conferences and in established international journals.

Part I
Innovation and Change from the Chronological View

Chapter 1
Centralised-Decentralisation in Singapore Education Policymaking

Paul Meng-Huat Chua, Yancy Toh, Sujin He, Azilawati Jamaludin, and David Hung

Abstract Centralised-decentralisation refers to the calibrated application of the forces of centring and calibrated release of the force of centring (resulting in decentring) in order to achieve coherence and optimal results and outcomes for a system. While the phenomenon of centralised-decentralisation is not unique to the Singapore education system, the fact that it is deployed pervasively across all policy contexts and that it recurs in the various levels of the education system (from the Ministry down to the teacher level) might make the phenomenon of centralised-decentralisation—from the perspective of implementation—uniquely Singaporean. This empirical paper, with data collected via interviews from a range of respondents (i.e. policy academics, school leaders, and middle managers), provides, amongst other things, evidence of the fractal nature of centralised-decentralisation, which speaks of the ingrained disposition of this habitual thinking in the daily policy and life of schools. Efforts have been made to ensure the trustworthiness of the findings arising from the research. Other findings of the research include the differentiated nature of centralised-decentralisation, the pragmatic motivation of the notion of centralised-decentralisation, and the need for calibrated trust between the Ministry and schools for the maintenance of the delicate balance between centralisation and decentralisation.

1.1 Context and Rationale

Decentralisation has been variedly defined. Mintzberg (1979) defines decentralisation as a phenomenon in which there is a "distribution of power in the organisation" (p. 184). Adapting it, Brown (1990) defines decentralisation as "the extent to which authority to make decisions is distributed among the roles in an organisation" (p. 36). Patrinos and Fasih (2009) characterise decentralisation as a process that

P. M.-H. Chua (✉) · Y. Toh · S. He · A. Jamaludin · D. Hung
National Institute of Education, Nanyang Technological University, Singapore, Singapore

gives "a voice and decision-making power to local stakeholders who know more about the local education systems than do central policy makers" (p. 2). To Patrinos and Fasih (2009), the devolving of power to make decisions at the local level could be analysed in terms of "Who to devolve it?" and "What to devolve?". Under the "Who to devolve?" category, power could be devolved to the professionals, i.e. principals and teachers (the professional-control model); community, i.e. parents and the community (the community-control model); or both the professionals and community (the balanced-control model).

In terms of the "What to devolve?" category, Caldwell and Spinks (1988), in one of the earliest educational books on the subject of decentralisation that spawn the trilogy of books on the self-managing schools, note that "resources" that are increasingly being devolved from the centre include technology (the means of teaching and learning), knowledge (the curriculum and the aims of schooling), material (the supplies in support of teaching and learning), people, time, and finance. Bullock and Thomas (1997), as well as Patrinos and Fasih (2009), enumerated areas of the schooling enterprise that could be devolved to the local entities: curriculum, pedagogy and assessment issues, human and physical/infrastructural resources, finance and funding matters, and issues pertaining to admission as well as those relating to what school information needs to be publicly published.

However, the central authority such as the central government will not decentralise the resources or areas of schooling to the local entities en bloc. Hanson (2006) rhetorically asks, "Is there really such a thing as a decentralised system?" Therefore, concomitantly with decentralisation, the central government will retain authority to make decisions over some areas of the schooling enterprise. This is not surprising as Goodlad in 1984 argues that although schools should be given more power ("rebalancing of power", p. 273), aspects of school-district partnerships should be maintained, e.g. the district having an oversight function through consultation, monitoring, and evaluation. Furthermore, Hanson (2006) argues that all decisions pertaining to the schooling enterprise, e.g. finance, personnel, and curriculum, "retain degrees of centralisation and decentralisation" (p. 11). Bullock and Thomas (1997) argue that reality is made up of a "mixed economy of allocative mechanisms" (p. 30) of centralisation and decentralisation and the issue is to find the "appropriate balance" (Hanson, 2006, p. 11) between them. In the Organisation for Economic Co-operation and Development (OECD) (2011) continuum of school autonomy (cited in Caldwell, 2015), ranging from one end of complete centralisation and the other end of complete school autonomy, there is a part-centralisation and part-decentralisation configuration of schools acting within the framework set by a higher authority.

Therefore, one expects to have decentralisation existing simultaneously with centralisation. For instance, the United Kingdom's (UK) Department of Education

and Science in its Parent Charter (Department for Education, 1991) articulates its educational strategy as one that involves retaining centralisation of the curriculum (through the National Curriculum) and assessment systems while devolving, amongst other things, finance to schools. In Singapore, a similar approach has been advanced by the Ministry to implement the curriculum of the future, dubbed C2015; the approach is known as "tight-loose-tight" (Ministry of Education [MOE], 2008, p. 3). Under this approach, there will be clearly defined (or "tightness") educational philosophy, strategic intents, and direction to guide the formulation of the national curriculum; school autonomy (or "looseness") to innovate at school and classroom level; and a comprehensive and clear mechanism (or "tightness") to evaluate if students have acquired the learnings translated from the intents and direction of the national curriculum.

While the phenomenon of centralised-decentralisation is not unique to the Singapore education system, the fact that it is deployed pervasively across all policy instantiations and that it recurs in the various levels of the education system (from the Ministry down to the teacher level)—as demonstrated in a section called "fractal nature" in this paper—speaks of the ingrained disposition of this habitual thinking in the daily policy and life of schools. That school leaders, Heads of Departments (HODs), and teachers are willing to adhere to the spirit of centralised-decentralisation might make the phenomenon of centralised-decentralisation uniquely Singaporean, i.e. from the perspective of implementation (L. W. Teh, personal communication, March 14, 2016). A paper setting out the formation of this ingrained habitual thinking or Bourdieu's habitus (Bourdieu, 1977, 1990) can be found in Chua, Toh, Jamaludin, He, and Hung (2016).

Although there is a number of Singapore education literature written on this subject of the simultaneous existence of centralisation and decentralisation of educational policies (e.g. Chua, Hatch, & Faughey, 2014; Ng, 2010; Tan, 2006; Tan & Ng, 2007)—a phenomenon called centralised-decentralisation by Chua et al. (2014)—they are mainly literature reviews in nature. This chapter attempts to advance the local literature in this field through the provision of empirical data on the nature of this phenomenon of centralised-decentralisation in the manner in which education policies are made and implemented in Singapore. Specifically, the research attempts to address the following research questions:

1. What is the nature and characteristics of the practice of centralised-decentralisation in Singapore schools, and how could one possibly attempt to account for the motivation of this practice of centralised-decentralisation?
2. Given the tensions involved in the co-existence of centralisation and decentralisation, how is the balance in centralisation-decentralisation (Hung & Chua, 2015) maintained?

1.2   Literature Review

1.2.1   School Autonomy

School autonomy, which results from decentralisation, can be understood in general terms as the delegation of a task or tasks by a local authority to agents, namely, the schools (cf. Wößmann, Lüdemann, Schütz, & West, 2007). Specifically, the OECD (2011) defines school autonomy around these two measures of delegated tasks:

1. School autonomy in allocating resources where schools have the authority to (i) select teachers, (ii) hire and dismiss teachers, (iii) establish teachers' starting salaries and determine teachers' salary increases, and (iv) formulate and allocate budgets.
2. School autonomy in (i) making decisions about curricula and assessments in determining curricula and assessment practices, (ii) establishing student-assessment policies, (iii) choosing which textbooks are used, and (iv) deciding which courses are offered (OECD, 2011).

In Singapore, school autonomy shares some of the characteristics set out by OECD (e.g. responsibility for school-based budgeting (Ng & Chan, 2008) and in determining school-based curriculum and assessment practices (Gopinathan & Deng, 2006). In addition, school autonomy in Singapore is characterised by school leaders being empowered to broadly set their own direction, vision, and mission (Ng, 2003); autonomy over a discretionary percentage of students to be enrolled into the school via school-based merit criteria (MOE, 2016a); as well as full autonomy over choice of pedagogy to deliver the national curriculum (MOE, 2008).

1.2.2   A More Nuanced Understanding of the Benefits
of School Autonomy

Instead of just autonomy alone, research has shown that autonomy, when combined with accountability, is most beneficial to schools (OECD, 2011). The Programme for International Student Assessment (PISA) results have suggested that when autonomy and accountability are combined intelligently, the resultant mixture of autonomy and accountability does lead to better student performance. In particular, the analysis showed that when there is greater autonomy in decisions relating to curricula, assessments, and resource allocation, better student performance could be expected, particularly when schools operate in a culture of accountability (OECD, 2011).

1.2.3   *School Autonomy and Centralisation in Singapore*

The Singapore government has been described as pragmatic and paternalistic (e.g. Neo & Chen, 2007; Trocki, 2006). The education system has always been a critical vehicle for supporting political agenda and economic strategies (Ng, 2005). Despite its intention for more autonomy to be given to schools, the government still ensures that schools remain rooted to a system of central coordination by the Ministry in ensuring that the ends are met (Ng, 2010). Relative to other jurisdictions such as Finland, school autonomy in Singapore does not mean being given a carte blanche in having a free reign in implementing reforms, without cognizance of higher societal needs and imperatives. It seems that a simultaneous existence of centralisation and school autonomy is very much pronounced in the Singapore education system, leading to some authors, for example, Tan and Ng (2007) and Chua et al. (2014) to theorise about the phenomenon called "centralised-decentralisation".

1.2.4   *Centralised-Decentralisation*

Centralised-decentralisation, as defined by Chua et al. (2014), refers to the calibrated application of the forces of centring and calibrated release of the force of centring (resulting in decentring) in order to achieve coherence and optimal results and outcomes for a system. This phenomenon is premised on the idea that ground personnel such as principals and the school leadership team need to make the various student-centric and school-centric decisions (Chua et al., 2014). But they do so within parameters such as the rationale and intent and other governing matrix (e.g. student-teacher ratio, as explicated in the following sections) of the policies. This is done so that while diversity and innovation are spawned, it is engendered within the broad direction of the Ministry, thereby maintaining some semblance of coherence as a school system. "Ultimately, the approach is designed to enable the system to reap all the benefits associated with tight coupling and a strong central authority without overly constraining the local actors, which would deprive the system of innovation and creativity" (Chua et al., 2014). An example would be useful here. For many years, a relatively high class size of about 40 students per teacher has been in operation. When the Ministry decided to reduce class size several years ago, it did not implement a specific teacher-student class size for all schools; instead, it created a new matrix of student-teacher ratios for each type of school (MOE, 2014), which in turn determined the overall allocation of teachers to schools. Within the total number of teachers allocated, each school has the flexibility to determine the appropriate class sizes (MOE, 2014). Therefore, some schools have decided to set larger classes for higher ability students while creating smaller sizes for students who are progressing more slowly (e.g. 20 students per teacher or even smaller, like 10–15 students per teacher).

1.3   Research Method

1.3.1   Data Collection

Recognising the contextual and complex nature of leadership (Bryman, Stephens, & Campo, 1996; Conger, 1998), qualitative methods were adopted to study the contextually rich and socially embedded centralisation-decentralisation phenomenon. Specifically, qualitative interviews (semi-structured, dialogic, and in-depth) were conducted with education policy-oriented academics and practitioners for the purpose of investigating the nature and tenets of centralisation-decentralisation characterising the Singapore education system. A pragmatic, convenience sampling strategy to recruit informants for policy-related research was adopted. Six academics and practitioners were identified based on the position of their leadership. These seven respondents comprised two academics from an institute of higher learning, with expertise in areas of educational leadership; two school-level leaders who were recent former principals and vice-principals; and two HODs (one current and one who is on secondment to an institute of higher learning.) Sample interview questions to unpack nuances of the education system in relation to the centralisation-decentralisation phenomenon can be found in Appendix.

   At least three interviewers from the research team were involved in each interview session with each informant. Such an approach enabled corroboration of the interpretation of interviewee responses. In addition, the multi-interviewer approach enabled the dialectic between semi-structured interview questions and the impromptu asking of follow-up clarification and probing questions. All interviews were audio-recorded and transcribed after each interview session. After each interview, we wrote analytic memos based on our impressions and reflections to capture more nuanced information.

1.3.2   Data Analysis

An iterative process, based on the constant comparative method (Corbin & Strauss, 2008), was employed in analysing the transcripts. A coding scheme based on patterns emerging from the interviews was developed. Successive rounds of coding to reveal themes and broader themes were conducted.

1.3.3   Trustworthiness of Research

Efforts were made to ensure trustworthiness (Lincoln & Guba, 1985) of the research. For instance, to ensure credibility—one of the most important factors in research trustworthiness (Lincoln & Guba, 1985)—the analysed data was collected via

interviews, a well-established data collection method; and one of the authors was very familiar with the culture of the institution from which data was to be collected (Shenton, 2004). Additionally, we checked possible factual errors in our interview data and the thematic categories by cross-checking with each research team member (Shenton, 2004). Furthermore, our observations and analytic memos were used in triangulating the interview data (Shenton, 2004). Transferability is built into the research as the interviews were in-depth which enabled adequately "thick descriptions" (Geertz, 1973) of the phenomenon of centralised-decentralisation to be written (Shenton, 2004). To ensure dependability and confirmability, a systematic documentation was made of the research procedures and interview questions used, raw data collected, and evidence of data analyses leading from research questions to conclusions (Yin, 2014) so that these could be subjected to external audit if needed. With the methodology narrated, the paper will transit to the findings of the research that is aligned to each research question.

1.4 Findings

1. What is the nature and characteristics of the practice of centralised-decentralisation in Singapore schools, and how could one possibly attempt to account for the motivation of this practice of centralised-decentralisation?

1.4.1 Evidence of Centralised-Decentralisation

Empirical evidence supporting the notion of centralised-decentralisation was uncovered in the research; academic G argues for its existence thus:

> … our [system] is a hybridised one. That is…I think, take this phase "tight-loose-tight". Okay. Obviously you must look at the School Excellence Model (SEM) because this is the school's self-evaluation and if teachers and principals are going to be judged by the quality of learning that they provide their students, then the School Excellence Model is the Ministry tool for judging. What does "tight-loose-tight" here mean? The Ministry sets out its policy objectives for education. That is the "tight". What is the last "tight"? Last "tight" is exam [and the SEM]. … So it is a uniquely Singapore thing.

Consistent with this notion, recent developments in education reflect this idea of centralised-decentralisation as evidenced in the slogan of "Top-down support for bottom-up initiatives" (MOE, 2005), where innovations from the ground are encouraged but within bounded directives from the Ministry. In this sense, centralised-decentralisation as a phenomenon is also termed as "guided autonomy" by School Leader Z. This cautious and pragmatic approach to education policies indicates that the Ministry maintains a considerable degree of power and authority at the top to guide the decentralised implementation of national directives, assuring that policy's rationales are realised.

Another manifestation of this phenomenon of centralised-decentralisation is "tactical empowerment and strategic alignment", as termed by Academic P. The latter has this to say about centralised-decentralisation:

> Singapore is both centralised and decentralised, both sides of the same coin—it is not a contradiction but a paradox. It is centralised at the strategic level but decentralised at the tactical level.

Under this characteristic, schools agree to strategically align with national strategies. The alignment with the Ministry and national strategies derives a certain level of synergy at a national level. Then, at a local level, tactical empowerment exists in that the principal, together with the staff, has the autonomy to adapt policies (but still in fidelity to the policy's rationales and other strategic objectives) within the broad remit of the strategic alignment, and customise education to the needs of the students, to best fit the profile of the students and meet their needs.

1.4.2   Motivation for Formulating Educational Policies in a Centralised-Decentralisation Manner

A philosophy of pragmatism (The Straits Times, 2015) is possibly the root rationale for the centralised-decentralised nature of school autonomy in the system. This pragmatism is directed towards allowing innovation and diversity to flourish to deliver the best student-centric education and yet to achieve coherence and direction at the national policy level.

According to Academic P, tactical awareness gives the school sufficient autonomy to tailor education (with fidelity to the policy's rationale) that suits their own student profile, since schools are most aware of their pupils' needs. Consequently, the education delivered is able to meet the diverse needs of students. The result is that, on the ground, certain levels of diversity and innovativeness are created, since schools have the leeway to serve their stakeholders in a way that best serves them. Despite these innovations and diversity, there is a sense of overall coherence and synergies at the system level with the assurance of attainment of the policy's rationales. This overall coherence serves to facilitate the ease of structured policy refinement and the attainment of high academic achievement on a system-wide basis with the corresponding space for talent development. Academic P further notes: "[Centralised-decentralisation] also allows, at a national level, a much more coherent picture because synergy can be derived and there is a national direction".

According to School Leader Z, choice that is afforded through the decentralisation aspect of centralised-decentralisation is needed to maximise the children's education, and she puts it this way:

> The school principal understands the school situation best especially in regards to readiness in taking on any initiatives. [It is] help[ful that] principals… bear in mind the constituents in our school community, like is it useful for the students. Therefore, principals pick and

choose initiatives based on the suitability to the school… For instance schools can't do everything from the toolkit as it is designed for a whole range of schools. The assumption is that you know the students' needs, what are the gaps in the school. Then you try to do things to help the students [based on] the kind of student profile that you have.

The HODs involved in the research share this viewpoint. For instance, HOD M says "generally top-down approach does not work as students have different needs and autonomy is important because there is no one-size-fits-all [approach]". Relating, HOD S says: "In different schools, because of the different profiles of the students, the emphasis is different, so autonomy helps to… customise certain programmes to better match the needs of the students".

1.4.3 Guidance to the Implementation of Decentralisation

In short, schools are not given 100% freedom; they operate on guided autonomy. School Leader Z has this to say: "So in a way, if you stand back and look at it, school autonomy is not freedom 100%. It is a sort of guided autonomy". HOD M sums it up neatly, "Firstly they must really understand the rationale of what is happening, why we are doing this. The rationale. Then if you believe in it, then you come on". As such, school decisions are made or guided by the bigger picture or policy imperatives and rationales set by the Ministry.

Other factors that could shape the exercise of autonomy include the Ministry's desired outcomes of education (viz. developing self-directed learners, confident persons, concerned citizens, and active contributors), student needs, school profile, and level of expertise in the schools. These disparate considerations are ultimately tied to the objective of implementing the policies in the manner that will benefit the students, i.e. to deliver a student-centric education. HOD M says:

> I think we are given some leeway [in terms of MOE's directives and school needs]. Because there are a lot of initiatives, so we can't do everything. So it's based on school needs and also governed by our school's makeup. We've got to pick, we can't do everything, but what will benefit our pupils – that is what we want… It cannot be [MOE] dictate – you are going to do this, you are going to do that, because it also depends on expertise.

HOD H mentions the Ministry's Desired Outcomes of Education as the source of guidance for the operationalising of autonomy at the school level:

> You have the freedom to choose from a variety of available choices, but these choices must be guided by guiding principles and most of the time guiding principles like the Desired Outcomes of Education, what we hope to achieve in nurturing the future and of course MOE from time to time will be sharing their policies so all these must be taken into account, in the context of autonomy.

1.4.4   The Fractal Nature of Centralised-Decentralisation

It was found that centralised-decentralisation is not a monolithic concept. That is, there is centralised-decentralisation at play at every level of the system. A useful metaphor to describe this phenomenon is "fractal" in the sense that there is a sort of self-similarity (Hutchinson, 1981; Song, Havlin, & Makse, 2005) of the existence of centralised-decentralisation at the various levels of the school system. For this research, based on the evidence, centralised-decentralisation has been found to exist at least at the school, department, and teacher levels.

Given the narrative thus far that centralised-decentralisation exists at the school level is already a foregone conclusion. Nonetheless, evidential quotations could be advanced here to reinforce the point: "And I think [school] autonomy also means that you have a certain level of understanding with your superintendent; principals pick, choose and customise initiatives based on needs of the school," says School Leader Z. School Leader H articulates school-level autonomy in terms of choice: "Schools have the autonomy to decide which MOE initiatives to adopt and not follow 'blindly' and not take on too many irrelevant roles". Relating, School Leader Z uses the choice metaphor in a buffet restaurant:

> If I use the analogy of the 10 dishes, usually it's HQ who say these are the 10. But then it could mean for all the schools and system but then mine is a secondary school. Then mine is an… autonomous school. Then there will be several things of the 10 which is not so relevant. This is what it means… So I must look at it.

In these examples, the Ministry and the superintendent represent centralised forces as they exist to provide direction, and the school leaders' ground-level decisions represented autonomy or decentralisation at play.

At the department level, centralised-decentralisation also exists. According to HOD M: "The autonomy [at the department level] comes in where the Middle Managers work on their plans and see how they achieve this [the school's decision]". At the teacher level, centralised-decentralisation also exists; according to HOD S, "within the classrooms teachers have the autonomy to make decisions 'within their own area'… teachers have the autonomy to do things differently, i.e. the way they want to motivate the students. Teachers are encouraged to use their own methods to motivate their students". Again, in these examples, the school represents the centralised force as it makes guiding decisions for teachers, who in turn use the autonomous space given to them via the notion of centralised-decentralisation to customise their teaching approaches to meet the needs of students.

In sum, Academic P says:

> Centralised-decentralisation, if you just use that phrase – can be applied to different levels so on the one hand, if you are talking at the national levels, there is the relationship between school and MOE HQ… But the same can be said of the principal and the rest of the staff at the school level. School department. So, up and down [the system], you can use the same concept.

The quotation demonstrates that the non-monolithic nature of centralised-decentralisation exists at the various levels of the Ministry-school system, i.e. a

pattern of self-similarity or fractal phenomenon exists (Hutchinson, 1981; Song et al., 2005). The non-monolithic nature of centralised-decentralisation is a layered notion, and we will explicate the other layer next.

1.4.5   The Differentiated Nature of Centralised-Decentralisation

Within the school's departmental level, decentralisation or tactical empowerment to HODs and teachers is not issued carte blanche style; instead, within the school department level, there is differentiated autonomy. Empowerment is provided by principals to middle managers based on factors such as competence, experience, and past success. HOD S notes that he "exercised less autonomy as a beginning HOD. Autonomy given is dependent on the individual's skills; on his/her track record, if the person is already competent in his basic roles and responsibilities". Other considerations include the importance and level of publicity of the programme, and decentralisation is provided in "measured proportion". That is, differentiated empowerment/autonomy exists within the local school departmental level.

2. Given the tensions involved in the co-existence of centralisation and decentralisation, how is the balance in centralisation-decentralisation (Hung & Chua, 2015) maintained?

1.4.6   A Delicate Balance Between Centralisation and Decentralisation

From the research, it was found that there is a delicate balance between the forces of centralisation and decentralisation at work. Academic P likens the centralisation-decentralisation tension to a mother-daughter relationship to illustrate the delicateness of the relationship:

> A concerned mother [has]… a teenage daughter, you are quite worried. Eh you go out, you better start setting some boundaries. You better come back at 11 pm. And if certain boys call you, you better tell me I want to know. Things like that. But there is always that very delicate balance, right?

Because of the delicate nature between centralisation and decentralisation, Academic G says: "So I think balancing centralisation and decentralisation is always going to be dynamic, always a work in progress".

Before transiting to the next section on how such a balance could be maintained, an authors' note on the nature of the balance is in order. As the rationale and other strategic dictates are determined by the Ministry, naturally, the balance is calibrated

by the Ministry, and it might be a moot point on whether there is still a balance of centralisation and decentralisation in the first place. It is the authors' argument that a balance could still be said to exist, or at least, an *enlightened* balance, since if the forces of centralisation are too strong, the system will not be able to benefit from the initiative and innovation arising from the school ownership of the policies. As a result, it is to the advantage of the Ministry that while it dictates the strategic rationale, intents, and other strategic parameters of the policies, it does give space for schools to own aspects of the policies and to adapt the implementation of the policies.

The delicate balance between centralisation and decentralisation (Hung & Chua, 2015) needs maintenance, and it depends on a number of factors, one of which is the calibrated trust from the centralised powers to the school leaders to practice their craft.

1.4.7 Trust

A relationship of trust is needed to negotiate the autonomous space between the Ministry and school. For instance, School Leader Z acclaims: "So autonomy comes with trust". Academic P unpacks the need for trust in more analytical terms:

> But there is always that very delicate balance right. That delicate balance is precisely one of — where do you draw? Where exactly should you draw the line. Second, the line is not a static line, it depends also on the trust level, but trust in itself is not a static concept either. Critical incidents affect certain things. So one of the things that we have found in this situation is of course how much can one trust and how much one can handle one's anxiety.

The Ministry needs to trust schools to exercise school autonomy responsibly. In addition, being highly contextualised, i.e. it is not "a one-size-fits-all" situation, autonomy is perceived differently by schools because of their different contexts, visions, missions, and pupil and staff profiles. As such, the Ministry needs to have a broad overview of the various school typologies and having put in place safeguards, trust in a calibrated manner, that schools will play their role responsibly in tactically manoeuvring within the strategic imperatives of the Ministry. There is another shade to the relationship of trust between the Ministry and schools. HOD M articulates thus: "Autonomy based on professional trust is given but monitoring is important". That is, with autonomy, there is the need for monitoring. The feedback systems reflected in the previous section also serve the purpose of gathering data and knowledge for monitoring, besides learning.

At a level below, i.e. at the interface between school leaders and teachers, the issue of trust plays out again. To HOD S, "the interpersonal relationship and trust between teachers and school leaders is very valuable. With that, then the idea of autonomy can be approached in a genuine way". Furthermore, since the understanding of autonomy varies from generation to generation of teachers, e.g. younger generation vs older generation of teachers, the issue of trust between school leaders and teachers is just as important, if not more important.

1.5 Discussion

1.5.1 A Role for Everyone

To operationalise the tactical empowerment within strategic alignment to national perspectives, or "to coordinate the good intentions" as how respondent P has put it, one could possibly advance a-role-for-everyone concept, similar to the Confucian concept of *Jun Jun, Chen Chen, Fu Fu, Zi Zi* (君君, 臣臣, 父父, 子子). That is, there are specific roles that everyone can take at every level of the system, together with the associated proper conduct, for social order to occur (Fairbank & Goldman, 2006). According to Academic P:

> I think the government ought to still do the government thing but they would restrict themselves to more strategic things. Then on the ground the people will also do their own things, but will restrict to the things they found strategic for themselves. Then this system will probably work.

Juxtaposing the earlier ideas, the people on the ground will need to align themselves to the rationales and policies in question and so in a way find their own responsibilities. The same respondent noted that if the good intentions are uncoordinated resulting in the absence of clear direction, then chaos will result, leading to the suboptimal functioning of the system. The a-role-for-everyone concept might explain why despite the bounded freedom of centralised-decentralisation, evidence from the research suggests that teachers seem to be comfortable in supporting the direction given by leadership at the school level and at the Ministry level.

1.5.2 Do Teachers Really Want Autonomy?

Though teachers may support the leadership direction, it is not the same thing as wanting more autonomy. Intuitively it is taken for granted that with increased autonomy, teachers will claim more ownership of their work, which might possibly lead them to be more willing to contribute and to put in more effort; this is the natural expectation of ours. However, it was found in the research that not every teacher appreciates the provision of school autonomy to him or her. Actually, the situation is more nuanced, i.e. teachers themselves are not a monolithic bloc. According to HOD S, "while some teachers want autonomy, some [would] rather not have [it]". According to School Leader Z:

> They [teachers] don't want to be accountable to people outside, you know. Right so, with autonomy there is responsibility. They don't want the responsibility. They don't want to be held accountable for something.

The apprehension of autonomy experienced by these teachers can be perceived as a result of the culture of conformity and aversion to accountability, which was largely absent during a more centralised system where responsibility lies mainly

upon the upper echelons of the whole system. This unexpected finding thus suggests that while autonomy has cascaded downwards to schools, the fruits of autonomy can only be more fully realised if autonomy is accompanied by a culture of risk-taking. While we mention about fractals in terms of policy implementation in the preceding sections, the most challenging aspect for leaders is perhaps to create fractals in terms of motivation for actors within and across the different layers of ecology. Perhaps only then will the notion of autonomy be fully embraced and harnessed. Recent developments in the Ministry have worked in the direction of encouraging teachers to embrace and harness the autonomous space to work for their students. Examples of such developments include the setting up of the Singapore Teachers Academy to nurture a "teacher-led culture of professional excellence centred on the holistic development of the child" (MOE, 2016b), as well as the establishment and enhancements made to the teaching track of career development, to make it attractive for teachers to assume teacher leadership roles.

1.6 Implications for Practice

In the implications section, the authors will focus on the qualities that school leaders and teachers need to possess in order to successfully negotiate and manoeuvre around the tension-fraught space of centralised-decentralisation. Two qualities are posited to be necessary: ecological leadership and teacher professionalism.

1.6.1 Ecological Leadership

In negotiating and manoeuvring the oxymoronic situation of centralisation and decentralisation, leadership will be critical. School Leader H comments: "School autonomy is dependent on the leadership…". Similarly, HODs S and M share the same sentiments as School Leader H.

A corollary is the question: "What kind of leaders or leadership would be needed?" The idea of ecological leaders (Toh, Jamaludin, Hung & Chua, 2014)—who move and function at multi-perspectival levels of the system—is advanced as possibly a suitable view of leadership for operating within this environment of centralised-decentralisation nature of school autonomy. Ecological leaders possess an awareness of what is happening at every level of the system and are able to appreciate the impetus and motivation for the policy rationale and content. Besides making sense of the demands associated with the various levels of a system, ecological leaders need to be able to make connections and manage the tensions and the dilemmas inherent in the demands of the various levels of the system. Besides, ecological leaders can take effective actions to address the situation at hand by expanding the resource space (like staff and time) within the school or ecosystem. For example, if the situation calls for it, the ecological leader is able to bring the

special qualities of staff to the forefront because of their potential to actualise the tactical plans within the strategic vision of the Ministry or is able to persuade the Cluster Superintendent to delay the implementation of the policy to another year.

Another characteristic of such leaders is one who is not only aware, appreciative of, and is able to connect the multi-perspectival view of the system, but also one who could mitigate both top and bottom expectations and needs through fostering and engaging in dialogue with the various levels of people in order to bring about coherency and co-ordination between the demands of the top and the needs of the bottom. For example, ecological leaders will be able to align the schools' and teachers' directions to the vision of the Ministry, or the ecological leader is able to give feedback to the Cluster Superintendent with regard to the issues and challenges faced on the ground in the course of the policy implementation. Two evidential quotations provide a reality check on the concreteness of the two examples just offered. HOD M says that in such a leadership stance, there is "a lot of dialogic process going on. Suggestions are valued and discussed. The background/big picture is given". Academic P emphasises: "As centralised-decentralisation [involves]… strategic alignment… [and]… tactical empowerment, so you must be courageous to interpret as appropriate… and yet have the wisdom to know exactly how to do it so that you can fulfil the best of both worlds".

To conclude this section, ecological leaders look for suitable opportunities to expand the resource space (e.g. capacity and time) within the school. Ecological leaders could also develop a shared and coordinated understanding and coherency of top-down policy rationales and other imperatives and bottom-up schools' and teachers' needs and challenges. If people without the right ecological competencies are in place, breakdowns can occur, and the system will not function properly as there might not be alignment and the envisaged synergies in a centralised-decentralisation system.

1.6.2   The Professionalism of Teachers

Besides leadership, the professionalism of teachers also matters in enabling the whole school to confidently and effectively negotiate the tensions and dilemmas of a centralised-decentralisation space in which Singapore schools are located. Teacher capacity, which is a constituent of teacher professionalism (Evans, 2008; Hargreaves, 2000; Whitty, 2000), is the angle of our discussion. For instance, given the autonomous space to choose suitable pedagogies to enact the curriculum, *capable* teachers *could* implement suitable pedagogies to successfully reach out to the students. HOD M notes "training is important, for mastery". In the interviews, the HODs cited many instances and examples of training in their schools, such as the learning of best practices from other schools, school-based professional development sessions on co-operative learning, and training conducted by the Ministry on, for example, holistic assessment to enable teachers to implement the holistic assessment policy.

Academic G provides another perspective on the importance of teacher professionalism by situating in notions connected with empowerment (Hargreaves & Goodson, 1996) and being reflective professionals (Schön, 1983): "There is a conscious effort to professionalise the teacher and to professionalise the teacher means to empower… teachers… to treat them as professionals, it is to treat them as capable reflective individuals". That is, the associated empowerment and reflectiveness of teachers that come with professionalism will enable them to take advantage of the autonomous space created by centralised-decentralisation to deliver a quality education to students.

1.7 Conclusion

Although centralised-decentralisation might not be a uniquely Singaporean approach, the demonstration of the existence of self-similarity or fractal-like repetition across the various levels of the Ministry-school system might suggest that centralised-decentralisation is actually practiced at the ground level. It is not just an abstract construct to guide the planning of educational policies but that the spirit of centralised-decentralisation is adhered to by school leaders, HODs, and teachers. The latter is arguably the uniqueness of the centralised-decentralisation phenomenon in Singapore. That such a spirit is so strongly held could be accounted for via the tight and self-locking assemblage of performance appraisal policies and practice, as well as the continuous reinforcements of the messages of centralised-decentralisation at the cluster meetings and in the different policies formulated (Chua et al., 2016). Implicitly embedded in the messages is one, as elaborated in Chua et al. (2016): the Confucian cultural value of a role for everyone, which serves for the orderly development of the Singapore education system.

Besides this characteristic of fractals, the research has also uncovered a few other characteristics of the centralised-decentralisation in the Singapore education system: pragmatism as a driving philosophy for the practice of centralised-decentralisation, differentiation in the practice of the phenomenon by school leaders, and the need to balance the tensions of centralisation and decentralisation through the exercising of calibrated trust by the Ministry.

Finally, as evidenced by the voices of the research subjects, a balance between centralisation and decentralisation allows, at a national level, for overall policy coherence (Mahbubani, 2013) to emerge, thus enabling synergies to be derived. Yet, the innovative agency of the ground could be tapped. In a way, it allows the system to achieve the best of both worlds, of agency and creativity, and of governmental guidance (Chua et al., 2016). This best of both worlds could arguably help to mitigate the "duality… [of]… market imperfections and government imperfections" that plague the effectiveness of many instances of public (or educational) policies (Wu & Ramesh, 2014, p. 305) planning and implementation. In other words, imperfections or less-than-optimal outcomes will result when either the people (or market) or the government is too dominant at any one point in time; a synergistic partnership needs to be calibrated between the government and people (or market).

Appendix: Sample Interview Questions

1. Based on your understanding of the academic literature and/or your work experience, how does the Singapore education system approach the giving of autonomy to schools?
2. What are some of the key characteristics of Singapore's approach to school autonomy?
3. What would you say are the key approaches of the Singapore education system to maintaining centralisation?
4. Do you think the system tries to balance decentralisation and centralisation forces at the same time? If so, how do you think this is played out?
5. What are some of the approaches that the Singapore education system takes for the reform of the curriculum?
6. How are the different approaches similar or distinct from one another?

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Paul Meng-Huat Chua is a Senior Teaching Fellow at the Office of Education Research, National Institute of Education. His research interests include sense-making of education policy, educational leadership, reflection and value-based leadership development, school and system improvement, comparative education, and quality assurance in education.

Yancy Toh was a Research Scientist at the Centre for Research in Pedagogy and Practice, National Institute of Education, Singapore. Her research interests include leadership studies, school reforms, innovation diffusion, complex systems, and seamless learning. She is particularly interested in examining the systemic influences that impinge on a school's capacity to sustain technology-enabled pedagogical innovations for student-centred learning.

Sujin He is Research Assistant at the Office of Education Research, National Institute of Education, Singapore. Prior to this, she was involved in curatorial research for arts and heritage organisations. She has worked on research projects on school autonomy and leadership, informal learning spaces, and making-centred learning.

Azilawati Jamaludin is an Assistant Profession at the Curriculum, Teaching and Learning Academic Group, National Institute of Education, Singapore. Her research interests include progressive pedagogies, reform pedagogies, institutional innovations, gamification, game-based interactivity, immersive environments, argumentative knowledge construction, trans-contextual learning, embodiment, embodied knowing, embodied subjectivities, trajectories of *becoming,* and construction of self.

David Hung is a Dean of Education Research at the National Institute of Education, Singapore. He has served as Contributing Editor and Associate Editor for several well-read international academic publications in the learning sciences field and appointed as journal reviewer for various well-established international academic journals. His research interests are in learning and instructional technologies; constructivism, in particular, social constructivism; social cultural orientations to cognition; and communities of practice.

Chapter 2
Transforming Education for All: Tower Hamlets and Urban District Education Improvement

Chris Brown, Chris Husbands, and David Woods

Abstract This chapter explores a case study in area-based reform, using the example of the remarkable transformation of educational outcomes in the London Borough of Tower Hamlets between 1998 and 2012. Drawing on interviews and official data along with school performance material, we argue that the transformation of schooling in Tower Hamlets depended on a number of linked factors: committed political leadership; challenging professional leadership; a robust approach to selecting from, and then rigorously managing, external policy imperatives; the engagement of schools; and the judicious spending of generous levels of resourcing. We cannot answer counterfactual questions with precision, but it is our belief that whilst different approaches would still have seen improvement in some schools, the coherent, area-wide improvement which we saw in Tower Hamlets would not have been possible without the strong political and professional leadership which the Authority, its leaders, and its officers were able to exert. We set the experience of Tower Hamlets in the context of literature on sustained education reform and draw lessons for other communities.

2.1   Tower Hamlets in Context

Tower Hamlets is an administrative borough in east London covering eight square miles and is home to 206,000 people. It is bounded by the River Thames to the south, the River Lea to the east, the Borough of Hackney to the north, and the City of London to the west. It grew out of the jumble of medieval buildings around the walls of William the Conqueror's Tower of London. Its river frontage fostered ship

C. Brown
University of Portsmouth, Portsmouth, UK

C. Husbands (✉)
Sheffield Hallam University, Sheffield, UK
e-mail: c.husbands@shu.ac.uk

D. Woods
The London Leadership Strategy, London, UK

building, which began to develop in the sixteenth century, and the Port of London stimulated associated trades: cheap inns, victualling, and chandlering. By the late eighteenth century, factories and rows of terraced houses consumed the once rural landscape. In the nineteenth century, the building of huge warehouses and docks and the arrival of central London railway termini displaced people from the city into the area, and it became known—pejoratively—as the "East End". By the end of the nineteenth century, the area was synonymous with poverty, overcrowding, and disease. Wages were low and housing poor. During the mid-twentieth century, bombing during World War II devastated much of the area—24,000 homes and much of its industry were lost. The post-war period saw the decline of the traditional dock industries, leaving substantial areas of land and buildings derelict. As a result, part of the borough was designated as an economic development zone, and since 1980 there has been massive expansion of new industries and employment.

Due to its location on the fringe of the City of London, the borough has historically attracted new immigrant communities. In the Middle Ages, sailors and merchants from all over Europe and beyond established roots in Tower Hamlets. Since the eighteenth century, the Spitalfields area has been home to Huguenot and later Irish and Jewish communities who gradually moved to other areas as they grew in prosperity. Following this pattern, in the late twentieth century, people from Bangladesh and other Asian and African countries were attracted to this area, resulting in a richly diverse multi-cultural population.

In 2012, there were 65,269 children and young people in the borough, representing 26% of its total population. Of these, 89% were classified as belonging to an ethnic group other than White British, compared to 26% in England overall. Furthermore, English is an additional language for 74% of its pupils; meaning that English, Sylheti, and Bengali are the area's most commonly recorded. Of those children and young people under 19 years, 55% come from a Bangladeshi background. What is more, data for 2006 show that 29,680 children—or 53% of all children in Tower Hamlets—were living in poverty, based on the proportion of children living in families in receipt of out-of-work benefits or tax credits, where the reported income was less than 60% median outcome. The borough's high levels of poverty are also evident in the high proportion of children entitled to free school meals (FSM), which in 2011 stood at 57%. Press coverage and academic studies alike describe Tower Hamlets as one of the poorest boroughs in the United Kingdom.

Tower Hamlets' children and young people have an exceptional range of additional needs. There were 1582 children and young people registered with the council as having a disability in February 2012. There were 6909 children—17% of a total 2011 school census population of 39,596—registered as requiring School Action or School Action Plus in response to their educational needs and a further 1392 (4%) with a statement of special educational needs (SEN). Finally, as of March 2012, there were 296 looked after children (LAC), 274 children with child protection plans, and 1,155 children-in-need cases. By any measure, this is a demanding population. There are 98 schools in the borough. Of these, 70 are primary and 15 secondary; there is a pupil referral unit and six special and short-stay schools. Early

years provision is delivered through more than 50 private and voluntary sector settings, and there are six Local Authority (LA) maintained nurseries.

Despite all this, Tower Hamlets has a remarkable story of education improvement to tell. That story begins in September 1997 with the appointment of Christine Gilbert as the borough's new Director of Education. The educational "legacy" inherited by Gilbert was "dire". The previous year had seen the publication of *The Teaching of Reading in 45 London Primary Schools* by Ofsted (England's school inspectorate). Based on the results of 45 inspections in the London Boroughs of Islington, Southwark, and Tower Hamlets, the report found that reading standards in Tower Hamlets were poor and that the quality of teaching in many schools was also unsatisfactory. Earlier in 1997, the borough had also been positioned 149th out of 149 local education authorities (LEAs) in terms of its performance, and a damning Ofsted *Inspection of Tower Hamlets* followed in September 1998. The inspection report noted that only 26% of pupils gained five or more higher grade for General Certificate of Secondary Education (GCSE) (the national qualification taken by 16-year-olds), compared to a national average of 43%; and only 47% of pupils achieved level four in the Key Stage two English tests (at age 11), compared with 63% nationally. These figures were:

> unacceptable, because they represent lost potential and a denial of the legitimate aspirations of pupils and their parents.... They also represent a poor use of public money. The evidence does not suggest that the expenditure deployed to combat disadvantage in Tower Hamlets since its incorporation in 1990 has achieved its primary objective of raising standards. (Ofsted, 1998, para 8–9)

Returning to the borough 2 years later, however, Ofsted found that the LEA had achieved a great deal (Ofsted, 2000): Although pupil test results remained below the national average, the gap had started to narrow at each key stage, and there had been some significant achievements in raising standards. Data from Ofsted inspections showed an improvement in the proportion of schools judged to be "good" or "very good" and that there had been a decline in the proportion of schools requiring improvement. The report concluded that in a relatively short space of time, Tower Hamlets had gone from having significant weaknesses to delivering what was required of it at least satisfactorily and often well.

By 2005, the *Annual Performance Assessment of London Borough of Tower Hamlets Council's Education and Children's Social Care Services* (Ofsted, 2005) found *dramatic* improvements. Attainment at Key Stage one and two was well above that of statistical neighbours, as was the proportion of pupils gaining five A*–C grades at GCSE. Attainment gaps too were narrowing although still below national averages. Tower Hamlets was providing a service that "consistently delivered well above minimum requirements for users" and inspectors awarded the borough the highest grade possible. The last Annual Performance Assessment of Tower Hamlets was written in December 2008 before this system of monitoring was scrapped: the borough maintained its rating, along with the judgement that it "consistently delivered outstanding services for children and young people", illustrating a continuing improvement upon its previous best performance. In a space of less

than 10 years then, Tower Hamlets had moved from a position where it was heavily criticised for a lack of strategic planning and the poor management of its services to one in which it was being praised for its high-quality services, sustained improvement in education outcomes, excellent partnership work, and being highly ambitious for its children and young people.

Although there has been no overall inspection since December 2008, the story of improvement continues in the borough's school data, as well as in documents such as Council Education Committee minutes and reports from education officers to scrutiny panels. The 2012 performance data for its secondary schools, for example, illustrates that Tower Hamlets (in attaining an average of 61.4%) had exceeded the national average by over 2% in terms of pupils achieving five A*–C GCSE grades, including English and maths. Similarly, in terms of expected progress between Key Stage two to Key Stage four, the borough had exceeded the national average by 4% in English and by 5% in maths. Encouragingly, the most deprived pupils (those eligible for FSM) also performed very well: 54% achieving five A*–C GCSE grades including English and maths compared to 36% nationally, meaning that Tower Hamlets had reduced its achievement gap to only 7% compared to a national gap of 23%. In addition, and quite remarkably, by the spring of 2013, every secondary school in Tower Hamlets had been judged either "good" or "outstanding" by Ofsted, with 7 out of 15 ranked as "outstanding"—over twice the national average (Ofsted, 2013). Tower Hamlet's primary schools also exceeded both London and national averages at Key Stage two and level four, with attainment in English at 89%, in maths at 86%, and in English and maths combined at 82%.

Our approach included interviews with Tower Hamlets officials, including two former Tower Hamlets Directors of Children's Services and five senior LA staff in post since at least 1997. We also interviewed five long-serving borough head teachers, as well as surveyed the heads of all primary and secondary schools in the area. Documentary data was analysed, including minutes from the Authority's *Learning, Achievement and Leisure Scrutiny Panel (2002)*, a copy of the *Tower Hamlets Council Strategic Plan (*2002*)*, copies of *Strategic Plan for the Educational Service (*2000*, *2002a*)*, and copies of the borough's *Educational Achievements and Progress Briefings (*2012*)*. We also scrutinised Ofsted reports, in particular the *Annual Performance Assessments* and their *Inspection[s] of Tower Hamlets Local Education Authority*. Our analysis of the turnaround led us to identify seven explanatory themes that drove the change in Tower Hamlets. These are ambitious leadership at all levels, very effective school improvement, high-quality teaching and learning, high levels of funding, external integrated services, community development and partnerships, and a resilient approach to external policies and pressure. These are now examined in detail.

2.2 Explaining Success

2.2.1 Ambitious Leadership

Tower Hamlets became an education authority in 1990, following the abolition of the Inner London Education Authority, at the same time as a corporate reorganisation of the council took effect, delegating decision-making and service delivery to the borough's seven neighbourhoods, a reorganisation which was said in the 1998 Ofsted report to have been a "disaster" (Ofsted, 1998, p. 11). Between 1990 and 1997, costs spiralled; the Authority became concerned with securing adequate numbers of school places in the face of a serious deficit and then, between 1994 and 1997, came largely to a standstill. The work of individual services was not given impetus and focus by clear leadership from the centre (Ofsted, 1998, p. 13). Despite this, the damning report ended with a note of optimism: the LEA understood the scale of the challenge and had appointed a new Director of Education, who had already put a new education development plan out for consultation. Hargreaves and Harris (2012) note Christine Gilbert, that:

> She left her job in a leafy suburb to move to Tower Hamlets—then the worst-performing Local Authority in England—to become its Director of Education. Leaders who perform beyond expectations deliberately seek out acute challenges and exceptional crises. They move towards the danger. (p. 7)

Ofsted (1998, p. 6) remarked that "she [Gilbert] is unequivocal about the need to raise standards urgently, and has won the enthusiastic assent of head teachers to a more challenging and ambitious approach". Collins, one of Gilbert's successors, says that it is "impossible to overstate her achievement".

Gilbert set about implementing a challenging Strategic Plan for the LEA for the period 1998–2002. Hargreaves and Shirley (2009) argue that Gilbert combined "visionary" leadership with a concomitant strategy to raise performance by establishing goals (within this plan) that were deliberately designed to be just out of reach (Hargreaves & Harris, 2012). Hargreaves and Shirley (2009) note that this strategy rested on the philosophy that "it is better to have ambitious targets and just miss them than have more modest targets and meet them" (p. 67). Recognising these efforts, Ofsted (2000) attributed much of the initial improvement in Tower Hamlets' performance to Gilbert:

> Much of the LEA's success in implementing the recommendations and improving its support to schools can be attributed to the high quality of leadership shown by the director and senior officers. Head teachers, governors and members all expressed their confidence in the management of the LEA. (p. 4)

Gilbert herself remembers that the plan allowed her to capture the ambitions of members and "to have a row with schools…once you have a plan and knew what you wanted to achieve, more falls in".

Following Gilbert came Kevan Collins, who took up his post as Director of Children's Services in Tower Hamlets in 2005 when Gilbert had been appointed

Chief Executive. Collins' initial assessment was that primary schools had already closed the gap "dramatically" but that secondaries were still lagging, with GCSE performance across the borough at 30%. The secondaries, although improving after 1998, needed to see primary improvements in literacy feed through so that the secondaries could, as Collins puts it, "turn properly" in English and maths achievement. He argues that after 2005 the primary need for the LA was to "turn the screw", sending bespoke analytical letters about primary results, intervening strongly to agree programmes of work needed in Year 6 to secure targets, and, as he puts it, "establishing the rhythm" of expectations at the time when national strategies were stepping back. The borough developed an in-depth knowledge of both its schools and the communities they serve. Hargreaves and Shirley (2009) note that the borough built trust with its schools and developed deep insight about what was happening (more so than could be gleaned simply from performance spread sheets). There were important significant early changes: not only was the advisory service restructured and brought closer to schools, but Christine Gilbert insisted on a separation between inspection and support. The result of these actions was the development of effective working partnerships with schools, based on tough decisions. Tower Hamlet's officers, head teachers, and advisers were trained in a rigorous and systematic way; and Ofsted (2000) suggests that this robust partnership represents a key feature of the LEA's leadership.

The real achievement of Tower Hamlets was not that it secured improvement in some schools but that it raised achievement across all its schools—in 2013 every one of the borough's secondary schools was good or outstanding (Ofsted, 2013). Gilbert is clear that the politicians were "ambitious for education from the day I was appointed". What happened after 1998 was that effective professional and political leadership worked together to translate the high ambitions elected members had into achievable and practical strategies for improvement. Collins meanwhile locates the political impetus for change in Tower Hamlets as being deep rooted: he cites the election of a far-right councillor in 1984 as a dynamic for political cohesion, drawing Bengalis into politics in the following election, producing councillors with strong ambitions for education. There was a "collective responsibility" across the borough, which made it possible to mobilise resources and enthusiasm for change. For him, the location of Tower Hamlets "on the edge of the City" with the "inheritance of the East End" creates a strong mentality of place; and once professional leadership was properly aligned with political leadership, there was a strong determination to "show the rest of the world what we can achieve… Poverty became a spur to ambition, not an excuse".

School leadership is vital to school improvement, as Leithwood and Seashore Louis (2012) note: "to date, we have not found a single documented case of a school improving its student achievement record in the absence of talented leadership" (p. 3). For Tower Hamlets, this is verified by examining the Ofsted performance data for 2005–2012, which suggests that the overall effectiveness of schools within the borough is highly correlated to the effectiveness of its school leaders and management in embedding their ambition to drive improvement ($r^2 = .912$); similarly, outcomes for individuals and groups of children within Tower Hamlets appears to

be strongly correlated to the effectiveness of the leadership of its schools and the management of teaching and learning ($r^2 = 0.999$). Over time, Ofsted inspections have seen a steady improvement in the grading awarded for the leadership of teaching and learning.

In terms of teaching and learning, data suggests that the focus of school leaders appears to very much be centred on maximising the achievement of the individual pupil. Specifically, this was achieved via a consistent and coherent approach to collecting and analysing assessment data, establishing processes to enable staff to take action on the basis of this data, and bespeaking resources to meet the needs of pupils. One respondent noted: "[we engage in] very close tracking of individual progress, so that children who are vulnerable to underachievement are identified early and interventions put in place"; another that "pupils have a personalised programme of support in their learning, the impact of which is monitored and altered as necessary".

2.2.2 Very Effective School Improvement

The Ofsted Report of 1998 was critical of the performance of schools and the Inspection and Advisory Service. It reported that the service was poorly regarded by schools, with an overemphasis on monitoring and inconsistent levels of support. By 2000, Ofsted noted that a radically restructured advisory service had been put into place, with clear strategies for supporting and developing schools, and also monitoring and intervention where required. During this period, the number of schools in special measures and serious weaknesses was a major concern to the LA, and challenging targets were set to reduce this number. Over the next few years, schools causing concern were monitored and reviewed very closely with appropriate support as required. For primary schools, the highly focused implementation of the literacy and numeracy strategies was paramount; and for all, schools' leadership was under particular scrutiny. Where head teachers were found wanting, the Authority took decisive action, and it has continued to do so. Indeed the data demonstrates that between 1998 and 2012, out of 48 schools causing concern or in Ofsted categories, 42 Heads were replaced. Crucially, the Director of Children's Services and Senior Officers have been closely involved with the appointment of new head teachers and have not hesitated to use their powers to prevent an appointment where they thought the governors' recommendation was inappropriate. Certainly, the high quality of head teacher leadership as evident through Ofsted inspections has been a major factor in the rapid improvement of Tower Hamlet's schools. In such a small borough, with less than 100 schools, the Authority knew its schools very well and has established a range of consultative forums to make sure that policies and support and challenge programmes are explained and that the views of Heads and other stakeholders can be taken into account. As well as direct input through the school improvement service, there are a range of officers who have everyday dealings with schools related to particular services and partnerships,

such as attendance, behaviour, special needs, and social inclusion. The shared intelligence about schools enables the Authority to support where it is required and challenge appropriately. Interviews and evidence from head teachers also indicate that there are generally positive relationships between the LA and its schools, which, despite some cutbacks, are still able to access a range of support services to support them in their endeavours to improve on their previous best performance.

Of course, the drive for school improvement on the ground has been led by school leaders and staff in individual schools, and we refer to this more specifically under the themes of ambitious school leadership and high-quality teaching and learning. Determined and resilient leadership along with high expectations has built a sustained momentum for improvement. Expert data analysis, benchmarked against other local and similar schools, has provided the impetus for ambitious target setting. Where these targets were met and even exceeded, it provided the springboard for even more success. Where targets were not met at first, schools were quick to put into place a range of interventions personalising support for individuals and groups of children and young people. Opportunities for after-school and out-of-hours learning are considerable in Tower Hamlets, providing a further boost for attainment and achievement. Over time a spirit of "collaborative competition" seem to have developed successfully, with some schools spurring on other schools to do just as well. Schools have also been encouraged to work together, and at the moment there are two teaching school alliances. It has been suggested that schools and school leaders within the borough worked together "with an additional twist of friendly rivalry in order to promote the greater good of their communities" (Hargreaves & Harris, 2012).

2.2.3　High-Quality Teaching and Learning

As with school leadership, examining the Ofsted data for 2005–2012 indicates that the overall effectiveness of schools is highly correlated with the quality of teaching (r^2 = .926). The borough experienced a massive teacher shortage in the mid-1990s with the result that teachers were recruited from abroad. Successfully reversing this position and attracting and retaining high-quality teachers is cited as a major feature of Tower Hamlet's approach to improving its educational performance (Hargreaves & Shirley, 2009). Evidence of commitment to solving the problem is provided in the minutes of the borough's *Learning, Achievement and Leisure Scrutiny Panel* (for Monday, 30 September 2002). The specific initiatives covered by the borough's strategy include (i) recruiting and retaining high-quality staff, (ii) encouraging and supporting local people into education and maximising work-based routes to qualified teacher status, (iii) improving the recruitment of newly qualified teachers, (iv) improving access to housing for teachers, and (v) professional development of teachers.

Of particular note was the desire of the Education Directorate to find out what attracted people to Tower Hamlets, what encouraged them into teaching, and what

persuaded them to stay in the borough. The borough's recruitment and retention strategy was developed and executed in consultation with "head teachers, governors, trades unions, [and] with government and colleagues in other boroughs to assess the nature and scale of the problem and redefine its strategy". As a result, "a number of initiatives had been introduced to promote the borough as a first-class teaching environment and facilitate high quality, stable staffing". Importantly, the Teacher Recruitment and Retention Manager added that these developments were "particularly important as there was no evidence to suggest the national initiatives were having a significant effect in improving teacher recruitment and retention in inner London". As a result, over subsequent years, Tower Hamlets has pursued efforts in relation to five key issues: to recruiting and retaining high-quality staff, to encouraging and supporting local people into education by developing work-based routes into teaching, to improving the recruitment and retention of newly qualified teachers, to improving access to housing for teachers, and to developing the professional learning of serving teachers. Extensive work was also done on stressing the positive advantages of working in Tower Hamlets—of being part of radical change, so that working in and for Tower Hamlets was "the place to be" for those committed to urban education. Attraction packages often carried a requirement to stay in the borough for at least a defined period as a condition of accepting the packages, and they were underpinned by a high-quality continuing professional development offer, again, at all levels, and for ambitious and successful teachers, an explicit commitment to career development and promotion from within. The Authority ran a Master's programme in close partnership with a university and, whilst many councils were closing theirs, kept a Professional Development Centre.

Less high profile but just as important in building strong community cohesion was the intensive work which Tower Hamlets did on encouraging and supporting local people into education roles. It has always been the Education Directorate's intention to improve recruitment to, and participation in, initial teacher training initiatives within the borough and its travel to work area, particularly from members of ethnic communities and in sympathy with a "workforce to reflect the community". In the last decade, the council had developed an extensive programme with special courses for training teaching assistants. The ultimate aim was to develop a clear progression route into teaching for these staff, the vast majority of whom were local people. By providing professional development opportunities at all levels, those who lacked qualifications or confidence could be offered a range of options, which might eventually lead them to a career in teaching.

2.2.4   High Levels of Funding

No account of the education transformation in Tower Hamlets can overlook resource. Tower Hamlets was well-resourced, with almost 60% more resource per pupil than schools across England and with higher levels of resourcing than almost all other London boroughs. Christine Gilbert contrasted Tower Hamlets with her experience

as Director of Education in Harrow, where money was always tight. One head teacher, appointed from outside the Authority, said that "the very high levels of funding [within Tower Hamlets] are in marked contrast to my experience outside of the borough"; and another remarked that "budgets are huge compared to anywhere else I have worked". Moreover, as schools in Tower Hamlets improved, so did the council's willingness to invest in education: improvement drew in more resource. So it could perhaps be argued that the transformation of schooling in Tower Hamlets is simply a consequence of high levels of resource.

But this argument runs into some obvious flaws. If the performance of schools in Tower Hamlets were simply a consequence of funding, the 1998 Ofsted Report would never have been written. If the performance of schools in Tower Hamlets were simply a consequence of levels of funding, the Authority would not have recorded exceptionally low levels of examination success in the early 1990s. If the performance of schools in Tower Hamlets were simply a consequence of levels of funding, we would still need to explain rapid improvements throughout the first decade of the twenty-first century. It is undeniable that Tower Hamlets' schools were well-resourced—far better resourced than schools elsewhere—but money needs to be spent wisely, and survey respondents noted that interventions have to be of "quality": "It's easy to look as though you're doing something by spending money on interventions, but the impact will be limited if the quality of the intervention is not good". If the Tower Hamlets story makes a strong case for high levels of education spending, it also makes a case for targeting that spending intelligently, for linking investment with outcomes, for monitoring the impact of spending, and for building the case for investment.

2.2.5   Integrated Services

In 2006a, b, the Children and Young People's Plans were introduced; the first from 2006 to 2009 and the second from 2009 to 2012. The annual performance assessments of services for children and young people conducted by Ofsted between 2005 and 2008 regularly reported that the council made an outstanding contribution towards improving outcomes in all five areas of its Children and Young People. The 2006 Report, for example, praised the Children and Young People's Plan as having a clear strategic vision, being focused on clear performance indicators and outcomes for pupils within a context of support and challenge. The priorities were firmly rooted in a community planning process, which involved all key stakeholders including children and young people. The Authority's use of benchmarking to review performance and to set challenging targets was identified as good practice and the Authority's track record of successful partnership with other agencies identified as a clear strength.

In 2007, the Report meanwhile stated that "the Authority has a very good understanding of the needs of its communities and targets resources precisely to achieve good outcomes for young people, particularly in relation to their very low starting

points. High expectations and an ambition to excel, combined with purposeful and well-judged interventions, succeed in supporting children and young people to overcome significant social and economic barriers". The 2008 Report further commented that "excellent partnership work ensures a joined up, cohesive, multi-agency approach to service delivery. The determination to overcome considerable social and economic barriers, improve outcomes, and reduce inequalities, is shared by all with considerable success".

The council's services were often described as making an excellent or outstanding contribution to improving the health of children and young people—particularly vital in such an area of socio-economic deprivation. Joint multi-agency strategies were judged to be very effective with a strong emphasis on prevention and detailed needs analysis. By the end of 2007, the Authority had exceeded national targets for achieving Healthy Schools Status and was meeting ambitious local targets, with particular praise for services for children with disabilities and the very good performance for the health of looked after children. Similarly, during these years, the outcomes for the safety and care of children were described as outstanding, with very strong and clear systems for information sharing and cross-agency working, ensuring that the needs of vulnerable children were being met. The Local Safeguarding Children's Board operating since March 2006 had proved to be very effective. In terms of making a positive contribution, there were excellent contributions to improving outcomes in this area, enhanced by collaborative work with a number of partners including the youth offending team, the police, and the voluntary sector. Opportunities for young people to have a say were provided through Local Youth Partnerships, the Tower Hamlets Youth Partnership, and the Youth Parliament. Inspection evidence indicated that young people's contribution to their communities was mostly very good with many young people being trained as peer workers and mentors.

In terms of economic well-being, the Authority was very successful in making substantial reductions in the number of young people not involved in education, employment, or training, through targeted and innovative approaches, although the proportion of young people achieving level two and level three qualifications at age 19 was below the national average but increasing at a faster rate than nationally, with a 10% rise since 2004 compared to a national rise of approximately 5%. We have referred elsewhere to enjoying and achieving the sustained improvements in educational outcomes for children and young people at all key stages with standards improving at a much faster rate than nationally. A particular feature was the excellent outcomes for vulnerable children, including looked after children and those with learning difficulties and/or disabilities.

Further impressive outcomes were achieved in these years. There was a sustained reduction in the proportion of young people not in education, employment, or training, which is currently 4.9%. Young people were encouraged to stay in education through the introduction of the Tower Hamlets Mayor's Education Award, the first of its kind nationally, following the end of the Education Maintenance Allowance in England in 2011. Health outcomes also continued to improve, as did outcomes related to staying safe and attendance in schools.

2.2.6 *Community Development and Partnerships*

As we have seen, Tower Hamlets experienced a powerful local identity shaped by history and experience. It was a sense of identity forged from the grinding poverty of the later nineteenth and early twentieth centuries and shaped by political radicalism in the interwar years. The first Community Plan for Tower Hamlets was launched in May 2001 and produced by the local strategic partnership including the council, residents, public service providers, businesses, faith communities, and the voluntary and community sector. There were three strands to this partnership—local area partnerships, community plan action groups, and a partnership management group. Since that date, there has been a range of community plans and actions to sustain community participation and cohesion and for young people to achieve their full potential as active and responsible citizens. In both *Performing Beyond Expectations* (Hargreaves & Harris, 2012) and *The Fourth Way* (Hargreaves & Shirley, 2009), Andy Hargreaves, Dennis Shirley, and Alma Harris argue that community development is central to the success of Tower Hamlets as a "turned-around district". They argue that whilst most local authorities had endeavoured to deliver more children's services to the disadvantaged and other communities, Tower Hamlets had gone further and had worked hard to create new capacity to strengthen community relations and engagement. For example, it had worked with faith-based organisations and formal agreements with imams from the largely Muslim community to counter the effects of children taking several days holiday for religious festivities such as Eid and taking extended holidays in Bangladesh during term time. Another example was the development of some schools into community centres, establishing extended services and providing resources and recreation for children, young people, and adults. The Authority has also developed a number of Children and Families Partnerships working very hard to engage parents. In 2005, the LA undertook a study of the impact of long holidays on the attainment of pupils and found that underachievement was worse amongst those with lower prior attainment. The mosques backed the council in stating that extended absences would be treated as truancy because the educational achievement mattered greatly to the community (and ISAP statistics show that 100% of pupils now have 90% or above attendance after an ISAP intervention).

Particular features of community relations and engagement in Tower Hamlets are the school and community-based projects used very effectively to promote citizenship and community cohesion. Activities promoted through the interfaith forum promote community cohesion and interfaith understanding across schools. The youth service reaches very good numbers of young people through a range of community-based services, and the youth participation team ensures that children's voices are heard. There are many opportunities for young people to engage in service development, and they are represented in many partnership groups, some attaining accreditation through their involvement. There is a Youth Parliament and a Youth Major Leads on the Youth Opportunities fund, which distributes funding for activities and facilities.

2.2.7   A Resilient Approach to External Government Policies and Pressure

Hargreaves and Shirley (2009) also argue that a key factor in Tower Hamlets success was:

> a resilient but not reckless approach to external government pressure and policy – accepting the importance of testing and targets but deciding to set their own targets and resisting the politically motivated pressure to build new high school academies since the Authority already had high-trust relationships with its schools that now performed very well. (p. 67)

During our interviews with LA officers, it was suggested that "what might work nationally might not always work in the Tower Hamlets context [in relation to culture, language, homogeneity of the population, etc.]" (Tower Hamlets official). However, there was also recognition from LA officers that Tower Hamlets had been determined to make government policies work for them and get the best out of them, and there had been many instances of effective partnerships working with the Department for Education and other government bodies. The low point in education outcomes in Tower Hamlets coincided with the coming to power of the Labour government in 1997. At the same time, Christine Gilbert became Director of Education, and one part of the new director's and Tower Hamlets' recovery strategy was to engage directly and positively with the government's requirement for education development plans, implement the national literacy and numeracy strategies, and emphasise rigorous targets, pupil tracking, and testing. A strategic education plan, including a rigorous education development plan for school improvement with a set of ambitious targets within a new climate of high expectations, was developed. With regard to literacy and numeracy, Tower Hamlets became a pilot for some early initiatives at Key Stages two and three and then robustly implemented the National Strategies setting their own ambitious targets for improvement. There was also a robust approach to schools causing concern, with clear policies and plans towards targeted interventions. Collins put it like this:

> We did not set out to be innovative or to reinvent education. We adopted the national secondary strategy. We adopted assessment for learning and we set out to be brilliant at implementation. Implementation was what we set out to be good at. We wanted to do basic, basic stuff and get it right.

2.3   Conclusion

The achievements of Tower Hamlets and its schools after 1998 were exceptional. Across the borough, all schools improved. Across the borough, the educational outcomes for all groups of pupils were substantially improved. And beyond this, the borough embedded a shared commitment to high standards and high expectations across the community, the council, and the schools. By any measure, the achievement is considerable. In this final section, we engage in speculation: What were the

key factors in Tower Hamlets' improvement? What are the lessons for policy and practice? And at a time when governments across the world continue to drive change in education, what are the implications for global educational practices?

It has been our contention in this paper that the transformation of schooling in Tower Hamlets depended on a number of linked factors: committed political leadership; challenging professional leadership; a robust approach to selecting from, and then rigorously managing, external policy imperatives; the engagement of schools; and the judicious spending of generous levels of resourcing. We cannot answer counterfactual questions with precision, but it is our belief that whilst different approaches would still have seen improvement in some schools, the coherent, area-wide improvement which we saw in Tower Hamlets would not have been possible without the strong political and professional leadership which the Authority, its leaders, and its officers were able to exert.

Charles Payne's account of American school reform, *So Much Reform, So Little Change* (2008), is subtitled "the persistence of failure in urban schools". His account of the failure of repeated waves of school reform to bring about significant improvement in America's urban schools is compelling reading. Payne (2008) is dismissive of reform which is disconnected from the daily realities of urban schools and of grand theories of change; he concludes that "there is no one lever we can move which will give us the purchase we need" (p. 47). Payne (2008) argues that successful reform depends on what he calls "five fundamentals": instructional leadership, professional capacity, establishing a learning climate[1], family and community involvement, and the quality of instruction. Moreover, successful school reform is "comprehensive, sustained and intense". Payne's book ends with a coruscating denunciation of what he calls "liberal and conservative theories of school reform"— the one arguing that school reform is impossible without serious assaults on poverty and the circumstances which create failure and the other that circumstances do not matter and that incentive structures alone can drive change (Payne, 2008, pp. 192–193). Both, he argues, are extremely damaging to children. In practice, says Payne, we know a great deal about successful reform, and he concludes his book with a mantra for effective reform:

> Give them teaching that is determined, energetic, and engaging. Hold them to high standards. Expose them to as much as you can, most especially the arts. Root the school in the community and take advantage of the culture the children bring with them. Pay attention to their social and ethical development. Recognise the reality of race, poverty and other social barriers but make children understand that barriers don't have to limit their lives…Above all, no matter where in the social structure children are coming from, act as if their possibilities are boundless. (Payne, 2008, pp. 211–212)

It is possible and useful to look at Tower Hamlets in the context of what we know about effective school improvement and reform across the world. For too long, the assumption of research and policy has been that effort must be focused on reforming and improving individual schools. But school reform at scale—successfully improv-

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[1] In the text which follows, Payne clearly means "learning climate" to "include[e]…the degree to which students perceive high expectations" (Payne, 2008, p. 46).

ing areas and districts—is more challenging. It is always possible for individual schools to improve by—either by accident or design—subtly altering their intake or shifting their relationships with neighbouring schools. In the long run, all this does is to move failure around the system. It is not a recipe for serious or sustained improvement.

Tower Hamlets is therefore important because of what it tells us about *area-based* reform. This is important for any number of reasons. If we can move our reform and improvement efforts from schools to areas, we have the prospect of improving the life chances for not subsets of children—important though this might be—but for all children and young people. If schools and their communities can bring about systemic improvement, then all benefit, not simply a fortunate few who have found their way into more successful schools. It is the achievement of Tower Hamlets that it has made significant progress on that score. The research is clear that there are some essential ingredients for school reform at scale. Heather Zavadsky's (2010) detailed study of five North American school districts (p. 272) is clear that the initial ingredient on which all else depends is "climate or culture"—the buzz, which leads to belief that success is possible and, eventually, establishes trust. Beyond this, "reform needs to look different" depending on the community, though standards and expectations need to be high and consistent. These were the lessons learnt in Tower Hamlets and—it is worth noting—learnt before Payne, Zavadsky, and Levin had synthesised their own understandings of the nature of successful urban reform.

The experience of Tower Hamlets since 1998 is inspirational. It shows that improvement is not only possible but achievable, that improvement in some schools does not need to be bought at the expense of others, and that improvement, once attained, can not only be sustained but surpassed. As a result, it is not unreasonable to argue that what Tower Hamlets has created are some of the best urban schools in the world. This is a genuinely exceptional achievement, worth celebrating, worth understanding, but above all, worth learning from.

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Chris Brown is Professor of Education in the University of Portsmouth's School of Education and Sociology. Chris has a long-standing interest in how evidence can aid the teaching practice and seeks to help practitioners identify and scale up best practice. He has written three books (including *Making Evidence Matt*er and *Leading the Use of Research and Evidence in Schools*) and several papers and has presented on this subject at international conferences.

Chris Husbands is the Vice-Chancellor of Sheffield Hallam University. He was previously Director of the Institute of Education, University College London. He is an academician of the Academy of Social Sciences and a council member of the British Education Research Association. He has held senior leadership positions in three UK universities and is an appointed Board Member of the National Trust Learning Panel. Chris's research interests are in curriculum and teacher development and in education policy in relation to schools and pedagogy. He works closely in and with teachers, classrooms, universities, and governments, to understand how, at classroom, school, national and international scales, can policy interventions, which improve teaching, be developed.

David Woods (CBE) is the Chair of The London Leadership Strategy and several local authority Education Challenge Boards, as well as a visiting Professor of Education at Warwick University and a Professorial Fellow at the London Institute of Education. He was formerly the lead Education Adviser for London Schools and the London Challenge and then the Chief Advisor until April 2011, as well as being the Principal National Challenge Adviser for England. He was also previously the Head of the Department for Education and Skills (DfES) Advisory Service and before that the Chief Education Adviser for Birmingham Schools.

Part II
Innovation and Change from the Systems View

Chapter 3
Wide-Scale Implementation Through Capacity Building of Senior Leaders: The Case of Teaching Thinking in Israeli Schools

Anat Zohar

Abstract This chapter focuses on bridging the gap between policy and practice in Israeli schools, in the context of implementing a national innovative policy in the area of teaching higher-order thinking (HOT) across the curriculum. The chapter elaborates on capacity building of senior instructional leaders who were national subject superintendents (NSSs), responsible for the quality of teaching, learning and assessment in specific school subjects. The model of implementation had three main features: (a) deep and long-term (3 years long) capacity building and the formation of a community of learners; (b) a balanced blend of tightness (in terms of defining the overall goal—developing students' HOT) and looseness (in terms of autonomy as to whether and how to engage in the change process); and (c) tailoring the change process to multiple, specific educational contexts. The workshop was part of a detailed plan of a top-down implementation process addressing changes in assessment, curriculum and learning materials and professional development. It made prominent contributions to the web of interactive changes that took place in learning and instruction of many school subjects, matching an ecological model of change. The analysis shows how a top-down implementation, together with a substantial degree of autonomy, can result in rich and diverse bottom-up initiatives. The NSS workshop thus demonstrated how long-term capacity building of a group of senior educational leaders can be used as a leverage for implementing an innovative instructional change on a large, national scale.

A. Zohar (✉)
The Hebrew University of Jerusalem, Jerusalem, Israel
e-mail: anat.zohar1@mail.huji.ac.il

3.1   Introduction

In discussing the challenges involved in scaling up education innovations, Coburn (2003) notes that definitions of scale that focus on the quantitative aspects of the implementation (i.e. the number of schools reached by a reform) mask the complex challenges of reaching out broadly while simultaneously cultivating the depth of change necessary to support and sustain consequential improvement. Describing the issue of "scale" as one of the key challenges for educational reform, Coburn asserts that it still remains largely under-theorised in the educational literature.

Accordingly, researchers have been highlighting the difficulties in changing learning and instruction on a large scale, arguing that large-scale efforts to improve learning and instruction often focus more on structural and administrative characteristics of reform than on fundamental changes in the instructional core (Cohen & Barnes, 1993; Cuban, 1990; Elmore, 2004; Fullan, 2007, Goodlad & Klein, 1970). Despite this pessimistic view, several recent efforts to improve education on a large scale by focusing on changes in learning and instruction are beginning to offer insights into the pedagogical aspects involved in the successful scaling up of such endeavours. The need to build teachers' capacities and to work closely with teachers within schools in order to support their new ways of instruction is considered crucial by numerous researchers (e.g. Cohen, Peurach, Glazer, Gates, & Goldin, 2013; Elmore, 2004; Fullan, 2007). Developing capacities is important not only for teachers but for other change agents as well. Spillane (2000) used a cognitive lens to examine patterns in how district leaders understand key instructional issues of a reform. The findings show that the interpretation of the reform message by the reform's leaders should be taken seriously as one of the factors affecting implementation along with the more conventional factors reported in the literature. Spillane, Reiser and Reimer (2002) later proposed a cognitive perspective on implementation focusing on fostering sense-making of implementing agents in the context of intellectually demanding educational policies. Accordingly, this chapter focuses on a capacity building effort that was a key element in the large-scale implementation of the "Pedagogical Horizon (PH)—Education for Thinking" policy.

3.2   Background Information

3.2.1   Educational Context

In order to understand the significance of the capacity building process described in this chapter, some background information about the relevant educational context is required. The Israeli education system is centralised. With approximately two million students (K-12th grade) and 4000 schools, there is basically one mandatory curriculum prescribed by the MOE that covers a large percentage of what is taught in most schools.

The MOE regulates the school system through numerous paths addressing various elements in the school's daily life (Nir, Ben-David, Bogler, Inbar, & Zohar, 2016). Curricula and pedagogy are regulated through a group of NSSs. For each subject, there is an NSS who is responsible for policymaking and for the practical sides of teaching in that particular subject, including teachers' professional development (PD) and student assessment. NSSs are chosen based on their instructional, administrative and leadership skills. Many of them therefore have remarkable instructional skills, but because of their heavy administrative duties, much of their time is consumed by administration, and they often do not have the time to invest all that they can in improving learning and instruction in their disciplines.

NSSs work with a team of instructors who help co-ordinate and lead the above-mentioned activities in each subject. Instructors also provide teachers with pedagogical support by visiting classrooms, giving teachers' feedback on their lessons and meeting small groups of teachers to discuss professional matters. The number of instructors who work with each NSS varies according to the number of students and teachers in each particular subject. The total number of NSSs is 60. About 25 of them participated in the processes described in this article.

3.2.2   *"Pedagogical Horizon (PH)—Education for Thinking" Policy*

Despite recurrent efforts to foster more progressive pedagogies throughout the education system, Israeli schools are still by and large quite traditional in terms of their dominant modes of learning and instruction (Nir et al., 2016). In 2006, the Israeli MOE adopted a new national educational policy called "Pedagogical Horizon—Education for Thinking" or PH for short (Office of Pedagogical Affairs, Israel Ministry of Education, 2009; Zohar, 2008). The rationale for the new policy was explained by making reference to the desired characteristics of future school graduates in the twenty-first century, emphasising the need for HOT abilities, such as the ability to make judgements and the skills for creative and critical thinking.

The emphasis of the PH policy is on pedagogy rather than on content, on *how to* rather than on *what to* teach. Stressing the importance of acquiring deep knowledge, the policy adopts the infusion approach to teaching HOT, i.e. thinking is integrated into school curricula rather than taught as an independent subject. A typical ideal lesson according to the PH policy therefore consists of both content goals and thinking goals that are addressed in an explicit way. The lesson is rich in providing cognitively challenging questions and tasks that leverage on the intense usage of thinking strategies such as argumentation, problem-solving, asking questions, making comparisons, decision-making, controlling variables, drawing conclusions and identifying assumptions. The classroom learning environment fosters discourse that is rich in language of thinking (words like because, therefore, justification, conclusion, assumption, etc.). In many cases, the PH combines instruction of HOT with

the existing curricula, aiming to change how to teach rather than what to teach. In several cases, the PH aims to substitute traditional instruction of certain topics in the curriculum with inquiry learning. In such cases, alternative assessment pertaining to students' inquiry projects may substitute part of the paper and pencil matriculation exam.

The move from a whole educational system focus on rote learning towards a focus on HOT and deep understanding cannot be brought about by mere decree; rather, the reform must employ a detailed and carefully planned strategy. Following an implementation model developed in the early 1970s by Tamir (2006), the implementation plan for the PH policy was to address three dimensions simultaneously: (a) curriculum and learning materials, (b) PD and (c) assessment. Curricula and learning materials are clearly important for marking the way and for assisting teachers in the preparation of new lessons, but since they are not "teacher-proof", they have little value without appropriate PD. Furthermore, since to a large extent, teachers "teach for the test", PD to foster teachers' capabilities for teaching thinking has little value if tests do not assess more than the recall of facts. Therefore, in order to be effective, progress in these three dimensions needs to take place simultaneously in a co-ordinated manner, with numerous interrelationships, thereby creating an ecological environment in which the three dimensions interact and support each other. The following sections will explicate this model, illustrating how it had worked in effect during the implementation process of the PH.

3.3   Methodology

This implementation research chapter is written based on the author's own observations, interpretations and insights. During the 3 years of implementation, my own role in the MOE was Director of Pedagogy. This position has traditionally been reserved for an academic who is appointed by the Minister of Education. The appointment is therefore a temporary one, often ending when a new Minister is elected. In this capacity, I was involved in the processes described in this chapter. I therefore cannot be regarded as an objective researcher. Accordingly, rather than to assess the processes I address, my aim is to provide an analysis and share with the readers some of the insights I had gained regarding the scaling of pedagogical reforms, which I believe can be significant for others. Nevertheless, the reader should bear in mind that the picture I portrayed was necessarily the one I saw through my own eyes.

In trying to discover the meaning of the events reported and analysed in this chapter, I integrated several sources of information: academic background about the field of teaching HOT and about the field of implementing wide-scale education innovations, data based on various documents of the MOE that had been made pub-

lic (in print or in the Ministry's website), my personal work diary, my practical experiences with the processes I was involved in and my personal thoughts and reflections on these processes. More specifically, three data sources reported here need further methodological elaboration. In years 1 and 3, open-ended and anonymous written evaluations took place in the last session of the NSS workshop (before summer break). An analysis of these evaluations provided the data for the section titled "Participants' Feedback". In year 3, I had written a long and detailed entry in my work diary while the civic NSS led a 3-hour long session of the NSS workshop describing his work in implementing changes in civic education. An analysis of this entry provided the data for the section titled "The Presentation of the Civic NSS in the NSSs' Workshop". Also in year 3, I had written another detailed entry while visiting a 4-hour long session that was part of a civic teachers' PD workshop. An analysis of this entry provided the data for the section titled "A Visit to a Session of Civic Teachers' PD Workshop".

All data sources were analysed using a pragmatic qualitative research approach (Savin-Baden & Howell-Major, 2013) that marked the meeting point of description and interpretation, in which description involved presentation of facts, feelings and experiences in the everyday language of participants, as interpreted by the researcher. The research had drawn upon the most sensible and practical methods available in order to answer a given research question. In a study employing pragmatic qualitative research, researchers have the freedom to mix and match research methodologies that are appropriate for answering their research questions (Savin-Baden & Howell-Major, 2013).

3.4 Description of Workshop

3.4.1 General Information

The goal in establishing the NSS workshop was to invest in capacity building of a senior group of leaders. The idea was to create a group of professionals among those who had already been working in key positions in the MOE, who would become knowledgeable about the teaching and learning of HOT and deep understanding and who would also be motivated to devote time and energy to improve learning and instruction in this context. These professionals would therefore be able to facilitate deep implementation because the knowledge they would acquire during the workshop will enable them to carry out their leadership roles with sound knowledge regarding the heart of the change process. Participation was offered on a voluntary basis in order to create a degree of self-selection and to promote participants' autonomy.

3.4.2   Description

The initial plan was a course of 56 academic hours that would be spread over one whole school year (meeting of 3 to 4 academic hours scheduled every 2 to 3 weeks). By the end of the first year, participants asked to continue the workshop for another year and then at the end of the second year asked to continue for a third year and then a fourth year (that for various reasons could not take place). Therefore, following participants' requests, the workshop actually consisted of 150 academic hours, spread over 3 consecutive years. The number of participants in each year was approximately 25. Seven participants held a PhD degree, and all others held a master's degree.

The core of the workshops' curriculum for the first year consisted of topics related to teaching thinking. The workshop had begun with a predetermined curriculum, built on the basis of the curricula of various university graduate courses about the instruction of HOT. The rationale for this part of the curriculum was to form a foundation addressing the main topics and concepts relating to teaching HOT and to introduce ideas about how to implement them in learning materials, PD and assessment. However, starting from the first year, and in a more pronounced way in subsequent years (as participants had gradually begun to implement ideas from the workshop in their practice), the participants took an active part in shaping the course's curriculum: they brought up topics they wished to learn, shared their own work experiences and led many of the sessions. This was done in order to accommodate the need of the participants to create a community of learners that had the time and opportunity to reflect on their own practice, sharing the insights they had gained from it. Interestingly, after the end of year 1, the topic participants felt they needed to learn most was assessment or, more precisely, how to change assessment so that it will be aligned with learning and instruction that highlights HOT.

Approximately 55% of the course's hours were led by academic experts, and 45% of the hours were led by the participants who usually presented cases taken from their work. Large chunks of the time were devoted to group work or full class discussions. Participants had ample opportunities to bring up problems and dilemmas from the field to share with their colleagues, to analyse them together, to reflect upon them and to hear suggestions from other participants about possible solutions. This intense discourse gradually created a shared language and meaning that was developed over the course of 3 years.

The main topics addressed during the workshop were the following:

- What are HOT skills? The general versus the infusion approaches to instruction of HOT, thinking and knowledge construction, teaching for understanding, metacognition, practical ways for applying metacognition in the classroom, teaching for transfer, learning about a variety of practical means and programmes for teaching HOT.
- Fostering specific thinking strategies (such as argumentation, posing questions and making comparisons).

- Instruction of HOT to students with low academic achievements, educational technology and teaching HOT, inquiry learning, assessment of HOT, high-stakes testing and teaching HOT, teaching thinking across the curriculum.
- Principles of designing in-service PD for HOT.
- A peer workshop in which NSSs presented models that they designed and implemented in their respective school subjects as a means for receiving feedback and for mutual brainstorming (Office of Pedagogical Affairs, Israel Ministry of Education, 2009).

As can be seen, the workshop prepared the participants for implementing all three dimensions of the model by (a) developing their knowledge regarding how to make changes in the curriculum so that it would be more thinking-oriented (e.g. substituting traditional teaching and learning of certain sections of the curriculum with inquiry teaching and learning) and regarding how to develop content-specific learning materials and activities geared towards fostering students' HOT; (b) having the workshop model the content, spirit and activities for PD that NSSs could later adapt to teachers' learning in their respective subjects. In addition, during the workshop, NSSs developed instructional modules to be used for teachers' PD in various subjects; and (c) developing NSSs' knowledge about assessment of HOT so that they would be able to lead changes in school-based assessment and in the matriculation exams. It should be noted that because participants came from diverse school subjects, the examples discussed in the workshop were rotated among the various subjects and the participants were requested to translate these examples into the content of their respective subjects. The participants could therefore use what they had learned in the workshop to advance the implementation of the changes in all three dimensions in their own school subjects.

3.5 Characteristics of the Change Process

3.5.1 A Blend of Tightness and Looseness

One of the major characteristics of the process was a unique blend of tightness and looseness. Fullan (2007) addresses this issue as he discusses motivation for change:

> All change solutions… face the too tight/too loose dilemma. If a situation is loosely formulated… the natural reaction is to tighten things. Command and control strategies do get results in these circumstances, but only for a short time and only for a degree. If we then say that we need to give people more leeway—give them resources and trust them to do the right thing—the press for change is lost. In general terms, the solution to motivating people is to establish the right blend of tightness and looseness… to build both into the interactive culture of the organisation. (p. 43)

In the case of the NSS workshop, the overall goal of the PH was presented in a rather tight and non-compromising way: transforming instruction in order to engage less in rote learning and more in tasks requiring thinking and deep understanding.

Another aspect of tightness and control was that in order to keep to the stated goal, plans for implementation and requests for funding submitted by the participants were carefully screened. Only plans that aligned well with the overall goal were funded. Participants received, however, much freedom in two main areas: (a) as explained earlier, NSSs participated in setting the overall goals of later stages of the workshop and in designing specific sessions; and, (b) in effect, the specific goals for each school subject were only loosely defined, and NSSs were free to define and shape specific goals and implementation plans (see below). These contributed to the participants' overall motivation and in particular to their sense of ownership because the specific plans they followed later during the implementation stage were their own creation rather than dictated from above.

3.5.2   Tailor the Change Process to Multiple, Specific Contexts

Apart from the issue of motivation, another major drawback in a tight central defini-tion of educational goals and implementation design is that it ignores the specificity of the educational contexts and circumstances in which the implementation actually takes place. Since the key to success (and to failure) of any educational endeavour is often found in the smallest details, the specific conditions of each school subject needed to be taken into consideration in order for the programme to work. Hargreaves and Fink (2006) argue that most externally imposed reforms never get implemented properly because their designs are too inflexible to accommodate to the specific and varying needs of specific educational circumstances. Thus, in addition to its signifi-cance in terms of motivation, the blend of tightness and looseness served another important purpose—the ability to adapt to the specific context of each school sub-ject (Fullan, 2007; Hargreaves & Fink, 2006).

School subjects differ from each other on many relevant levels, such as the num-ber of students who take each of them (is it a mandatory subject like language and mathematics, or is it an elective like high-school physics or advanced history?); the homogeneity or heterogeneity of the student population(s) and their typical socio-economic status (SES) backgrounds; students' ages (is the subject taught across all ages like language, or only in a specific age group?); and specific characteristics of the teachers' population.

These specific circumstances raise difficulties to any central top-down imple-mentation design. The looseness of the PH initial implementation design solved this potential problem by encouraging each NSS, together with his or her senior staff members and accompanying steering committee to plan their own implementation process, according to the idiosyncratic conditions in which they had been working. Consequently, although all implementation designs focused on the same general goal, no two actual change processes were the same. According to Hargreaves and Fink (2006), participants' freedom to adapt the change process to their specific needs potentially contributed to the longevity and sustainability of the educational change under consideration.

3.5.3 The Medium Is the Message: Modelling the Culture of Thinking

Several of the previous sections could have applied to workshops about any peda-gogical topic. However, another characteristic of the workshop, i.e. that it modelled the culture of thinking, was more unique to the goal of the PH. In a thinking class-room, the teacher's role is less authoritative than in a traditional classroom. Her main goal is to facilitate thinking processes rather than to be the source of knowl-edge, and she is an active participant in her students' quest for knowledge and understanding. In order for students to feel comfortable to express their views and to experiment with tentative ideas, the class atmosphere must feel safe. These char-acteristics of the culture of thinking were modelled during the workshop. Since this workshop served as the model for many additional workshops that NSSs later con-ducted for their senior staff and teachers, the adoption of the culture of thinking in the NSS workshop initiated a process of implementing this culture in wide circles across the system.

3.5.4 Capacity Building Across Multiple Levels to Increased Fidelity

As noted earlier, the risk in wide-scale instructional change processes is what Spillane (2004) calls "the telephone game", namely, that until the message travels through the various levels to reach the classroom, it becomes so diffused and dis-torted that it is no longer useful. The difficulty, then, is how to transport the message of an innovation in learning and instruction through the system with high fidelity. This can be done by leaders who develop other leaders ("The Long Lever of Leadership"; see Fullan, 2005, p. 27), that is, careful attention needs to be paid to developing the leadership of others in the organisation (Fullan, 2007; Hargreaves & Fink, 2006). Rather than happening automatically, this process needs careful planning.

From an organisational point of view, the NSS workshop was not an end to itself but a link in a carefully planned implementation process focused on the learning of educators on various levels. This allowed a transmission of the messages involved in the PH in an accurate way across the system to increasingly widening circles. The NSS workshop served as the basis for an implementation fan by preparing a group of informed and motivated key leaders (tier 1). In addition, four other PD courses (of 56 h) for more junior leaders were initiated in order to create a pool of approxi-mately 100 potential leading instructors in diverse school subjects (tier 2). In the next implementation phase, NSSs in each subject and the corresponding leading instructors who had participated in the second tier workshop (with additional help from external experts) created a subject-specific leadership team. This team designed the specific implementation plan for each school subject, including the development

of appropriate learning materials and model thinking lessons. Another role of each leadership team was to prepare additional instructors and leading teachers who would be able to work with teachers (tier 3). Finally, this infrastructure was responsible for numerous PD courses for teachers (tier 4). During the 1st year of working with teachers, approximately 16,000 teachers (13% of all teachers in Israeli schools) participated in PD courses that were part of this process. Instructors and leading teachers also provided on-site tutoring to teachers (a more detailed example of how this process was conducted in one specific subject is described below). In addition to providing continuing support to teachers from the first cohort, the same infrastructure was used in subsequent years for PD of new cohorts of teachers. The four tiers of the implementation plan are represented in Table 3.1.

Various elements from the NSS workshop (activities, guest lectures, PowerPoint presentations, video clips and learning materials) were passed on to tiers 2 to 4. In this sense, the spirit of the NSSs' workshop as well as many specific activities served as a model that was replicated across the system. This contributed to preserving the fidelity of the PH message throughout the system and to the generation of a uniform language.

Another potential gain from these processes contributed to what researchers called "sustainable improvement" or "staying the course" (Fullan, 2007; Hargreaves & Fink, 2003, 2006). Many of the NSSs, instructors, experts and teachers who participated in the PD processes typically stayed in the system for a considerable number of years, thereby potentially contributing to the sustainability of the PH policy. Compared to bringing in external companies, infusing the capacity building into the pre-existing administrative infrastructure of the MOE (NSSs, instructors and leading teachers) thus contributed to developing stable leadership for fidelity, continuity and sustainability.

Table 3.1 A summary of the implementation fan

Tier no.	Participants	Nature of workshop
1	NSSs ($n = 25$)	Participants from diverse school subjects study together
2	Leading instructors ($n = 100$)	Participants from diverse school subjects study together
3	Instructors and leading teachers ($n = 350$)	Subject-specific workshops: participants are from one subject only
4	Teachers ($n = 16,000$ on 1st year)	Subject-specific workshops: participants are from one subject only

3.6 Participants' Feedback

The most significant (although indirect) feedback from the participants was their request to continue the workshop beyond the first year. NSSs are very busy people who work under considerable constraints and pressures. Making time for regular meetings that are not mandatory is no trivial matter. The consistent manner of attendance during the first year suggested that participants felt the workshop was a valuable way to spend their time. This impression became even clearer when, as noted earlier, participants unanimously asked that the workshop continue for a second, a third, and finally a fourth year (which did not materialise despite their request). Only two or three of the participants dropped out each year, mostly because of job transitions. As mentioned earlier in the "Methodology" section, open-ended, anonymous written evaluations took place in years 1 and 3. Their analysis revealed several recurrent themes.

Participants reported that the workshop was challenging, intellectually enriching and useful in terms of the acquisition of relevant professional tools. Specifically, they mentioned the tools they acquired for developing students' thinking in the various school disciplines, the significance of learning about metacognition in general and about meta-strategic knowledge in particular, the importance of addressing thinking goals as explicit educational goals, the significance of learning about the language of thinking and the contribution of deepening their knowledge about assessment in general and about open-ended assessment and rubrics in particular. They stressed the fact that the workshop gave them *practical* tools:

> Even while I was still in the midst of the learning process, I felt I could start working with the tools I acquired. I learned a lot. I changed my perception about teaching and learning in my discipline.

> It gave us tools that are relevant for our work. From the initial stages, we practised how to formulate questions in various cognitive levels in all subjects until in subsequent stages we went even deeper into the process of inquiry learning.

> We studied and experienced numerous tools and thinking strategies and enriched our pedagogical language.

Another salient point in the written feedback was the intensity of the participants' feelings towards the collaborative dialogue that developed in the workshop. Although this was not one of the workshop's initial explicit goals, the data showed that in this respect, the workshop responded to a pressing need that until then had never been addressed. It turned out that just like teachers and principals, these superintendents worked individually rather than as a group and were not used to sharing their experiences with colleagues. They expressed a disturbing feeling of isolation and were thus empowered by the collaborative discourse generated in the workshop around meaningful issues in learning and instruction.

Several people explicitly said that this was the first occasion since they had begun their job in which they participated in a forum that (a) addressed pedagogical issues

and (b) fostered conversations among peers. They reported that they learned a lot from listening to each other, that seeing what other colleagues were doing increased their ability to apply the workshop's goals in their own work and that the creation of shared language about teaching HOT was important from the point of view of creating a coherent agenda in the system as a whole (Office of Pedagogical Affairs, Israel Ministry of Education, 2009):

> This was the only place in the Ministry that held pedagogical discourse and that enabled me to talk about issues that disturbed me academically on a professional level. There was a feeling of professional learning that is relevant for my work. It was the only place where I did not feel lonely facing the Ministry, the teachers, parents, etc…. I think it is necessary to continue this workshop in the future…

> Several of the ideas that came up when we were working in small groups fertilised my own way of work.

> It was interesting. Most importantly is that it enhanced peer dialogue among NSSs.

> We created a common pedagogical language.

Interestingly, many of the participants mentioned assessment as a common area in which they felt they needed additional learning. Although a large portion of the third year's workshop was devoted to assessment, participants still felt at the end of the year that they needed to learn more about this field and in particular about how to construct assessment that would be well aligned with teaching for thinking and deep understanding. The common request of several NSSs for more profound learning in this field (that was also expressed in several informal discussions) reflected the fact that these practitioners viewed changes in assessment as crucial for the process of implementing thinking in a systemic way.

3.7 The Workshop as Part of an Ecological Network of Changes

In order to fully understand the role of the workshop in the PH implementation process, a brief discussion of the underlying conception of educational reforms is called for. In an earlier publication discussing pedagogical reforms (Zohar, 2013), I had described the complexity and interactivity of factors related to changes in learning and instruction and argued that rather than explaining such changes by a simple model of causes and effects with direct interrelationships, a complex model of system thinking is more appropriate. An ecological system is a good example for system thinking that consists of networks of factors with multiple and complex mutual interactions. Introducing a pedagogical change in one component of the system often affects other components and processes in the system. Rather than being the outcome of a single activity, the final state of the system is dependent upon the equilibration of numerous factors, activities and forces (Zohar, 2013). As will be

discussed subsequently through the description of several concrete examples, this conception of ecological change should be kept in mind when thinking about how the workshop interacted with other components of the system. Although the workshop was an important component in the implementation of the PH, it was not carried out in a vacuum. As noted earlier, two additional significant processes that took place simultaneously were gradual changes in the national assessment that created an incentive and increased the motivation to teach for HOT and the development of adapted curricula and learning materials that provided guidance and resources for the change process. Rather than being an isolated activity, the workshop was therefore part of a comprehensive network of changes that encompassed PD, assessment and development of learning materials. In this sense, the workshop was part of an ecological network of changes that interacted with and supported each other.

The following sections are a depiction of how the workshop had interacted with other components of the system, as opposed to an argument in favour of any simple linear causal effects it might have had. In what follows, some of these interactions in which the workshop had a key function are described.

3.7.1   Interactions Between the Workshop and Various Components in the System

The workshop had interacted with numerous components in the system in a web of outcomes. As explained earlier, each NSS was free to plan the implementation in his/her subject according to the specific circumstances of that subject. At the end of the first year, after the goals of the PH were made clear and NSSs became familiar with some of the prevalent methods to teach them, special resources were made available for the purpose of implementation. NSSs were invited to submit an implementation plan, including extra resources they thought it would require. These subject-specific plans were usually made by NSSs and their senior team of instructors.

A report written at the end of the third year of implementing the PH showed that changes aligned with the overall goals of the PH had actually taken place in 24 different school subjects (Office of Pedagogical Affairs, Israel Ministry of Education, 2009). Such changes, led by the NSS of each subject, were observed in four main areas: (a) In all 24 subjects, changes took place in curricula and learning materials (including digital); (b) PD of instructors took place in 19 subjects (the five subjects with no PD of instructors comprised only one or two instructors. For these subjects, the NSS worked directly with teachers); (c) teachers' PD took place in all 24 subjects; (d) changes in national examinations (the matriculation exam taken at the end of high school or the Meitzav exams taken in fourth and eighth grade) to increase the frequency of HOT tasks had gradually begun to take place in 18 subjects.

These changes were idiosyncratic to each subject, determined by its unique conditions and context. For instance, in English as a second language, the call to

implement HOT in the curriculum coincided with a quest for improving the teaching of English literature, thereby generating the idea of integrating the teaching of literature with HOT skills such as analysing and interpreting, sequencing and identifying parts and whole. This change in the curriculum was accompanied by extensive PD and changes to the matriculation exam. In geography, the PH policy coincided with the final stages of writing a new curriculum. Thinking objectives were added to the new curriculum document and to learning materials (written and digital) that were prepared for its implementation. Extensive PD courses combined teachers' learning about HOT with learning about new topics in geography, and new HOT test items were added to the matriculation exam. In chemistry, a new curriculum focusing on scientific reasoning and inquiry had been in its initial stages of implementation when the PH policy was announced, but the implementation encountered considerable difficulties. Following the increased funding for PD that was made available for the purpose of developing students' thinking within the PH, the implementation process was able to move forwards in a faster and deeper way. The chemistry NSS reported that since thinking had become a system-wide goal, she felt that the process of wide-scale implementation of the new chemistry curriculum became easier and smoother. Also, she reported that the knowledge she had acquired during the workshop had helped her to upgrade the PD. She had particularly mentioned metacognition as an area in which her knowledge was initially lacking and reported that the workshop had enabled her to develop metacognition in the chemistry programme in a deeper way than before. In order to gain more insight into the inner working of these changes, I will describe in more detail the change processes in one subject. For this purpose, the following sections will focus on change processes in civic education.

3.8   Change Processes in Civic Education

Civic education in Israel is a mandatory subject in high school with a mandatory matriculation exam. During the same period in which the PH was implemented, the MOE formulated a policy change concerning the importance of education for democracy. Consequently, high school civic education went through a substantial transformation and received a special budget. Part of the budget was used for adding more hours to the teaching of civics. Among other things, an exceptionally large budget (compared to other subjects) was made available for teachers' PD. The implementation of this change created a unique opportunity for introducing in-depth changes to the pedagogy of civic education.

3.8.1   Summary of Implementation Process in Civic Education

The civic curriculum which was published in 2002 had already included extensive thinking goals such as teaching students to think critically, to formulate reasoned arguments, to evaluate claims and to make comparisons. However, these goals had not been addressed explicitly in most classrooms. In this sense, a large gap existed between the intended and the enacted curricula (Zohar & Cohen, 2016). As part of the implementation of the PH in the civic curriculum, several actions were taken to enhance the frequency and quality of thinking activities:

1. *Reducing the scope of the curriculum.* In order for teachers to be able to devote time for extensive thinking activities, the scope of the curriculum was reduced by 20%.
2. *Instructors' PD.* In addition to the NSS who had participated in the NSS's workshop (tier 1), six leading instructors had participated in an intensive leaders' PD course (tier 2). The NSS and these six instructors later led a PD course for the additional 22 civic instructors (tier 3). All the resources (i.e. the course's curriculum, lesson plans and PowerPoint presentations) that were developed for the instructors' PD course were later loaded to the instructors' website. The instructors' course thus served as a template for teachers' courses that were eventually led by instructors all over the country. Consequently, in 1 year, a total of 1,200 teachers participated in 34 PD courses of 28 academic hours each (tier 4). In addition, an online course of 56 h was developed. The instructors also visited schools and supported teachers in their classrooms. In the following years, the same infrastructure was used for deepening the learning of the first cohort of teachers as well as to run courses for a new cohort of teachers.
3. *Designing model learning activities.* The NSS, the leading instructors and additional experts developed a set of learning activities and lesson plans that model how to integrate specific thinking strategies with specific topics in the civic curriculum. Working as a team, they collaboratively negotiated the form and content of such materials in civic education. These materials were developed primarily for the instructors' and teachers' courses, but further purposes for these learning materials were (a) to help teachers in implementing these lessons in their classrooms and (b) to serve as model units for helping teachers to develop on their own similar learning activities and lesson plans (in additional topics).
4. *Developing a website.* The website was developed with a section for instructors and a section for teachers. The website serves for communication purposes and as a resource repository, consisting of numerous ideas for lessons, lesson plans, learning materials as well as a forum for teachers' questions and answers.
5. *Changes in the written matriculation exams.* The NSS and the leading instructors analysed the matriculation exams of previous years to determine the cognitive levels of HOT questions. Following the findings from that analysis, gradual changes began to take place in the formulation of questions, in the cognitive level of the questions and in the rubrics designed for scoring students' replies.

6. *Implementing a Performance Assessment Inquiry Task (PAIT) replacing 20% of the written matriculation exam*. One of the most significant changes was the implementation of the PAIT—an inquiry project addressing a practical problem that students carry out in small groups. The score for this task replaces 20% of the matriculation final score. Implementing the PAIT on a national level was a major enterprise requiring elaborate efforts in order to carefully design the supporting materials for teachers, the assessment rubrics and the necessary teachers' PD (for more elaboration, please see following sections).

The diverse course of implementation described for English, geography, chemistry and civics confirms that the participants of the workshop indeed tailored the change process to each individual context. In addition, this diversity highlights an important facet of the ecological model: rather than simple cause and effect relationships, the workshop's outcomes merged with a web of other events that affected various factors in the system according to their local context.

3.9 Examples of How HOT Is Addressed in the NSS's Workshop and in Civic Teachers' PD Workshop

In order to gain a better insight into the NSS workshop and the way it affected the implementation process, a narrative account of one session from the NSS workshop and one session from a teachers' PD workshop is described in this section. These accounts are based on notes written in my personal work diary while I was observing the sessions.

3.9.1 The Presentation of the Civic NSS in the NSS's Workshop

During a session that took place in year 3 of the NSS workshop, the civic NSS volunteered to present the change process he had been leading across the system. He chose to focus on the implementation of the PAIT. Thirty participants were present in the session that was 3 h long. A summary of the session is presented in the following paragraphs. This session is an example of how the workshop can possibly evolve once participants have taken a leading role in shaping the course's curriculum. At the same time, it also sheds more light on how the workshop interacted with other components in the implementation process.

The civic NSS began by explaining the requirements of the PAIT: Students needed to investigate an actual civic problem in the real world. An example of a popular topic chosen by numerous schools was equal occupational opportunities in terms of gender. Within this general topic, students had to define a more specific subproblem relevant to their own local district, for example, inequality among male

and female teenagers' after-school jobs. In the course of their investigations, students often discovered that laws and regulations indeed existed, but were not enforced. Consequently, students formulated practical recommendations for solving the problem.

Students were requested to write a short literature review, to collect data, to provide a solution to the problem and to write a paper documenting their work. In order to complete the task, students had to apply distinct thinking strategies for each stage of their research: formulate a research question; extract main ideas from written texts and integrate information from several sources (required for writing a short literature review); plan a practical investigation; collect data; extract information from the data collected by making comparisons, organising data and summarising it; draw conclusions by presenting an evidence-based argument; and, finally, provide a written reflection about their learning process.

By providing this detailed description of the learning sequence of the PAIT (whose final score was used as part of the matriculation final score), the NSS had in fact discussed a new section of the civic curriculum (addressing the PAIT), combining inquiry learning and HOT in the learning and assessment of civic content. Moreover, he went on to describe how the PD, the development of learning materials and the new mode of assessment were combined to support each other during the implementation process. The NSS described how members of the civic education leading team (who had participated in tiers 1, 2 and 3 of the PD) used ideas that were initially drawn from the NSS's and leaders' workshops (that were not specific to the civic curriculum) for preparing subject-specific learning materials. The outcomes of this process were teaching modules and PowerPoint presentations that were used later in teachers' civic education PD courses all over the country. Based on these uniform materials, each instructor later prepared an individual-specific variation of teachers' PD course. The NSS continued his presentation by providing a detailed description of the civic education teachers' PD courses, explaining that several sessions were devoted to various stages of the PAIT and the thinking skills they involved. For example, session 2 addressed the formulation of research problems with an eye to connecting them to major concepts in the civic curriculum. Session 5 addressed data analysis, emphasising the thinking strategies of making comparisons and of formulating evidence-based arguments. Session 7 addressed the rubrics for assessing the PAIT, thereby illustrating the relationship between the PD and the changes in assessment. This description shows how ideas about fostering students' HOT that were first introduced in the NSS workshop were adapted to the specific content of civic education, transferring through the various tiers of the PD.

With respect to changes in assessment, the NSS explained that although the grade of the PAIT consists of 20% of the final civic matriculation score, it is the classroom teacher who grades it. This illustrates the overall policy of increasing teachers' autonomy. Other aspects of this policy encompass teachers' autonomy to choose the topic for the PAIT investigation, to decide the number of hours they will devote to the PAIT in class and to have the freedom in making decisions about the nature and relative weight of various components within the assessment rubrics.

The NSS described many of the steps he needed to carry out during the implementation process. On the level of the whole school system, there was a need to allocate additional teaching time (see the addition of teaching hours and the reduction in the scope of the curriculum described earlier) and to secure the necessary budget for its enactment, to change the regulations of the national matriculation exam, to work together with the MOE Division of Matriculation Exams in order to co-ordinate the detailed changes in testing mechanisms, to prepare the inspectors for the forthcoming changes and to discuss the changes with the teachers' union. In addition, there was a need to secure even more funding, because the union had demanded a compensation for the extra work teachers were required to do. In order to develop reliable rubrics for assessing the PAIT, detailed work was done in collaboration with various people, such as a group of experts from the National Centre for Testing and Evaluation. On the school level, various preparatory activities were conducted with school principals, school management teams, teachers and students. These activities show how an intricate web of structural and pedagogical changes had to be intertwined in order to implement the PAIT across the whole school system.

The NSS shared his field-based impressions with his colleagues, reporting that he could see three phases of implementation: Phase one takes place whenever the PAIT is first presented to a new audience. This phase is characterised by confusion, doubts, uncertainties, anxiety and sometimes even anger. Phase two takes place when teachers study the PAIT basic model and is characterised by teachers' rigidity and their wish to receive detailed and clear instructions which they can follow verbatim. This is usually followed by phase three. After gaining experience with guiding students through the task, teachers understand the process in a deeper way, thus internalising its spirit. This causes them to become more relaxed. In this phase teachers gradually begin to be more flexible and creative. The evidence for this statement is that teachers at this stage typically bring up new ideas for students' investigations, for teaching and for assessment. The NSS's policy is to encourage such flexibility, granting teachers freedom and autonomy to follow their ideas. This is expressed by a continuous process of updating the requirements of the task according to the feedback received from instructors and teachers. In effect, teachers thereby "tailor the change process" to fit the specified educational contexts in which they are working. Consequently, diverse new forms and contents for the PAIT emerge. It seems that the provision of clear goals, capacity building and extra means, together with a considerable degree of autonomy, releases a wealth of creativity in instructors and teachers alike.

The presentation of the civic NSS was followed by a lively discussion among the participants of the workshop. It should be noted that during this period many of the other NSSs were experimenting with implementing similar processes in their own school subjects and the orientation of the discussion was, therefore, quite practical. Among the issues brought up by the participants are the following: the need for ongoing teachers' classroom support and how best to achieve it; how to improve the formulation of the task's sections related to students' written reflections; how to

co-ordinate between individual and group scoring of the PAIT; how to avoid plagiarism; and how to increase teachers' enthusiasm and motivation for change.

The civic NSS summarised the discussion by affirming that the first 2 years of the implementation process indeed raised numerous challenges. He highlighted the advantages of the four-tiered implementation process, explaining the flow of knowledge from the NSS workshop to the leading instructors, to the larger group of civic instructors and finally to teachers. He concluded the session by making several optimistic remarks. He reported that his informal conversations with many teachers showed that they are gradually beginning to discover the advantages of the PAIT, such as increased teachers' autonomy and flexibility and a possibility for the expression of a larger variety of students' skills.

3.9.2   A Visit to a Session of Civic Teachers' PD Workshop

During the 2nd year of the implementation, I had often visited teachers' PD courses as a passive observer, writing comments in my diary for the purpose of future discussions with the courses' leaders. The topic of a particular session described here was the rule of law (Part 2, Chap. 5 in the textbook by Adan, Ashkenazy, & Alperson, 2001), combined with the thinking strategy of making comparisons. Twenty-eight teachers and two instructors were present.

After allowing the teachers some time to browse the chapter in the textbook in order to remind themselves of its main ideas, one of the instructors first made some explanatory notes regarding key concepts and ideas in the chapter and then stated that the thinking strategy of making comparisons can be extremely useful for addressing students' challenges in understanding difficult concepts in the chapter. For example, comparisons can be made between the rule of law in democratic and nondemocratic states, between the formal and the substantive senses of the rule of law and between diverse types of criminal offences. It was noted that making comparisons is a useful strategy for deepening students' understanding of key concepts in the curriculum, as well as for data analysis in the PAIT.

During the workshop, the instructor presented several instructional strategies for teaching the content of the chapter through making comparisons. For example, she presented a PowerPoint slide with an empty table titled "A comparison between the rule of law in a democratic and nondemocratic state". Teachers were requested to work in groups on making a detailed comparison, including the formulation of relevant criteria, based on the chapter. In order to create a first-hand experience with the learning activity, teachers in this part of the workshop were asked to work in a way that simulated the work of their students. Teachers seemed engaged by the task, discussing its details in an animated way. In subsequent stages of the workshop, the leader suggested several additional ways for working with students on making comparisons. The participants experimented with these modes of learning and instruction in an active way, discussing their instructional rationale. In the final part of this session, teachers had the opportunity to work in small groups in order to apply the

instructional strategies they had learned so far, so as to create additional lesson plans combining the teaching of (new) civic concepts with making comparisons. Teachers came up with interesting and innovative lesson plans. This part of the session highlights teachers' creativity and autonomy.

3.10   Summary and Discussion

The NSS workshop fostered leaders' knowledge and thus had a prominent role in the effort to support a deep change in learning and instruction. The workshop fulfilled the idea that focusing on capacity building and sense-making of implementation agents in the context of an intellectually demanding educational policy (Spillane, 2000; Spillane et al., 2002) may facilitate deep pedagogical change (Coburn, 2003). It was based on the assumption that leaders' understanding of central pedagogical principles of a reform affects implementation in a crucial way (Spillane, 2000). The workshop therefore had a major role in the distribution of a coherent pedagogical message across the system, using an organisational structure of an implementation fan. The message travelled across several tiers of PD until it had eventually reached the teachers and, then, finally reached their students. Each of the NSSs who had participated in the workshop was a leader in his or her own field. The workshop was only one component in a network of changes that NSSs engaged in following the PH policy in teaching and learning of approximately 20 school subjects. It should thus be regarded as a necessity rather than as a sufficient condition for each of these changes.

The description of the comprehensive pedagogical changes that took place in civic education and the changes that took place in other subjects showed that changes were indeed generated and shaped by several interacting factors. The workshop was part of a detailed plan of a top-down implementation process that addressed changes in three dimensions: assessment, curriculum and learning materials and PD. The three dimensions interacted with each other in intricate ways, described throughout this chapter. For example, assessment was a major topic in the NSS workshop, particularly alternative assessment and construction of rubrics. The civic NSS who had studied this topic in the workshop, used the pertinent knowledge for designing changes in both the assessment and the PD dimension. This knowledge was crucial for designing the PAIT assessment (that was part of the matriculation grade). It was also used for planning particular sessions in tiers 3 and 4 of the PD. Another example of an interaction between the workshop and the three dimensions concerns knowledge about instruction of thinking strategies. The civic NSS studied this topic in the workshop. Subsequently, this knowledge supported a substantial change in the civic matriculation exam. In other words, knowledge about thinking strategies that was first encountered during the PD workshop eventually affected the assessment dimension as new types of questions requiring students to formulate evidence-based arguments were added to the matriculation exam. This knowledge also supported the development of learning materials when the NSS

initiated and supervised the development of digital and written civic learning activities that integrated thinking strategies with civic content. Finally, it supported the design of the PD dimension when the NSS used this knowledge for designing and supervising tiers 3 and 4 of the civic PD courses. Additional facets of the instructional changes that were influenced by the NSS workshop interacted with factors that were independent from the PH policy, such as the decision to write a new curriculum in geography. This pattern of complex interrelationships matches the ecological model described earlier.

Two additional characteristics of the change model were the blend of tightness and looseness and a call for participants to tailor the change process to multiple, specific contexts. Despite the top-down uncompromising goal of integrating HOT into learning and instruction in each subject, each NSS created a unique change process according to the circumstances and contextualised needs of his or her subject. It seems that the combination of a focused top-down goal-setting with capacity building, resources and autonomy to shape the process according to individuals' own goals and understanding released sources of energy and creativity in educators on all levels.

In sum, the workshop made prominent contributions to the web of interactive changes that took place in learning and instruction of many school subjects. These changes were not a direct causal outcome of the workshop because each change was shaped by numerous other factors that resulted in a variety of contextualised changes. This change pattern matches the ecological model presented earlier. The NSS workshop thus demonstrated how long-term capacity building of a group of senior educational leaders could be used as a leverage for implementing an innovative instructional change on a large, national scale. The analysis shows how a top-down capacity building designed to construct leaders' new knowledge, together with a substantial degree of autonomy, can bring about rich and diverse bottom-up initiatives.

In retrospect, a dilemma concerning this process is whether it created the correct blend of looseness and tightness or freedom and control (Fullan, 2007). As explained earlier, the ultimate goal was predefined in a clear and uncompromising way, but the means for reaching this goal were left to the discretion of the participants. This started with the free choice about whether or not to take part in the process, continued by the freedom to choose the specific policy goal for each school subject and, finally, became apparent in the diverse implementation plans and actual processes that took place in each subject. The main disadvantage of this approach is that the freedom involved in the implementation cannot always be organised in the most systematic and rational way. For instance, the choice of subjects that was part of the process was not predetermined according to some rational considerations. Instead, it was determined by NSS's individual choices of whether or not to join the workshop. The most extreme example of this was exemplified by the mathematics cluster. The mathematics NSS chose not to participate in the workshop, and therefore this central subject was not included in the process. Although there were understandable reasons for this choice (mainly the complex problems in mathematics education that the mathematics NSS who was new at the time had to deal with), I believe that the ratio-

nal considerations for including mathematics in the process are so robust that no systemic plan would have left it out. Another significant example of the dilemma regarding the right blend of freedom and control pertains to the equilibrium between capacity building and empowerment on the one hand and the focus on results on the other hand (Elmore, 2004; Fullan, 2007; Hargreaves & Fink, 2006). While there was a strong emphasis on the former, the latter only existed in soft terms. Participants received encouragement, incentives and positive feedback for results, but no sanctions were activated in cases of poor results. My personal impression was that the enthusiasm, sense of ownership, sense of commitment and creativity of the participants were made possible by the freedom they had experienced and that any effort to regulate the process more strictly would have undermined it. Yet, since the answer to this dilemma is deeply rooted in cultural contexts, and in the absence of a more formal evaluation of the implementation process, further studies are needed to provide clearer guidelines regarding the right blend of freedom and control in future endeavours to implement similar innovative programmes.

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Anat Zohar is a professor at the School of Education of the Hebrew University of Jerusalem. From 2006 to 2009, she served as the chairperson of the Pedagogical Secretariat at the Ministry of Education. Her areas of academic expertise include science teaching, learning and instruction, development of students' thinking, metacognition, teachers' professional development in the context of teaching thinking, gender and science learning, gender and education for the gifted, bridging the gap between educational policy and changes in learning and instruction and how to integrate educational projects in the field of developing students' thinking for the entire system.

Chapter 4
Spreading Educational Technology Innovations: Cultivating Communities

Fei Victor Lim, Yew Meng Kwan, and Meng Leng Poh

Abstract This chapter describes an approach to promote the development and spread of educational technology innovations. The approach nurtures a culture of innovation and reflective practice of Information and Communication Technology (ICT) use for teaching and learning amongst teachers under Singapore's 3rd Masterplan for ICT in Education. It discusses system support, processes, and strategies which a centralised agency, like the Ministry of Education Headquarters (MOE HQ), employs to encourage schools and teachers to participate in ground-up experimentations of ICT-mediated innovations, translation, and spreading. This chapter discusses cultivating eduLab communities to facilitate spreading and adopting effective educational technology innovations across schools. The chapter describes processes for translating research ideas into innovations for scaling, by (1) scanning ideas, (2) prototyping innovations through projects, and (3) spreading or scaling up through communities. It elaborates considerations for evaluating innovations and strategies to scale up innovations. The chapter proposes that scaling includes explicit knowledge and tacit dimensions of teachers adapting innovations for contexts. Thus, communities and champions are drivers for spreading. The chapter extends the principle of "structured informality" to describe top-down supports for bottom-up efforts, that is, how system structures leverage informality in communities, where HQ officers and teachers dialogue to build understandings, adapt core principles to contexts and develop champions who further drive diffusion. The chapter proposes design principles for cultivating communities based on literature from communities of practice and discusses this using three case examples. It concludes with how design principles align with the principle of structured informality to use communities as mechanism for scaling.

F. V. Lim (✉)
National Institute of Education, Nanyang Technological University, Singapore, Singapore
e-mail: victor.lim@nie.edu.sg

Y. M. Kwan
Ministry of Education, Singapore, Singapore

M. L. Poh
Yishun Secondary School, Singapore, Singapore

4.1   Introduction

The appropriate use of Information and Communications Technology (ICT) can enhance learning and teaching. In particular, educational technology innovations usher in unprecedented possibilities to transform learning and teaching practices, which can in turn deepen and enhance the learning of students.

In Singapore, schools are given the autonomy to adopt and adapt a variety of approaches that cater to their students' profile and best meet their learning needs. The Ministry of Education Headquarters (MOE HQ) articulates clear students' learning outcomes and provides guidance as well as professional development to teachers and school leaders.

Since 1997, MOE has implemented the Masterplans for ICT in Education. The 1st Masterplan for ICT (mp1) in Education (1997–2002) laid a strong foundation for schools to harness ICT, particularly in the provision of basic ICT infrastructure, the promotion of a widespread acceptance for its use in education and equipping of teachers with a basic level of ICT competency. The 2nd Masterplan for ICT (mp2) in Education (2003–2008) is built on this foundation to strive for a more pervasive use of ICT in education by formally integrating ICT into the curriculum, establishing the baseline ICT standards for students and seeding innovative and differentiated use of ICT amongst students. The 3rd Masterplan for ICT (mp3) in Education (2009–2014) focused on enriching and transforming the learning experiences of students through the use of ICT, so as to equip them with the critical competencies and dispositions to succeed in a knowledge economy. The goal was for students to develop competencies for self-directed learning (SDL) and collaborative learning (CoL), as well as become discerning and responsible ICT users, through the effective use of ICT.

The efforts described in this paper are situated within mp3. Progress had been made by the end of mp3 towards the goal of students developing SDL and CoL competencies and with more teachers delivering ICT-enriched learning and teaching. By the end of mp3, there had been a positive cultural shift in the use of ICT for learning and teaching amongst schools. Mp3 has also provided rich learnings in reinforcing the importance of building an ecosystem in schools, partnering different stakeholders, having differentiated support for schools and ensuring that the use of ICT in teaching and learning is anchored on sound pedagogy.

4.1.1   Bringing Ideas into Practice

The Technologies for Learning (TfL) branch sits within the Educational Technology Division (ETD), in MOE HQ. The functions of TfL include leading active experimentation and reflective practice on innovative use of ICT in learning and teaching, identifying and translating ICT-enabled pedagogical principles for enriched

learning experiences and harnessing strategic partnerships to actualise, sustain and spread innovative ICT-enabled pedagogical practices.

In nurturing a culture of innovation and reflective practice of ICT use for teaching and learning, there has been a deliberate focus on engaging schools and teachers in experimentation and innovation efforts. This was to encourage teachers to engage in professional discourse; learn, reflect and explore together; deepen their practice; and improve their craft.

There were also efforts made to identify pedagogically sound and effective ICT practices grounded in research and to create opportunities for ground-up experimentation in learning with ICT. More importantly, there was an emphasis on the spread of viable ICT-enabled pedagogical practices derived from such ground-up innovation projects to benefit other schools in the system.

eduLab is an MOE innovation programme spearheaded by ETD TfL to provide system's support for active ground-up experimentation and for the spread of innovative ICT-enabled pedagogical practices amongst schools. The translation of educational technology innovations can be broadly categorised into three main types of activities: (1) scan, (2) prototype and (3) spread. These activities are built around existing eduLab teacher communities.

Scan Through the eduLab communities and networking sessions, ideas and possibilities are explored amongst teachers, specialists in HQ, and researchers in the universities, to enhance and improve learning. In addition, HQ conducts scans for emerging innovations and applications in educational technology that are of relevance and interest to educators in Singapore. Findings, insights, and learning gleaned from these scans in turn inform possibilities for innovation projects.

Prototype Through a process of review and selection, noteworthy ideas are funded by eduLab. Different schools come together to prototype and test innovative pedagogical practices in their local contexts. HQ works in partnership with schools and researchers to study the efficacy of these practices and distil a set of design principles, accompanied by teacher-designed lesson packages tried across different schools and student profiles, ready for use and adaptations by other schools.

Spread Identified practices and ideas that have been tried and tested by schools and researchers are made accessible and brought to more schools through a range of strategies that include both structured professional learning as well as emergent community-based approaches. The scaling-up strategy is designed based on the needs of a teacher in adopting and adapting an ICT-enabled practice.

Apart from structured professional learning that equips teachers with a range of pedagogical strategies derived from the innovation projects, MOE orchestrates across-school eduLab communities as a way to impact teacher practice and sustain educational innovations.

Since 2013, TfL had begun to nurture eduLab communities around pedagogical innovations derived from prior innovation projects, such as the FutureSchools@ Singapore programme and eduLab projects. Figure 4.1 shows how eduLab projects
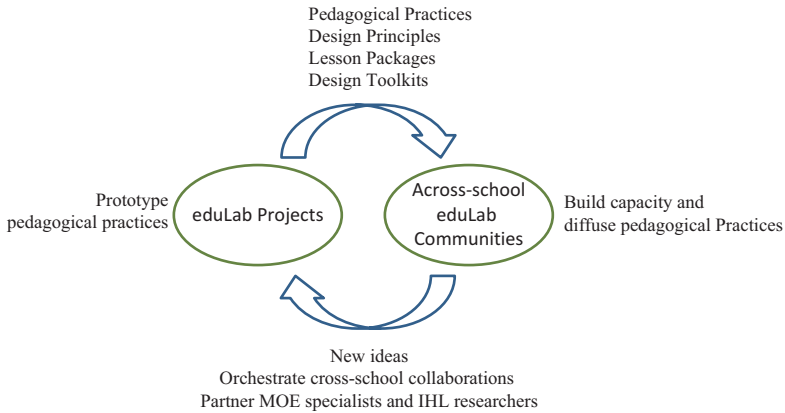
Pedagogical Practices
Design Principles
Lesson Packages
Design Toolkits

Prototype
pedagogical practices   eduLab Projects   Across-school
                                                         eduLab
                                                         Communities   Build capacity and
                                                                               diffuse pedagogical Practices

New ideas
Orchestrate cross-school collaborations
Partner MOE specialists and IHL researchers

Fig. 4.1 Synergy between eduLab projects and the eduLab communities

synergise with the eduLab communities by continually generating pedagogical practices (e.g. design principles, lesson packages, toolkits) that eventually become part of the repertoire of practices championed by the communities. Conversely, the community interactions create conditions and opportunities for teachers, specialists, and researchers to jointly work on practice-related challenges through funded eduLab innovation projects. This creates a virtuous cycle for continued growth of the community, expanding and enriching the repertoire of practices for the community over time.

4.1.2 Strategies to Spread Educational Technology Innovations

Recent literature recognises that an effective educational innovation in a particular institution cannot be successfully scaled up by mere replication into another context. As such, the confluence of sociocultural factors in the successful implementation of an educational innovation needs to be considered from an ecological perspective (Hung, Wu, Seah & Lee, 2015; Pang, Lim, Choe, Peters & Chua, 2015; Peurach & Glazer, 2011).

> Current literature … mostly take the respective innovation or project as the focus. Although they provide detailed accounts about scaling individual local level innovations, this level of analysis lacks the bird-eye or systems' view of scaling. Understanding scaling at the system level is essential to inform policymakers of different scaling patterns, help policymakers understand teachers' and students' needs on the ground and allocate resources more efficiently. (Hung et al., 2015, p. 270)

Looi and Teh (2015, p. 3) describe the "tight-but-loose framework", by which the "synthesis of both bottom-up and top-down approaches" allows the "flexibility of taking advantage of local opportunities when accommodating existing local constraint, on the other hand, in the fidelity to core principles of innovation or practice".

Table 4.1 Criteria to evaluate educational technology innovations

Criteria	Dimensions	Considerations
Value-add	Conceptualisation	Supported by evidence
		Addresses a learning need
		Based on sound pedagogical approaches
		Enabled by ICT affordances
	Competitive advantage	In comparison with other practices
		In comparison with other tools/applications
Readiness of use	Implementation	Availability of MOE expertise to implement
		Availability of lesson resources
		Learning design
		Lesson plans
Affordability	Cost	Infrastructural
		Recurrent
		Economies of scale (upon adoption)

The effectiveness of scaling up an innovation is not simply measured by counting the instances of successful implementation across contexts (Dede & Coburn, 2007; Sutton & Rao, 2014). As such, a range of proxy indicators, including the number of schools adopting the practice, as well as qualitative feedback from teachers enacting the practice, are used to measure the effectiveness of the scaling-up endeavour. More meaningfully, the mindset shift and the growth in professional competencies have been engendered in teachers who have adopted the ICT-enabled practices developed in the project schools. This is evident from the stories captured, teachers' positive feedback after attending professional learning sessions and encouraging reflections after implementing the practice in their classroom with close support from TfL.

Given the recognition of the interplay of sociocultural factors in the scaling up of effective educational innovations, as well as the complex multifaceted dimensions of scale, it is useful to consider carefully the requisite enablers which support the successful scaling up of an innovation. This set of considerations includes, and goes beyond, the quality of the innovation. A concerted set of strategies was designed to facilitate the translation of research into usable pedagogical principles and implementation strategies. These strategies are (1) accessible practice, (2) affordable technologies, (3) available lesson resources, and (4) adaptation support.

These strategies guided the experimentation efforts with a view to scale up effective practices to benefit more schools in the system. The effective practices developed from the exploratory work were carefully evaluated based on (a) evidence to value-add to teaching and learning, (b) readiness and (c) cost. Table 4.1 summarises the key dimensions considered in these criteria.

The criteria used are consistent with the index to evaluate digital technology innovation developed by Fullan and Donnelly (2013). Successful and effective practices from innovation projects or experimentations were subsequently given additional support for scaling up. Following from the understandings discussed above,

the following were strategies to scale up successful ICT innovations developed in the project school to benefit the other schools in the systems:

Accessible Practice The innovative practice was made accessible to all teachers through a clear and simple set of core design principles that had been distilled from the experimentation in the project schools. The innovations were packaged into ready-to-use, pick-and-go resources for teachers to adopt with relative ease.

Affordable Technologies Low-cost technologies were identified to make adoption more accessible to schools. These alternatives were able to sufficiently support the ICT-enabled practices developed in the project school. While these technologies may not have offered the same integrated experience as the more costly technologies used in the project school, a careful selection of the right set of technologies could approximate the technological affordances required for the practice.

Available Lesson Resources The project schools made available the lesson resources that had been created from their innovation journey. The resources were uploaded on a portal, the ICT Connection[1], accessible to all Singapore teachers. Schools adopting the practice adapted the lesson resources accordingly for use, rather than develop resources independently.

Adaptation Support Given that school contexts and student profiles are different, using a "tight-but-loose framework" encouraged adaptation of lesson resources and re-contextualisation of the design principles for each setting. TfL officers worked with teachers in the eduLab communities to facilitate the adaptation of the practice across schools.

The cultivation of eduLab communities, as part of the strategy of adaptation support, was instrumental in the scaling up of effective educational innovations. This is because the eduLab communities provided an environment for the development of teachers' capacity and the building of teachers' ownership.

4.2 Spreading Educational Technology Innovations Through eduLab Communities

The approach to cultivating eduLab communities stems from the work of Wenger, McDermott and Snyder (2002) on communities of practice (CoPs). CoPs as defined by Wenger et al. (2002) are "groups of people who share a concern, a set of problems, or passion about a topic, and who deepen their knowledge and expertise in this area by interacting on an ongoing basis".

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[1] The ICT Connection can be accessed at http://ictconnection.moe.edu.sg

While Wenger et al. (2002) had laid out these broad principles to guide the cultivation of communities, there are not many documented examples of how such an emergent community building effort can be implemented at a centralised system level like MOE to effectively facilitate across-school teacher communities. It is common to see organisations attempting to use traditional project management approaches to cultivate communities with little consideration of its emergent nature as described in literature.

Communities of practice (Wenger et al., 2002) are useful in spreading tacit knowledge which cannot be transferred merely by artefacts containing the information related to particular innovations. While the community building approach suggests an organic and more emergent touch to the scaling-up endeavour, this has to be balanced with well-defined structures that can create and support the enabling conditions for success. Hung et al. (2015: 88) propose a "centralised-decentralisation view" with "top-down supports for bottom-up initiatives, where flexibilities and adaptivities occur throughout the system with sufficing standards (as largely determined by teacher readiness, leadership supports, and infrastructural adequacies) as target goals at each local instantiation". The principle of structured informality is appropriated from the work of Savery and Duffy (1995) and Lim, O'Halloran, and Podlasov (2012), which promotes designing of structured informal learning experiences to meet objectives but allowing openness and flexibility for discovery, interaction and a joint construction of knowledge. By extension, in any community building effort, there will always be a need to continually engage members to understand their needs and concerns so that the focus, direction and activities of the community can be jointly constructed. This implies a responsive and flexible approach in the orchestration of community events.

Cohen and March (1974) posited a similar view where planning or design is viewed as an interpretation of past decisions rather than a programme for future decisions. This can be interpreted as taking an iterative approach to planning rather than developing a fixed set of programmes with targets and indicators decided for the entire year. This is a useful concept which interestingly is consistent with the concept of emergence in nurturing communities proposed by Wenger et al. (2002), which comprises an iterative series of action-reflection cycles focused on creating value for members of the community. An iterative approach makes sense when the solution to the known problem is unclear or when there are multiplicity of satisficing design solutions. There could also be instances where we are unsure as to whether we have identified the right problem to solve.

If we can classify design problems as a continuum over two axes, then efforts in nurturing for communities would be similar to designing for problem spaces with ill-defined solutions or ill-defined problems (see Fig. 4.2).

This means that planning and designing for communities is very different from that of traditional project management where we often see clear goals, milestones, and timelines. Cultivating communities would entail iterative development over time based on regular input, feedback, and needs gathered from prior community engagement sessions. Such problem-solution spaces are akin to agile development

Fig. 4.2 Communities to address ill-defined problems or ill-defined solutions

and start-up environments, requiring community champions to adopt a different mind-set in problem finding and design.

Applying these ideas to our context of cultivating communities, our community champions would need to be creative in identifying the needs of teachers. Every face-to-face community engagement event is an opportunity to clarify needs and gather feedback from members on possible future events and directions for the community. Every community engagement event is developed and refined based on the input gathered iteratively. A design mantra that could guide this work would be "iterative action-reflection cycles". Important questions to ask would include:

- What are the needs of our teachers?
- How do know we are addressing the right problems?
- What should the focus be?
- How would this feedback or information influence my plan?

Also, given that the CoPs described by Wenger et al. (2002) are more emergent and organic in nature, it was decided that the communities initiated and led by MOE HQ be termed "eduLab communities" instead. In spirit, the eduLab communities are consistent with the CoPs described by Wenger. In practice, however, the eduLab communities, initiated as a platform to scale up effective educational technology innovations, had to balance between the meeting of teachers' needs, which were more organic and emergent, and the spread of specific practices arising from the innovation projects, which required a certain structured informality.

Successful scaling up of educational innovations is dependent on the capacity of teachers to apply these practices in the classroom. Teachers should be able to recognise the learning needs based on the profile of their learners and have strong subject mastery to know how the educational technology innovation can improve their students' learning. As such, a focus in the scaling-up efforts was on building the professional learning of teachers to use these educational technology innovations

meaningfully and effectively. The cultivation of eduLab communities to accomplish this was effective as it provided an environment to sustain professional learning beyond formal events, such as workshops and seminars.

Lave and Wenger (1991) posited that learning is social in nature and is intertwined with the sociocultural context where the learning is situated. The key thrust and implication of this statement is that learning and cognition is inseparable from contexts, cultures, and human activities. Such learning would have a strong emphasis on creating or cultivating the social structures or processes where people can learn in groups, negotiate meaning, organise, and share resources in real-life settings. Teacher learning in a community is thus a process of social participation, a journey of meaning-making and identity formation in real world and authentic settings, which eventually brings about a sense of identity and the deepening of the teacher's craft (Wenger, 1998).

It is this understanding and the appreciation of the importance of the sociocultural dimension in teacher professional learning that has led to a greater emphasis in MOE and schools in adopting a more practice-based on-site learning strategy for teachers, such as CoPs and professional learning communities. From MOE's perspective, we see the centrally facilitated cross-school communities as important social infrastructures which augment school-based communities in building teacher capacity and in the diffusion of pedagogical innovations across schools.

4.2.1 Cultivating eduLab Communities

Teachers joined the eduLab communities primarily through workshops conducted to generate awareness of specific innovative ICT-enabled practices. Altogether, the eduLab communities consisted of teachers representing 345 schools which is more than 90% of schools in Singapore. eduLab communities offered teachers follow-up connections from structured workshops and outreach events. TfL officers facilitated these eduLab communities where teachers connected with peers who had similar passions, learnt from one another and engaged in co-designing lessons with TfL and researchers. Once developed, lesson packages were shared with all schools through online repositories like the ICT Connection and Community pages. The eduLab communities connected teachers with experts and researchers related to their domains to keep teachers abreast of innovative practices. Based on the ICT-enabled practices developed from the innovation projects, five eduLab communities were formed to facilitate the spread of specific practices. They are (1) ICT in English Language, (2) ICT in Mathematics, (3) ICT in Science, (4) Mobilised Learning, and (5) MakersTech.

The ICT in English Language eduLab Community comprised three networks: (1) Critical Viewing (of Visual Texts and Films), (2) Assessment or Learning (with Automated Marking Tools or Learning Analytics), and (3) Media Literacy (through Digital Storytelling or Newscasting). The Critical Viewing Network was interested in the representations of knowledge across different modes and meaning-making

resources (e.g. language, images, and gestures). It promoted a systemic approach, stemming from Michael Halliday's Systemic Functional Theory to the analysis of visual texts (e.g. advertisements, online news, posters, and films) so as to develop critical thinking and discourse analysis in students. The teaching approach was supported by freely available web-based annotation and collaboration tools. The Assessment for Learning Network sought to explore the digital tools and platforms for enhancing students' engagement in the learning of English Language or Language Arts. It harnessed the affordances of Automated Marking Tools or Learning Analytics while adhering to the principles proposed by Black and Wiliam (2009) for designing formative assessments. The Media Literacy Network aimed to empower students as responsible digital users who can critically access, analyse, and evaluate sources to deconstruct information, before they collaboratively create multimedia messages for effective communication with authentic audiences. It allowed students to develop twenty-first-century competencies and deeper understanding in Total Curriculum through ICT-enabled strategies such as Digital Storytelling or Newscasting.

The ICT in Mathematics eduLab Community encouraged teachers to generate their ideas, discuss their approaches, and share their thoughts on the use of ICT for mathematics. With collective knowledge residing in this space, Singapore mathematics educators who used ICT to enhance learning and teaching could reach out to others in the fraternity. By building on the diverse expertise and professional knowledge of this fraternity of mathematics teachers who were interested in using ICT to engage students, the community also functioned as a support group for mathematics teachers who wanted to seek more information in the use of ICT for mathematics.

The ICT in Science eduLab Community explored the implementation of ICT-supported inquiry-based learning activities to cultivate scientific literacies in learners. They explored ICT-supported inquiry-based learning environments to facilitate the development of mastery learning and scientific inquiry in students. Below are the nine scientific literacies distilled from the stages of scientific inquiry (Wenning, 2007):

1. Asking Questions
2. Acquiring Knowledge of Facts/Concepts and Forming Relationships of Concepts
3. Modeling and Using Simulations
4. Planning and Carrying Out Investigations
5. Using Data and Information
6. Using Mathematics and Computational Thinking
7. Constructing Explanations
8. Engaging in Arguments from Evidence
9. Obtaining, Evaluating and Communicating Information

The Mobilised Learning eduLab Community embarked on designing learning experiences in fieldwork, outdoor learning and physical education, by harnessing affordances provided by mobile technology and the physical environment. Diverse practitioners' professional experiences were built on to meet students' learning needs in learning beyond the confines of the classroom. Teachers learnt from each other during community events such as workshops and networking sessions.

The MakersTech eduLab Community explored how educators could develop educational contexts that link the practice of making with technology to formal concepts and theories, as well as support discovery and exploration in the design process through thinking routines. Through this learning community, teachers were supported to introduce ICT-enriched maker activities into the curriculum and develop and share ICT-enriched maker lesson resources.

TfL had also put in place Learning Designers, as champions, to support the eduLab projects and the eduLab communities. The Learning Designers worked closely with teachers in the innovation and adoption schools and customised their support based on the needs of the teachers. For example, in the ICT in English language eduLab community, TfL officers worked with teachers from different schools in different ways based on the profiles and needs of the teachers and students. Some schools were involved in a research study to ascertain the time saved from the use of an Automated Marking Tool (AMT), some were supported with lesson plans and resources to carry out lessons, and others were supported with co-designing of lessons and lesson observations. The Learning Designers and eduLab Community leads provided differentiated close school support based on the needs and profiles of the teachers. The growth in the spread of the practice, as well as the feedback and appreciation from the teachers, affirmed the value of this approach.

In the ICT in Science eduLab Community is the name of a community, the ICT-enabled practice that was developed through an eduLab project was scaled up. This ICT-enabled practice assists students who are often not able to apply the necessary science concepts to understand certain problems or situations, to make connections between science theories and to understand the natural phenomenon. Leveraging the affordances of technology, students were engaged in using various tools in ICT platforms for collaborative and self-directed learning. The learning environment for the learning of science was extended beyond the classroom to students' daily lives. Students had opportunities to inquire and make connections between what they learnt in the classroom and what they observed and experienced in their daily lives. This allowed for seamless learning that extended beyond curriculum time and the confines of the classroom and connected theory to practice, thus helping to strengthen students' conceptual understanding. It also greatly facilitated students' ability to take more ownership of their learning. The "mobilised" science curriculum, designed by teachers from four schools and TfL's Learning Designers, facilitated and scaffolded student-centred learning activities. A set of design principles was developed to lend more accessibility for teachers to create lessons to better suit school needs and contexts.

In the following section, we expand on the work of one of the eduLab communities, the ICT in Science eduLab Community, as an example of how the design principles have been adapted and used in varied contexts across three different case studies.

4.2.1.1 Professional Growth of Science Teachers Through Synergistic Partnerships

A unique partnership between TfL officers, a lead teacher, and teachers from three secondary schools in redesigning a chemistry topic with ICT-infused science practices is illustrated to show differentiated school support. In this partnership, individual strengths were harnessed: the lead teacher offered her subject knowledge and pedagogical skills; the TfL officers provided leadership for meaningful use of technologies; and the teachers ensured that the redesigned lesson was adapted for their unique student profiles while adhering to Collaborative Science Inquiry (CSI)design principles developed earlier from another eduLab project. The redesigned curriculum made students' thinking visible through co-created digital artefacts useful for formative assessment. After each lesson enactment observed by all involved in the partnership, changes were made based on the student interactions observed, before re-enactment in another school. The last enactment in the third school also served as an open classroom for other members of the ICT in Science eduLab Community, to collect diverse perspectives for further refinement and to encourage professional discourse amongst the community members. This partnership between TfL, lead teacher and teachers not only catalysed the adaptation of the CSI practice to unique school contexts but also grew the teachers professionally. Findings from teacher reflections demonstrated that their ICT practices became more participatory and constructivist-oriented. Teachers' professional growth was observed as an outcome in "The Competent Professional" and "The Collaborative Learner" of Teacher Growth Model (TGM), a representation of core learning areas for Singapore teachers' holistic professional development. The community leveraged strategic levelers through lead teachers to gain access to their actively participating teachers, so as to ensure the multiplication of the outcomes of the community's efforts.

4.2.1.2 Collaborative Science Inquiry (CSI) for Visible Teaching and Learning of Chemistry Concepts

In another example, CSI framework and design principles were used to deliver a systematic approach to empower high school chemistry students to visualise concepts and construct conceptual knowledge to better grasp essential yet complex concepts required for higher-order application. A CSI teaching and learning platform grounded on model-based scientific-guided inquiry with a suite of web 2.0 tools was harnessed to create a constructivist learning environment. The 5E approach (Engage, Explore, Explain, Elaborate, and Evaluate) was used to guide a sequence of learner-centred activities using collaborative working spaces, core thinking routines, and multimedia artefacts. The CSI learning environment was versatile enough to support a variety of teaching strategies and learning experiences for both self-directed learners and collaborative learners with teacher facilitation. Observations showed that the questioning pedagogy and core thinking routines were effective in

raising students' curiosity and motivating students' questioning to resolve misconceptions and deepen learning

4.2.1.3 Collaboration with a "Heart"

A biology teacher attended a CSI workshop due to the challenges she faced in teaching science. Her challenges included students' inability to apply their understanding of scientific theories to real-world situations and their inability to collaborate effectively. During the workshop, she was attracted by the practice because it was aligned to her immediate needs. The practice has a clear set of pedagogical principles infused with technology. The CSI design principles, infused with technology, and together with exemplars, provided her with clear operational guidelines for designing authentic and collaborative science inquiry-based lessons with technology. Soon after, she partnered the CSI team of officers in deep lesson co-design and used web 2.0 tools to manage students' learning and provided platforms to make her students' thinking visible. The students learnt science concepts collaboratively through a case-study approach. In a lesson on "Transport in Human—The Heart", students read and discussed an authentic case of a patient with genetic heart disease by asking questions, making observations, and doing research online. Using an online collaborative platform, the students then worked together to construct an explanation for the disease. In the course of learning, students developed a strong level of understanding through the creation of a paper heart model and digital concept maps to summarise the key concepts acquired. The misconceptions surfaced from the online discussions were useful areas for students to reflect on and for the teacher to address any gaps in learning. Through this process, the teacher embraced constructivist beliefs and organised more student-centred activities that promoted independent learning, group discussions, and student meaning-making. She believed in the potential positive influence of the use of ICT as a means to amplify her repertoire of teaching practices and to make her a more reflective practitioner.

It was envisioned that through the MOE-facilitated across-school eduLab communities, teachers could access innovative practices and community resources developed over time and connect with peers to learn from one another so as to continually improve their craft.

TfL officers handheld teachers through the eduLab communities to co-design lessons, provide mentorship, and support the adaptation of the practices. Teachers who had benefited from our professional development paid it forward through submitting lesson ideas to a repository, known as the ICT Connection, to be shared with the teaching fraternity. The ICT Connection also empowered the teachers with a rich repository of lesson resources curated by TfL. This ensured that no teacher had to start from scratch if they wanted to explore an innovative practice, as they could build on the lesson ideas and benefit from the reflections provided by other teachers on the ICT Connection. In addition, teachers built on lessons downloaded and uploaded their own adaptations for even further development by others. In the

eduLab programme, teachers put up proposals as a team of schools to pursue and push their ground-up ideas with a view for sharing across schools.

Peer learning also took place through the eduLab programme where teachers from the school with the innovation worked with teachers from other schools to translate and spread the practice. Teachers worked together to curate one another's resources and develop skills and competencies. TfL officers, as Learning Designers of eduLab projects and leads of eduLab communities, also generated knowledge and insights of the pedagogical practices through the iterative process of working with teachers.

4.3   Reflections and Implications

In the course of TfL's efforts in nurturing various eduLab communities to spread educational technology innovations, there have been several learning points, of which three of them, which affirm existing literature on CoPs, are discussed here. The first is on the role of working across organisational silos, the second on the critical role of champions in an eduLab community, and the third on the barriers and motivators in the nurturing of an eduLab community. Underscoring these learning points is the fundamental recognition that while communities are bottom-up platforms, there is need for top-down structures and designs that are iteratively designed to create champions and build capacity to spread educational technology innovations. The principle of structured informality is applied to provide structural support to facilitate an informal and iterative approach towards the nurturing of eduLab communities to spread educational technology innovations.

4.3.1   *Working Across Organisational Silos*

As TfL officers worked with teachers to develop a community, it became increasingly apparent that a community does not exist by itself. It is usually related to or linked to a wider network of communities which in some ways are related to or relevant to their practice. For example, while teachers might be members within their schools' professional learning community, they might also be members of subject chapters and other networked learning communities facilitated by other institutions or organisations. Some could possibly be members of associations and societies that steward the knowledge and craft of particular professional practices. Hence it was not uncommon for teachers to be participating members of more than one community. These connections between different communities can be interesting spaces for new learning and innovation to take place. Wenger's (1998) concept of boundary encounters, brokering, and boundary objects provides interesting insight and describes the potential to facilitate across network learning and innovation. Wenger posited that it is at these boundaries that an innovation within one

community can spread or value-add to the practice of another community. Thus, it is an important space to cultivate.

Wenger (1998) uses the terms boundary encounters, boundary objects, and brokers to describe the interactions. Boundary encounters take place when members of one community engage in activities with members of other communities. Such activities could take many different forms, such as meetings, learning journeys, or problem-solving discussions. Such boundary encounters provide rich contexts for learning with production of insights and knowledge. The outcomes of these boundary encounters could be the creation or design of new artefacts or boundary objects that become part of the practice of use in the community. Examples of such objects could be curricular resources, learning applications, tools, systems, or documents. These boundary objects co-created together through a process of participation are deemed as useful and relevant to the practice, meeting particular needs.

In light of this, a certain structured top-down support is needed to organise exploratory innovation projects that involve multiple stakeholders across organisational silos, from the onset. The cultivation of such projects mitigates the "Not Invented Here" syndrome, which often arise during the taking over of a proven-to-be-effective, but not perfect, innovation for spread. Intentionally structuring collaboration across communities facilitates a negotiation of needs, agendum, and practicalities, which will inform the development of the educational technology innovation, with a long-term view of eventual scaling up. While more complex to initiate, such projects that eventually emerge will inevitably meet the needs of the multiple stakeholders involved and have ownership and commitment from the partners.

4.3.2 Developing Community Champions

To bring about such contexts of learning at the boundary of communities would require brokering, that is, structured top-down support. The potential of new learning and innovation at such boundary encounters implies that it is important for community champions to actively and consciously look out for and design for such interaction possibilities, especially in informal settings.

Building on Simon's (1996) concept of goalless designing, Chua (2008) highlights the usefulness of adopting an attitude of openness characterised by an "opportunistic attentiveness to how new means-ends might emerge … akin to the entrepreneurial, attentive search for new business opportunities".

This point aptly describes the nature of work of community champions. Similar to how a start-up would regularly hit the road to find profitable problems to solve, community champions would regularly engage teachers to understand what the challenges on the ground are and find worthwhile problems to solve. As community champions, they are keenly attuned to not only the needs of the community members but also to new developments related to their practice, new opportunities to share their craft, as well as new developments in other communities that might be of interest to their

members. These community champions become key nodes and brokers of useful information and pedagogical support across formal and informal networks.

A community champion would likely need to have a mind-set similar to that of a start-up, where they are:

- Curious to learn
- Focus on possibilities
- Achieve breakthroughs (with negligible resources)

In the cultivation of eduLab communities, MOE HQ had appointed TfL officers to take on the role of these community champions. However, going forward, it is useful to also nurture the other members of the community, especially the teacher participants, to take on the role of community champions. Having a teacher-practitioner, rather than an officer from the HQ, championing the practices in the eduLab community adds to the sense of credibility and practicable nature of the innovations. A teacher champion will be viewed as one of their own and would be perceived to bear a more authentic and practical lens on the possibilities and challenges of the educational technology innovation. Having teacher participants emerge as champions is also an indicator of the growth and maturity of the learning community. As the mantle of community leadership is gradually transferred over to the teacher, the TfL officers can shift into the role of facilitator of learning and identify opportunities for cross-communities collaboration. The transfer of community leadership also indicates a shift from the structured to the informal, where top-down support gradually fades in favour of bottom-up efforts. This shift also points to the maturity of the eduLab community and heralds well for sustainability and scalability of the educational technology innovations.

4.3.3   Barriers and Motivators

While efforts have been made to consider how to plan and orchestrate community activities that would meet the needs and address the concerns of community members, it is also important to reflect on the barriers and motivators for members to participate. Hew and Hara (2007) conducted an empirical study to surface the key barriers and motivators for knowledge sharing in a CoP. The main motivators and barriers highlighted by the study are as follows:

- Motivators
- Collectivism—Passion and desire to improve the practice
- Personal gain [knowledge]—Stay current with the development in teaching
- Personal gain [support]—Find solutions or support for classroom challenges or problems
- Interest of the seeker—Learn new skills to improve the craft
- Environment —Safe and respectful environment
- Reciprocity—Desire to help peers and friends

- Barriers
- Lack of time
- Lack of management support
- Low awareness of activities
- Lack of incentives
- Lack of recognition

These motivators and barriers continue to serve as considerations in designing the structures and processes for teachers to participate in the eduLab communities. For instance, as a teacher's participation in the eduLab communities is kept broadly informal, the extent of time commitment a participant needs to make is managed. However, when a teacher participant contributes more to the eduLab community, such as co-designing lesson resources and co-leading professional development workshops with HQ officers, a set of recognition systems are activated. School leaders will also be involved so as to obtain school management's endorsement and support. These motivators include letters and certificates of appreciation that are sent through their school leaders. For teacher participants who go the extra mile and contribute to the growth and development of other teachers in the learning community, an official letter of acknowledgment and testimony will be sent through their school leaders. This balance between informal involvement for most members and formal recognition for specific members who contribute more to the community is consistent with the structured informality principle where top-down structures facilitate the cultivation of an organic community to spread educational technology innovations.

4.4 Conclusion

This chapter described the efforts from a central agency, like MOE HQ, to scale up effective educational technology innovations through the cultivation of eduLab communities. It highlighted the importance of top-down structures and bottom-up couplings to support and facilitate community building. While the work remains fairly nascent, there have been positive stories of teachers' learning and growth, as well as encouraging tales of partnerships across various stakeholders.

The eduLab communities ensured that the innovations from exploratory projects on educational technology were not confined within the project schools and could sustain beyond the project funding. The ultimate goal of the eduLab communities was to nurture a culture of innovative and reflective teacher practitioners. While the central agency has functioned as a catalyst to spark off a more widespread adoption and adaptation of educational technology innovations, the successful percolation of these practices across schools in the system was fundamentally dependent on teachers. The strategy of developing eduLab communities contributed to this by facilitating an interest-based sustained professional development for teachers, who will return to their schools as change agents who are connected to expertise, resources and other peers across schools in the system.

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Fei Victor Lim is Assistant Professor at the English Language and Literature Academic Group, National Institute of Education, Nanyang Technological University. Victor researches and teaches on literacy education and is interested in innovations in teaching and learning. He was Deputy Director and Lead Specialist at Educational Technology Division, Ministry of Education, when the study was conducted.

Yew Meng Kwan is Deputy Director in the Educational Technology Division, Ministry of Education, Singapore. He oversees innovation projects that look at harnessing innovative ideas from teachers and schools for meaningful teaching and learning with ICT that bring about twenty-first-century learning. His interest as an educator is in fostering communities of practice and teacher reflective practices.

Meng Leng Poh an award recipient of the Fellow of Academy of Singapore Teachers in 2015, is currently the Head of Department for ICT at Yishun Secondary School. He has been sharing innovative ICT-based pedagogical practices with teachers on a plethora of platforms since 2009. His interests lie in the use of innovative pedagogies to teach science so as to bring about active and engaged learning with application to real-life problems.

Chapter 5
Towards a Framework of Diffusing Education Innovations at Different Levels of the System

Imran Shaari, David Hung, and Yusuf Osman

Abstract This chapter delves into crafting a classification framework of different types of education innovations for diffusion at various levels of the system. Education innovations are complex, and their diffusion efforts are contingent on multiple dimensions that include teachers' capacity, students' abilities, schools' supports, expert knowledge, and the enabling system infrastructures. Existing classifications of innovations can inform the diffusion efforts, but we posit these to be insufficient in capturing the nuances of challenges in operationalising innovations in the local context. Adapting grounded approaches, this study collected qualitative data that included interviews, focus meetings, and observations, to analyse and subsequently develop a classification framework of innovation types that accounts for teachers' concerns, the learning communities' perspectives, and the enabling leverages. The classification system calls for focused roles that can be performed by the respective learning communities to diffuse the innovations at that particular level of the system which best suits the innovation.

5.1 Background

In 2013, a central agency of an education department commissioned learning communities (LCs) to "harvest" ICT education innovations [henceforth, we refer to in this chapter as "innovation(s)" interchangeably]; this was seeded through the various central agency's initiatives. It was part of a wider attempt to seed and sustain technology-mediated innovations in more classrooms and schools. The intent was to enthuse teachers across the system to "take up" the innovations by scaffolding them through workshops and other teacher professional development activities and to subsequently create a sustainable teacher-led community around these innovations.

I. Shaari (✉) · D. Hung · Y. Osman
National Institute of Education, Nanyang Technological University, Singapore, Singapore
e-mail: imran.shaari@nie.edu.sg

The aim of this chapter is to rationalise the issue of "harvesting" and to question whether LCs administered by the central agency is necessarily the *best* approach. We hypothesised, based on the observations made, that the LCs may not be able to orchestrate all the innovations efficiently from the central agency. Instead, different approaches contingent to the innovations and readiness of both the schools and teachers to adopt the innovation should be recommended.

The central agency's officers were spearheading the LCs. Their projects were funded to enhance teachers' teaching capacity and learning. This chapter discusses the initial findings with the view towards establishing a framework that helps school and education leaders understand the appropriate level of system take-up for the different types of innovations.

5.2 Diffusion of ICT Education Innovations ("Innovations")

By the "harvesting" of innovations, we mean how they can be diffused or spread. We avoid the term "scaling" because the spread of innovations is a nonmechanistic process, mitigated significantly by teacher capability (Hargreaves & Shirley, 2009). Diffusion is the process where "an innovation is communicated through certain channels over time among the members of a social system" (Rogers, 1983, p. 11). "Harvest(ing)" or the spread of innovations can be done by different members of the education ecology at various levels of the system, such as teachers, schools, and system levels.

We agree with Rogers' (1983) assertion not to assume that all innovations are equivalent units of analysis. Their characteristics may be perceived differently by individuals, affecting the innovations' diffusion rate. Rogers' work, which focuses on business-centric innovations, informs us that diffusion through LCs requires unpacking the knowledge embedded in the innovation at different levels in order to orchestrate the efforts needed.

Like Hargreaves (2003) and Chapman (2004), we also believe that education innovations can be complex to diffuse because of the need to interpret and transform subject-matter knowledge in the context of student learning. Education innovations are social in nature and dependent on teachers' capacities, students' abilities, and the availability of mediating technology (Timperley & Alton-Lee, 2008). In Shaari et al.'s (2014) project, for example, it was witnessed that schools informally classified education innovations according to the presence of different pedagogies, in order to arrive at multiple desired learning outcomes. This resulted in the adoption of diverse structures to enable work processes that linked different stakeholders. However, Shaari et al. (2014) did not account for the system perspectives of the innovations. This phenomenon raised the question of how education innovations, which are initiated by the central agency through the LCs, influence the diffusion of innovations.

In the present study, cultivating learning culture across teachers by the LCs was done through the innovations. Bruner (1996) suggests that directing the attention on

innovations may cost meaningful learning because the learners would adopt performance goals; however, it can also be an impetus for joint efforts to build community. Thus, we are postulating that LCs are necessary, but they may not always be led by the central agency in subsequent diffusion efforts, although it may be initially useful as a catalytic phenomenon.

5.3 Towards a Framework for Situating Diffusion of Innovations at Different Levels

There is a large body of research on LCs concerning classroom reform and teacher learning. These studies have experimented with LCs that are confined in classroom settings and centred on the teacher and students as the primary focus (Bielaczyc & Collins, 1999; Chan & Pang, 2006). They found that the LCs are able to address the needs of students and teachers to deal with complex issues and to figure things out in collaborations by communicating with people who have diverse ideas and sharing what they have learned with the others. The success of many LCs motivates the envisioning of how LCs can aid to spread innovations across schools (Dede, 2004; Dede & Nelson, 2005).

In this study, the LCs took charge of six different ICT-mediated innovations. The innovations focus on learning domain that includes (1) Assessment for Learning (AfL) with automated marking tools, (2) collaborative science inquiry, (3) collaborative mathematics, (4) digital games-based learning, (5) multimodal literacy, and (6) mobilised learning (Ministry of Education [MOE], n.d.-a, n.d.-b, n.d.-c). Out of the six innovations, mobilised learning and digital game-based learning can be applied to teach a variety of subjects, whereas the other four innovations are specifically for the teaching and learning of a particular subject, such as English, math or science.

5.3.1 Attributes of Innovations, Context of Diffusion, and Concerns Theory

Diffusion researchers are concerned about the issues of how to characterise innovations (Hazen, Wu, Sankar, & Jones-Farmer, 2012). Rogers (1983) proposes an approach to classifying the identifiable elements of the technology that are perceived as interrelated to the innovations. He describes the diffusion process as an "uncertainty reduction process" (p. 232) and suggests that his classification may assist in addressing the elements usually found when diffusing innovations. In turn, the reduction process helps to predict the innovations' rate of diffusion.

However, this approach is viewed as objective because it comes from the technology imperatives lens (Markus & Robey, 1988). The characteristics appear

independent of contexts of the diffusion process. In the education contexts, different stakeholders could bring with them a set of challenges to the diffusion process that will raise a variety of potential problems. In Dooley's (1999) work, for example, it was found that it is truly the teachers who impact the use of innovations in the classroom, although the diffusion process is dependent on the change in the facilitator's vision and leadership quality.

Furthermore, some scholars have emphasised the link between the characteristics of schools and the adoption of innovations. The schools that are more likely to adopt innovations are those that are wealthy and large and have change-oriented leaders. Other scholars have found that organisational autonomy, decentralised authority, staff professionalism, and features of organisational climate such as openness, trust, and free communication correlate with behaviour that encourages acceptance of innovative ideas (Deal, Meyer, & Scott, 1975).

An important aspect of diffusion is knowing how to situate the innovation for the stakeholders' local contexts. It was proposed by Hazen et al. (2012) that the characteristics of the individuals' local context would likely moderate their perceptions of the innovations and the intention to adopt. Similarly, Fuller (1969) developed the concerns theory, where she argues that each of the systems' components have concerns about the same innovations. For example, teachers are concerned about the lack of supports and influence on their teaching. School management is concerned about the implementation process. The system is concerned about the sharing of resources. Fuller's (1969), Hall and Horde's (1987), and Dooley's (1999) research revealed that concerns could change over time in a fairly predictable and developmental manner.

In our study, we believe that if we can classify the innovations according to their different concerns, we may be able to design interventions relevant for the appropriate levels of the diffusion efforts. Thus, the classifications should take into account the different concerns brought up by the LCs. By extension, the classification should also address how it may influence the system. In the next section, we lay out the methodology employed in our study before elaborating further on the ICT-mediated education innovations and the concerns interpreted from the LCs' lens.

5.4 Research Approach

We adapted Glaser and Strauss's (1967) grounded theory strategies for qualitative research because, in centralised education systems, the literature about LCs for diffusion of ICT-mediated education innovations is almost non-existent. We used the term "adapted" as opposed to "used" because unlike the purist form of grounded methodology, relevant literature assisted in informing the data collection process and analysis. For instance, Rogers' (1983) classification of innovations and literature on teachers' concern was used in framing the initial framework. Allan (2003) explains that this approach is acceptable in avoiding the tensions between case study paradigm and grounded study methodology.

Table 5.1 Describing the study's context

LCs(pseudonym)	Descriptions by the participants about the innovations (Adapted from Shaari & Osman, 2015)
MLC	Formed in 2013, a senior IO and an IO spearheaded this LC. The innovations included digital inquiry-based learning trails and outdoor learning using mobile applications to facilitate learning across contexts. The innovation component has guided field investigations. They were designed to develop students' higher-order cognitive, collaborative, and scientific skills. Learning trails that used mobile applications with location service functionality was offered to help situate students' learning in authentic settings. This was to assist in expanding students' inquiry experiences beyond classrooms. The innovations may be suitably applied to topics in schools that involve real-world contexts or data collection and outdoor or applied learning and that make use of technology
CSILC	In 2010, the innovation was funded through the National Research Foundation. It was an innovative pedagogy that used modelling and visualisation technologies to facilitate students' collaborative inquiry approach to learning science. The innovation has evolved from its original version since. Presently, the elements of the modelling can be conceptualised through the use of free and widely available technologies that have the functions to facilitate students' inquiry learning. The LC developed the stages of questions related to the model and evaluated the technologies for the lesson design. Finally, they presented the proposal to potential science teachers in helping them to address their needs
CMLC	This innovation focuses on networking classrooms by using collaborative tools that facilitate the learning of mathematics. The practice is to employ the generative design principles that focus on the four learning principles: space for play, change in agency, participation, and dynamic structure. In a structured learning environment, learners will be made aware of the boundary for learning in the collaborated spaces. The intention was to empower mathematics teachers to use existing and available technologies that will engage students to learn collaboratively. Generative design principles utilise the functions of different spaces that manifest multiple representations of teaching and learning
AMLC	The innovation's objective is to evaluate and score students' writings automatically. It is a utility tool, which can assist English teachers in overcoming issues of time, cost, and reliability in written assessments. AfL pedagogy imbued the innovation. The idea was conceived by one of the IOs because there were not many ICT-infused lessons involving the English language in the education system. Initially, the participation rate was low. In 2015, with a shift in focus from secondary to primary English, along with schools' strategic ICT direction, led by the three IOs, the participation has grown to 20–30 primary English teachers
DGBLC	The innovation focuses on leveraging learning affordances of digital games with the view to meet desired pedagogical outcomes. The innovation was crafted to explore how teachers can harness collective knowledge and experiences in using digital games for students' learning. Particularly, the innovation's objective is to help teachers implement game-based concepts into their lesson design. In essence, the innovation is a context for teachers to participate and appropriate understandings about the pedagogy afforded by digital games

(continued)

Table 5.1 (continued)

LCs(pseudonym)	Descriptions by the participants about the innovations (Adapted from Shaari & Osman, 2015)
MLLC	In 2012, a senior IO who specialises in the concepts of multimodality and systemic functional linguistics (SFL) incepted this innovation. The concepts are useful in the teaching and interpretation of visual texts. The innovation emphasises making meaning from texts, the ability to use media literacy competently, and awareness of what constitutes multi-semiotic experience. Thus, the tasks are to "help students to comprehend the meaning of the different features embedded in a text, in particular, the affordances of multimodal composition and the ideologies in which texts are a part of. The significance of helping students to access the multimodal nature of texts also implies the need to equip teachers professionally with the demands of the pedagogical knowledge and competence required of the new literacies so that they can teach their students effectively" (p. 84)

A context of study deemed important to the Ministry of Education was chosen: a partnership between a unit of the ministry and schools in the form of loose connections of six LCs were studied (see Table 5.1). The LCs were made up of innovation officers (IOs), management staff, and teachers who were interested in the innovations. The description of the study context is in Table 5.1.

In sum, the motivation was to assist teachers in enhancing students' learning through the innovations and equipping students with the necessary skills to navigate the globalised and digitalised workplaces of the future. For example, the principles of innovations were shared. Relevant practices were jointly enacted with teachers. Subsequently, we hope there will be teachers' networks formed for promoting the innovations.

5.4.1 Data Collection, Analysis, and the Validation Process

This study used qualitative data sources: 14 in-depth interviews, 8 observations, 3 publications about the innovations, and 6 reports submitted by the IOs. In developing the classifications, we specifically analysed the collected data that described the innovations. Following Glaser and Strauss's (1967) approach, the initial characterisation was not based on a preconceived theoretical framework. Rather, it was based on the general perspectives of the LCs and informed by the extant literature on innovations. The process included abstracting data that described a particular innovation, recording challenges, reading descriptions found in the ministry's in-house publications, attending workshops organised by the IOs, and talking to teachers on topics revolving around the innovations.

5.4.2 Data Analysis

Table 5.2 is an example of thematic coding, where the classification theme "technicality" was derived (see Table 5.3). First, the key points regarded as important were identified in the transcripts, and codes were assigned.

Second, the codes were analysed, and those that related to a common theme were grouped together. In the example in Table 5.2, TC_1, PDV_1, and TC_2 form the initial concept of technical complexity. Third, this concept was later merged with other similar concepts that emerged. For example, the concepts (technical complexity; , teacher concerned/perception, school capacity, system resource/capacity) are common topics in discussions of the issue about technicality of innovations that in turn formed the broader category of technicality (see Table 5.3).

In summary, the classification exercise was grounded as well as informed by the literature and the participants' prior experiences.

5.4.3 The Validation Process

To ensure consistency, the researchers discussed the descriptions of the themes internally. A senior researcher and the participants who were familiar with the study but did not take part in the first level coding would challenge the themes to be in line with the relevant literature and their experiences to validate the findings. In the focus meetings, for example, the themes were conceptualised in the PowerPoint format for presentation by the researchers. A theme-generation discussion would follow. Subsequently, groups of two to three IOs discussed the concepts analytically, enabling them to reflect deeply on the current findings. The different groups would refine their thoughts to reach agreements as they interacted with each other. If necessary, video recordings of the meetings were viewed. Additionally, participants' reflections on their involvement were used to generate reports for the management staff to validate. The emerging pattern of concerns grounded by the LCs lens is described in the following sections.

Table 5.2 An example of the thematic coding process

Id	Key point	Code
TC_1	Something we cannot control	Control factor
	Innovation growth is something difficult	Difficult innovation
TC_X	Technology prevalence that can be used	Easily available
PDV_1	Technical complexity is high; teacher practicality is low	Technical complexity
TC_2	Two levels	Levelling
	Need to use java	Programming language
…	….	….

Table 5.3 An example of the emergence of category "technicality"

Concept	Category
Technical complexity	Technicality
Teacher concern/perception	
School capacity	
System resource/capacity	

5.5 The Innovations and Its Concerns

The emerging substantive themes highlight that education innovations are complex and messy in nature, which confirms Toh, Jamaludin, Hung, and Chua's (2014) work. The IOs had concerns about the innovations' history and the issues of intellectual property. Occasionally, they had difficulties in appropriating the innovations with teachers' perceptions. They also discussed the influence of changing technology on the innovations.

5.5.1 Mobilised Learning: Its Scope and the Concern of Creating an Integrated Framework

Mobilised learning is about helping students learn in and outside of their classrooms by making use of mobile devices. The cost of mobile devices is comparatively cheaper, and schools are able to purchase them at competitive prices. Thus, a wide range of tools are available and can be used to create learning trails for different subjects that link in and outside of the classrooms. As a result, many projects that make use of mobile devices to learn in and outside of classrooms could be classified as mobilised learning. The innovation faced the challenge of collating all the projects into one integrated framework.

5.5.2 Collaborative Science Inquiry ("CSI"): The Concern of Adding Value and the Need for Technical Competency

The LC had abstracted CSI from its original context successfully. However, they faced the challenge of straddling between maintaining the innovation's affinity and historicity. Since science inquiry is already a common practice among the science educators, the LC needed to differentiate CSI in adding value to the science teachers' community. On the other hand, another innovation (i.e. Open Source Physics) is perceived as a highly specialised innovation that requires a high level of technical knowledge, thus discouraging teachers from participating.

5.5.3   Collaborative Mathematics: The Concern of Customising for Diverse Learners

It is challenging for collaborative mathematics to be appropriated to meet the needs of different abilities of students as a package, as the IOs worked closely with each teacher to appropriate the innovation to the classroom setting. The innovation faces the challenge of convincing mathematics teachers to use the online tools available, as well as helping teachers understand the approach needed to use the tools. The innovation has been developed further in modelling the Spaces, Technologies, Activities, and Representations (STAR) approach, enabling ICT integration with the lesson plan.

5.5.4   Automated Marking Tools (AMT): The Concerns of Tool-Centricness and a Change with Minimum Effect

AMT is a tool that offers spell check functionality with a higher level of accuracy than Microsoft Word's spell check. It can help teachers track grammatical errors and syntax. However, the tools are still not robust enough in helping the practice of spreading the AfL pedagogy through process writing. This innovation is practical in the sense that it helps teachers save time in marking. However, the innovation is tool-centric, thus benefitting students more than influencing change in teaching practices.

5.5.5   Digital Game-Based Learning (DGBL): The Concerns of the Traps of Origination and Mutation

DGBL faces the challenges of the trap of origination and the trap of mutation. Since the innovation was preconceived to reside in the virtual world, it faces the trap of origination if it remains in that manner. This trap inhibits the appropriation of the innovation for use in classrooms. On the other hand, appropriating the innovation too much can lead to the trap of mutation. This trap affects the innovation's identity and uniqueness. Moreover, the availability of too many games for a subject resulted in another challenge. The IOs needed to find ways to decide which games the innovation should be focusing on.

5.5.6   Multimodal Literacy: The Concerns of Its Lack of Usefulness for Examinations

Multimodal literacy helps students to understand visual texts through levels of engagement that invokes the students' emotions. The innovation can assist students in questioning the texts critically, enabling variation for teachers' adaptation. Despite the innovation's usefulness in developing media and digital literacy, the teachers are not convinced of their benefits because these skills are tested minimally in the examinations.

5.6   Characterising the Education Innovations for Different Levels of Diffusion

We seek to develop the substantive themes (the challenges and concerns) to a preliminary framework as they emerged from the LCs perceptions. The influencers include technology, teachers' perceptions, the LCs' competency, and students' capacity.

First, we compare and contrast the themes with Rogers's (1983) innovation characteristics: "relative advantage", "compatible" and "complexity". The following details are noted:

- *Relative advantage* is defined as "the degree to which an innovation is perceived as better than the idea it supersedes" (p. 15). The impact of the challenges and concerns on relative advantage is not understood.
- *Compatible* is defined as "the degree to which an innovation is perceived as consistent with existing values" (p. 15). The innovations might be compatible with existing values and pedagogy. However, they could be overwhelming for students and perceived as lacking relevance.
- *Complexity* is defined as "the degree to which an innovation is perceived as difficult to understand and use" (p. 15). The six innovations did not exist in isolation. Community building elements were part of the diffusion process. Therefore, the innovations' complexity would likely differ across social contexts, depending on peer supports.

Secondly, the outcomes of the comparisons with Roger's (1983) framework brought us to focus on the LCs' perceptions, the concerns brought up, and the different levels of stakeholders—namely, teachers, schools, and systems. To further our efforts in developing the preliminary framework, focus discussions with the participants were held in accounting for these concerns subsequently. The efforts of multiple comparative analyses are consistent with Glaser and Strauss's (1967) methodology of advancing the themes. The iterative discussions with the participants enabled us to develop the following characterisation of the education innovations that account for the concerns, grounded in their local contexts.

- *Adaptability* is the degree (from high to low) of abstraction of the innovations' design principles from their original context.
- *Technicality* is the degree (from high to low) of perceptions of the teachers' ability to use the innovations.
- *Accessibility* is the degree (from high to low) of availability of the technologies that support the use of the innovations.
- *Relevance* is the degree (from high to low) of perceptions of the innovations' ability to address teachers' immediate needs.
- *Change* is the degree (from high to low) of teaching practices promoted by the innovations that can radically change the current teaching practice.

To illustrate these characterisations, original case instantiations from which the innovation was first introduced were used. For example, since the design principles of modelling are preserved, an innovation implemented in a school in scientific modelling and visualisation is highly *adaptable*. Open Source Physics (OSP) could explain the concern of *technicality*. The technical difficulties surrounding programming simulations largely remain the prerogative of a small group of experts with the technical capability. Mobilised learning is an example of high *accessibility* because mobile devices are widely available. *Relevance* could refer to applications such as the AMT, which are of almost immediate application once introduced to teachers but perhaps oriented towards efficiency purposes. We view that if the degree of *change* is minimal (low), the innovation is less disruptive to the current teaching practices that in turn entice more teachers to try it out. If a radical overhaul of the current teaching practices is necessary, the innovations' degree of change could be high. In this situation, it may be better to diffuse the innovations at the school level because of the supports that the schools can offer. The categorisation suggests that levels of diffusion at the teachers', schools' and systems' levels are crucial in addressing the different concerns. A possible framework for situating the innovations along the categories of adaptability, technicality, accessibility, relevance, and change is shown in Table 5.4.

The degrees (high, middle and low) are not arbitrary. They were jointly formulated and refined qualitatively through discourse and dialogues between the researchers and participants over a period of 6 months. In grounded methodology, quantitative tools in determining the degrees, such as assessment rubrics, were avoided. The text in parenthesis in Table 5.4 captures the nuances of the discourse.

This classification system was then used as a foundation to discuss the LCs' perceptions about the diffusion (see Table 5.5). We discussed the details of the table with the participants to improve on the classification. In this example, DGBL is a likely fit for school-level diffusion by the LCs as it met most of the criteria required for a school diffusion-fit profile (see column 2 of the table).

Table 5.5 is not claiming that the diffusion/innovation fit can assist in diffusing innovations. Rather, it was a grounded attempt in validating the practicality of Table 5.4. Thus, it can be argued that it is to further ground the categorisation (i.e. Table 5.4) to the LCs' perceptions. In Table 5.4, the characterisations of the innovations are defined, and the degrees to which the innovations are associated with the

Table 5.4 Framework for situating the innovations

Characteristics	Levels		
	Teacher	School	System
Adaptability	*H* (less cumbersome as dealing with many stakeholders is minimal)	*M* (school has some capacity to link back to original context)	*L* (different stakeholders still intact and the system still has leverage on the stakeholders)
Technicality	*L* (pool of teachers voice out that learning curve may be steep if the innovations are too technical)	*M* (school has some capacity to assist in diffusion)	*H* (system has the resources to leverage support for the specific technical know-how)
Accessibility	*M* (depending on curriculum deliverables)	*H* (school can consolidate the prevalent technologies to support the diffusion)	*L* (if it is highly adaptable like in the use of mobile phones, no system support is required—but system support is required for rigid technology that supports the innovation)
Relevance	*H* (innovations that are of high relevance are preferred)	*L* (easier for school to push for the buy-in because school has the leverage on the teachers)	*L* (if necessary, system affordances need to be kicked in)
Change	*L* (teachers prefer incremental change to their teaching practices)	*H* (school management pedagogical leaders scaffold the implementation)	*M* (limitation for systems to change how teachers teach in the classroom, but system can influence indirectly)

Table 5.5 An example of a classification system determining diffusion fit for the innovations. This table illustrates an innovation that may be diffused through schools

School diffusion fit profile	Characteristics of innovations	ML	CSI	OSP	DGBL	AMT
M	Adaptability	H	H	L	M	N. A
M	Technicality	M	L	H	M	L
H	Accessibility	H	H	L	H	H
L	Relevance	L	M	M	L	H
H	Change	L	H	M	H	L
		3	2	0	5	1

characteristics are perceived. In comparison, Table 5.5 was used in validating whether the consolidated perceptions fit into the LCs' schematic of diffusion. For example, the DGBL's IOs concurred that pedagogical leaders' supports in scaffolding teachers at the school level are needed. Importantly, the DGBL technology should be made available to schools. The IOs' assertions were a close match with the school/diffusion-fit profile (see column 1 and column 6 of Table 5.5). While

column 1 was derived jointly by the researchers and all the participants (including the management), column 6 was validated by the DGBL LCs.

5.7 Implications for Future Research

Diffusion of education innovations continues to be a concern for school reform. The novelty of the level-diffusion framework is our contribution in this research domain. The development of the framework is still ongoing, and there is ample room for improvement. The framework now focuses on the LCs' perceptions about innovations. Future research can focus on students as the stakeholders. Additionally, quantitative instruments are currently not feasible to measure our framework. In short, the wider socio-infrastructure for the diffusion of innovations can be included in future studies. For example, the readiness of schools could be an important factor to include.

Thus, for the immediate future, it would seem appropriate to explore the development of some standard set of measurements for different probable instantiations because the diffusion/fit profiles are dynamic. Similarly, it would be important to continue work on the issues of instantiation relevant to the innovations. For example, it could be valuable to go beyond perceptions of the LCs while they were part of the central agency, perhaps by following through the innovations' development in the schools over time. Since any changes in one of the variables may shift the diffusion pattern, the findings from this future study could be integrated into enhancing the operationalisation of the framework.

5.8 Conclusion and Implications for LCs as Diffusion Practitioners

It is clear that diffusion can occur from teachers, schools and system levels. The innovations' inherent nature requires the LCs to resituate to play specific roles at these levels. For school-level diffusion, there is a need for firm support from the school leadership to encourage the sustainability of the innovations.

Highly relevant innovations can be more easily diffused at the teacher level because they have the potential to increase teachers' efficiency. LCs' supports through conducting professional development (PD) courses are envisaged. For instance, they can assist in integrating relevant ICT tools with the courses.

In other instances, an innovation such as mobilised learning can be diffused from school level rather than the system level. The sociotechnical supports should be available at the schools. From our analysis, at this juncture, OSP may be best situated at system levels because of the difficulty of teacher and school appropriations.

The teacher-led, school-led and system-led diffusions call for distinct roles—albeit recognising the possibility of overlaps—in which the LCs can contribute further. Figure 5.1 illustrates the LCs' changing roles. In summary, we envisage agile LCs that can reappropriate their roles to sync with the innovations profiles and levels of diffusion. Future research could address a variety of issues, ranging from testing the validity of the diffusion-fit profiles to extending the classification concepts to encompass broader innovation types at a more refined level such as students' outcomes. The following sections discuss further the changing roles of LCs.

5.8.1 Considerations in Formulating Policy for Levels of Diffusion

For now, the subsequent recommendations are likely relevant for instantiation where the LCs' perceptions have influenced the innovations. In formulating policy for levels of diffusion, the following aspects might need to be considered first.

Teacher level diffusion aspects:

- Teachers could easily pick up materials on the innovation from an online repository of innovation-related practices. These materials should be regularly updated to remain relevant.
- The innovations would likely meet teachers' immediate teaching needs. The teachers know about the details of the innovations but may need encouragement to adopt them.
- The teachers are aware that the technologies that support the innovations are prevalent.
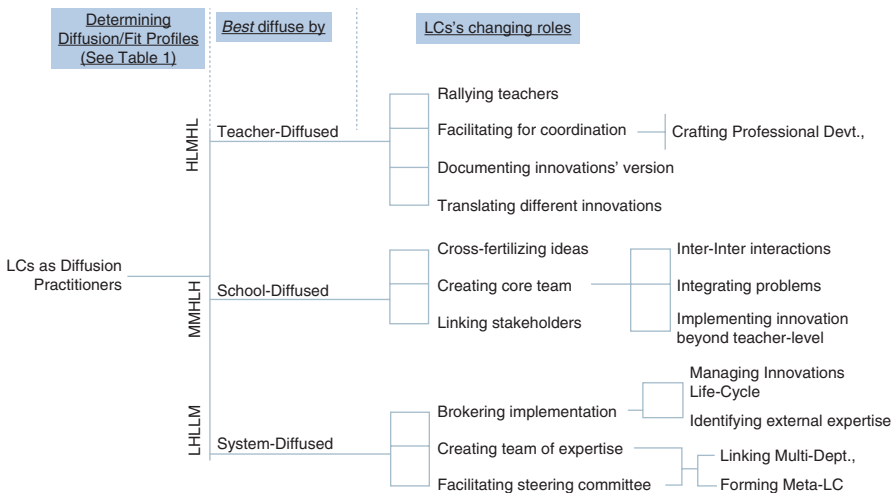
Fig. 5.1 LCs' changing roles for diffusion

- The teachers can take up the innovations with ease, with support such as PD conducted by the LCs.
- The LCs can help to infuse the innovations into teachers' PD courses.
- There are possibilities that teacher training institutions can assist by including the innovations in their teaching modules.
- Schools can take a hands-off approach to encouraging teachers to take up the innovations.

For teacher level diffusion, the LCs can play a central role in rallying the teachers together. They can gather teachers on a platform such as conferences, where teacher-to-teacher interactions can happen to share ideas. The LCs could harmonise the ideas into coherent packages for the purposes of integrating the innovations into their lessons and ensuring that the innovations' principles are adhered. The teachers might want to implement them independently. The LCs can adopt a hands-off approach and offer administrative support in planning and executing the innovation in their lessons. The teachers are expected to tap into their schools' resources to help them with the customisation and adaptation of the innovations, enabling modification for different usage. LCs should document these adaptations for enhancements. To do so, the LCs must be able to translate the adaptations for the benefit of other teachers by accounting for the different contexts. It is important to note that the divergence of teachers' interests can endanger diffusion efforts. Through intensive communication, strong personal commitment, and frequent interactions, the LCs can build an informal learning network of teachers, with the view to deepen laterality so that the teachers can move beyond their divergent interests to encompass improvement to their pedagogical practices.

School-level diffusion aspects:

- Schools to create activities in enhancing the innovations.
- Schools to adopt principles that can transcend across the curriculum.
- School to decide the innovations' relevance to the schools' vision and mission.
- Schools have the capacity to create provisions for personalised scaffolding.
- LCs can consolidate the different uses of the innovations from the schools in a knowledge database.

For school-level diffusion, the LCs can play a central role in cross-fertilising the ideas across schools. The LCs can form a core team of key decision-makers with the schools who are willing to meet regularly, so as to direct its efforts. In contrast to the teacher level diffusion, this approach should aim for a higher intensity of interlocal interactions and a more integrated problem solution across schools. Preferably, the core team should consist of the LCs' leaders or lead specialists, Heads of Department (HODs) and experienced teachers. We have seen the benefit of involving external consultants to bring fresh ideas and act as mediators. The core team can maintain the integrity of the key tenets of the innovations throughout the entire diffusion process. Essentially, the core team assumes the role of a champion resource but has the directive authority to enforce the innovations' principles beyond the teacher level. Importantly, the core team must be better prepared to resolve teachers'

diverging interests and be able to translate between different cognitive contexts. The core team should also be able to address problems on a more integrative level, offering solutions beyond the predefined principles, and with the help of pedagogical specialists if necessary. In essence, the boundary of the core team can be expanded and shrunk according to the complexity of the tasks. Connections among the LCs' management, core team supervisors, and school leaders are critical to ensuring the diffusions are successful. They can assist in coordinating the allocation of resources and addressing conflicting responsibilities.

System-level diffusion aspects:

- The system can sustain the innovations' original contexts and sociotechnical affordances.
- The system can create formal links to the original resources.
- The system can link the different dimensions of the innovations.
- The system can coordinate functional units to extend the innovations' principles.
- The system has the resources to shorten the time needed to diffuse the innovations.
- The system can facilitate consistent contact with the innovation creators for consultation purposes.
- The system can link the LCs to the larger community of experts to broaden their resources.
- The system should enable collaboration across schools to discover ways to address new challenges.
- The system can create meta-community to discuss appropriation of the innovations.

For this diffusion level, the LCs can play a role in brokering agreements. The LCs can form a centralised team of expertise with teaching units in the system. The team of different experts is necessary to help in diffusion efforts because schools may not have all the resources to do so by themselves, whereas the system may not have the influence to assert the change effectively. The characteristics of the innovations, the complexity of coordinating the resources, and the demand for highly intense interactions for integration into the system level necessitate the LCs to negotiate an intricate web of idea generation, boundary marking, and compromises. Agile LCs are proposed to help in ensuring that the efforts by the multi-departments, schools, and teachers remain coordinated. The LCs must be able to play coordinator roles to more complex roles such as a specialist. An influential steering committee should be established to support the LCs in the form of meta-LCs, comprising of past members and experienced supervisors. The meta-LCs can enable unrestrictive cooperation of members to overcome challenges manifested from the interests of teachers, schools, and the system.

In our study, the innovations were developed with a few specialised schools. The central agency supported the projects. The LCs were the system initiative to be used as a vehicle for the diffusion. It would be instructive to investigate the LCs and system perceptions on school-initiated innovations in enhancing the framework.

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Imran Shaari is Research Scientist at the Office of Education Research, National Institute of
Education, Singapore. His research interests are partnership in schools, network of schools, com-
munity of practices and the lateral and horizontal diffusion of innovations.

David Hung is a Dean of Education Research at the National Institute of Education, Singapore.
He has served as Contributing Editor and Associate Editor for several well-read international aca-
demic publications in the learning sciences field and appointed as journal reviewer for various
well-established international academic journals. His research interests are in learning and instruc-
tional technologies; constructivism, in particular, social constructivism; social cultural orientations
to cognition; and communities of practice.

Yusuf Osman is a Research Assistant at Office of Education Research, National Institute of
Education, Singapore. He received his Honours degree in Sociology at the National University of
Singapore. His research focuses on partnerships, communities of practices and learning
communities.

Chapter 6
Community-Based Design Research to Sustain Classroom Innovation with ICT

Chew Lee Teo

Abstract For any partnership between learning scientist and school to impact practice, there is a need to expand the current repertoire of design research so that research development can be organised to engineer new forms of learning as well as the system and organisational structure surrounding it (Penuel W, Spillane JP, The Cambridge handbook of the learning sciences. Cambridge University Press, New York, 2014). The knowledge-building initiative in this chapter describes an attempt to expand the variables of the design research for "codesigning" and "co-creation" of the practice, structures, and processes to take place so as to shape and sustain the innovation. Particular emphasis is placed on supporting multiple interactions among stakeholders to allow for contextualised insights to be derived to deepen the innovative practices, impact students' learning, and increase the ownership of the innovation. This initiative spans across 7 years and has grown steadily from two schools to the current ten schools, with one of the schools having embarked on the journey of implementing whole-school integration since 2016. This chapter describes the implementation journey (including a case study) from the researcher's lens. The analyses informed the design considerations at the student-teacher-classroom level and school leadership levels while being cognizant with how the innovation fits within other educational initiatives such as technological integration, curricula coverage, and assessment demand.

6.1   Introduction

This chapter describes a partnership initiative in advancing knowledge-building (KB) practice and technology in Singapore classrooms. This partnership began by supporting schools in creating localised models of KB practice through an intensive codesigning effort with teachers and then moving on to build a network of schools to sustain quality KB practices. We present snapshots of the partnership and the

C. L. Teo (✉)
National Institute of Education, Nanyang Technological University, Singapore, Singapore
e-mail: chewlee.teo@nie.edu.sg

considerations taken to ensure the approach remains sound and rigorous, so as to impact students' learning.

Knowledge building has been defined as "the production and continual improvement of ideas of value to a community, through means that increase the likelihood that what the community accomplishes will be greater than the sum of individual contributions and part of broader cultural efforts" (Scardamalia & Bereiter, 2003, p. 1370). Knowledge-building practice places students' ideas at the centre of the classroom enterprise; 12 knowledge-building principles (Scardamalia, 2002) characterise the complex, interactive system that makes it possible to keep those ideas on a continual improvement trajectory. Knowledge building is represented in the *Cambridge Handbook of the Learning Sciences* as one of five foundational approaches within the learning sciences.

6.2 Tensions of Implementation

We started our journey on KB practice in the Singapore classroom wanting to foster a knowledge-building culture and maintain a close fidelity to KB principles, pedagogy, and technology inherited from the North America research. Many local educators have, with all good intention, advised against that. They felt that given the challenge and culture of a regular classroom in Singapore, the way for knowledge building to work here is likely to blend it into current practice and adopt what is most useful.

Amidst the concerns raised of implementing KB in Singapore, we decided to start small but continue to focus on translating complex learning science theories into classroom practice and on allowing local communities to see the possibility of a knowledge-building community in action. The lead researcher in this initiative had an immersive experience in the KB hub school in Toronto, and so the team was able to project a vision of KB classroom-in-action in a local context. We reviewed past KB initiatives in Singapore and tried to understand the inherent tensions in introducing KB practice to Singapore schools and teachers. Adapting from Knapp's (2008) frame on learning organisations, we analyse the intrinsic tensions from the current context:

1. *Principle-based practice in practice*. Pursuing principle-based KB practice is deemed to be a lofty educational goal. These were two dilemmas we faced: (i) how much to downplay the theory of an idea-centred classroom? At each KB presentation to teachers and school leaders, we would almost feel apologetic for the need to talk about KB principles. However, as the practice in various sites matured, we realised that the schools which continued to deepen and sustain the practice were those who kept bringing back the principles. (ii) We were often criticised for the lack of clarity in the "what" of KB practice. We struggled to deliver a "quick-fix guide" for fear of boxing KB classrooms into steps and

procedures. We will describe our journey in navigating between principle-based and procedural-based practice in later sections.

2. *Multiple and competing educational agendas.* "…that KB is not at all critical [in school]" was mentioned by one of our most supportive principals while trying to explain to us KB practice in relation to many other programmes in school. This statement defines a common challenge the KB initiative faced as an instructional reform in our system. It stood in the midst of many other agendas, such as the twenty-first-century competencies, professional learning community, and students' literacies. How well KB practice survived in schools and within the ecosystem depended on how well we presented it as a "programme" that could amalgamate multiple agendas.

3. *Understanding new tasks required of KB practice within current structures and routines.* In a high-achieving and coordinated system such as Singapore, there exists strong administration support and established curriculum, assessment practices, and teachers' development. This abundance phenomenon presents a double-edged situation; on the one hand, teachers seemed unfazed by the new vocabulary. On the other hand, it is difficult to challenge the current notion of "what works" to embrace the notion of "beyond best practice". The biblical reference that "no one sews a patch of unshrunk cloth on an old garment, if he does, the new piece will pull away from the old, and a worse tear will result" becomes vivid in this tension. We observed that those who started off recognising the difference in KB pedagogy and technology experienced more success in designing an authentic KB experience than those who said, "That is what we have been doing".

4. *Extensive research information but limited practice information on KB in the local context.* Although the impact of KB theories, pedagogy, and technology on students' cognition and development has long been established as a worthy ground for educational reform, it has received diverse comments from practitioners for its theoretical and abstract nature. The lack of localised professional development events, resources, and practical examples of KB practice created an impression that there are many unanswered questions about KB practice in action. The need for teachers and schools to own the process of recreating the principle-based practice in their school did not help the situation. We knew our localised resources were thin.

6.3   Implementation and Enactment

In reviewing the tensions of designing a KB initiative that involved extensive pedagogy and technological innovation, we needed an implementation plan that projected beyond the current state of affairs and considered structures and process which allowed for scaling. We had to project beyond what works for our students now to what works best. Some form of theorisation was required. Thus we proposed a design experiment as an implementation approach for this work (see Fig. 6.1).
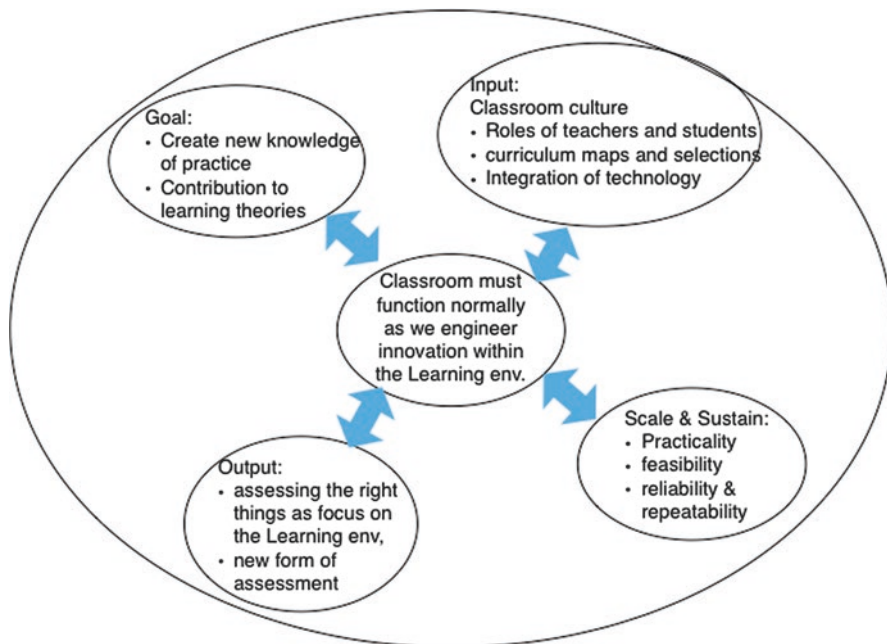
Fig. 6.1 Central ideas of a design experiment in class that governs the way researcher interacts with teacher and students in a class

6.3.1 Design Experiment Setting the Backdrop in Which Different Interactions Were Influenced Within the School Ecology

We unpacked the different design experiments for deepening and sustaining KB with different communities in the school (Brown, 1992; Collins, Joseph & Bielaczyc, 2004; Penuel & Spillane, 2014; Plomp & Nieveen, 2007). We envisioned different design experiments layering in. We unpacked the considerations within each design experiment that influenced the way we engaged heads of departments (HODs) (see Fig. 6.2) and school leaders (SLs) (see Fig. 6.3) in understanding the practice. The HODs and SLs were not just seen as support; they were involved in similar engagements as with the teachers but of a different nature in terms of the practice, e.g. setting directions and setting up processes and structures.
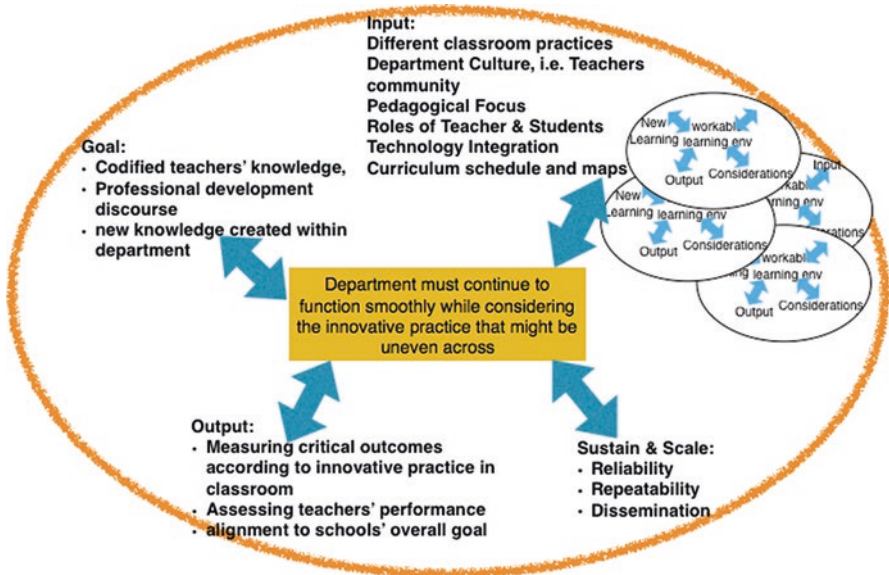
Fig. 6.2 Central ideas of a design experiment in a department that governs the way researcher interacts with HOD and teachers in that department
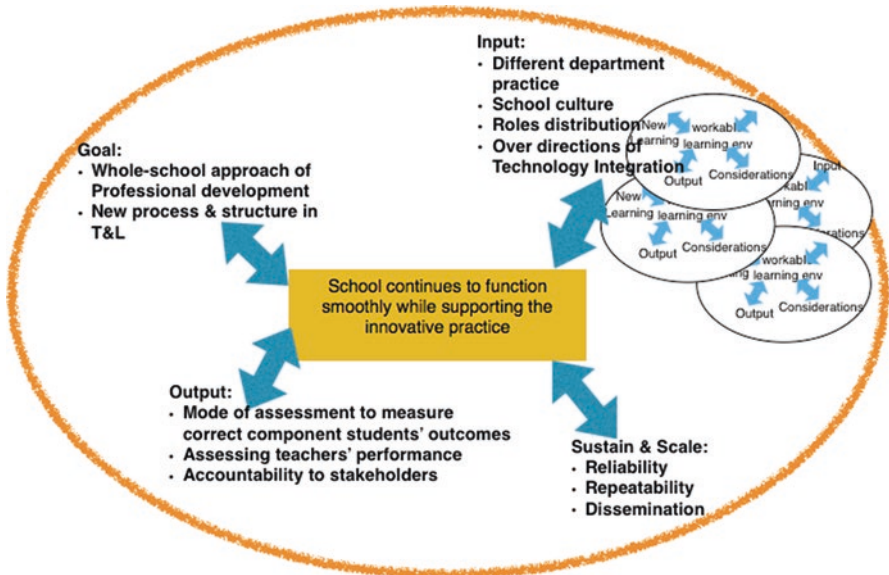
Fig. 6.3 Central ideas of a design experiment in a school that governs the way researcher interacts with school leaders

Table 6.1 Mapping of KB principles into design and strategies adopted in practice and the kinds of interactions that support such practice

Selected KB principles that shaped the practice and interactions	Principle-based practice: design and strategies	Interactions in partnership: principle-based innovation
Real ideas and authentic problems	*Classroom practice*: Teacher and students identify problems that arise from their efforts to understand the world and pursue sustained creative work surrounding them	In the partnership, we provided insights from data derived from practices across different classrooms, and these were shared with the teachers as often as possible (even if analysis is not complete). This allowed teachers to see an added perspective of their practice and experience an evidence-based design process. Such moves served to help teachers break away from their comfort zone and provide them some level of quality assurance of what they were doing to move along with the lesson design
	Teacher's practice in deepening classroom practice: Teachers review real challenges and issues they encountered in their class and define the impact they want to have on their students' learning experience according to what they understand of KB practice	
Improvable ideas	*Classroom practice*: Students' ideas (questions, information, observation, etc.) are treated as improvable rather than simply accepted or rejected. Teacher and students work continuously to improve coherence and utility of ideas	In the partnership, we worked with the teacher lead and head of department to make sense of curricular requirements and worked out space for teachers to have autonomy in achieving the curricular requirement. For example, we worked with a teacher lead to get teachers to knowledge-build online about the curriculum topic on light and heat energy. They explored questions about the content and thinking process surrounding the topic, as well as the ways to cover these topics meaningfully. This exercise served to support teachers in taking greater ownership of their practice
	Teacher's practice in (re)designing curriculum: Teachers see curriculum as a way to integrate students' ideas to support an innovative and novel approach for quality teaching and learning to happen	

Table 6.1 (continued)

Selected KB principles that shaped the practice and interactions	Principle-based practice: design and strategies	Interactions in partnership: principle-based innovation
Embedded and transformative assessment	*Classroom practice*: Assessment is integral to knowledge building and helps teacher and students to advance knowledge through identifying advances, problems, and gaps as work proceeds	We challenged teachers to design the learning environment by reflecting on the KB principles. We challenged them about alignment to learning objectives to both process and content knowledge
	Teacher's practice – shaping and defining the practice: Teacher adopts and uses KB pedagogy and technology within a real classroom context, prioritising smooth running of lessons within existing structure. They identify, collect, and analyse students' learning artefacts to understand practice and its impact	
Symmetrical knowledge advancement	*Classroom practice*: Expertise is distributed within and between teacher and students, with knowledge exchange and co-construction reflecting the understanding that "to give knowledge is to get knowledge"	We refrained from providing lesson plans and ready resources to the teachers. Most resources shared were adopted from other classes, and thus teachers who were using these supports understood that they had to use it accordingly to the way their students responded to the activities
	Teacher's practice – professional learning community: Teachers create professional development artefacts from their' own implementation (individual KB stories), especially among the early adopters; teachers demonstrate possibilities and feasibilities of the practice in a local context	
Rise above	*Classroom practice*: Teacher and students work with diverse ideas in complex problem spaces; they work towards more key ideas, concepts, and higher formulations of problems	We supported teachers in archiving their design and enactment of classroom practice and worked with them to synthesise these practices into patterns and trends of pedagogical models
	Teacher's practice – making sense and creating new knowledge about the practice: Teachers are encouraged to see beyond operational challenges, hick-ups, and avoid oversimplifications of what knowledge-building practice entails, and move towards generating key ideas and higher-order questions about the practice	

6.3.2   Designing the Principle-Based Approach

Throughout the implementation, we were deliberate in modelling principle-based practices and in ensuring that the activities and interactions happening in our communities demonstrated the KB principles (Table 6.1). The overarching principle that guided our work was that of *symmetrical knowledge advancement* throughout the school ecosystem. This symmetry was two-fold: First, it was for researchers to immerse themselves in an authentic practice environment of teachers and to be part of the community's effort to engineer innovative practices in view of every challenge of a teacher's daily life in the classroom, with no one part of the classroom treated in isolation. In this way, we could understand the practice, value the effort, and use the practice and evidence as the basis for building a coalition to transform other classrooms. Second, it was to ensure the partnership maintained its focus on deepening KB classroom practice and served to provide classroom-based evidence for school leaders and middle management to decide how and when they wanted to scale the practice.

6.3.3   Creating a Value Proposition for the Practice by Highlighting the Emergent Nature of Knowledge-Building Practice

KB pedagogy requires teachers to shift from adopting procedures to translating principles into their practice. What does this look like in practice? First, we tried to understand the emergent nature of KB practice. Any particular activity in a KB classroom taken in isolation might look identical to any other classroom, didactic or otherwise. For example, students testing a hypothesis through experimentation in a science laboratory could occur in either a KB or didactic classroom, depending on what led to that experiment being conducted in class. Was it driven by students' exploration, or was it based on teachers' need to check the experiment as done according to the stipulated, subject instructional objectives (SIOs)?

This also means that KB teachers need to, on a regular basis, discuss and express the rationale behind their classroom activities more than what they are currently doing. We need KB teachers to reveal their explicit theories of action and reflect on their implicit theories underlying those actions (Argyris & Schön, 1996), be it in teachers' meetings, discussions on lesson ideas, responses to classroom events, and so forth. When teachers were provided opportunities to run through detailed accounts of teaching and learning activities based on real students' artefacts and not inferred from their impression of what had taken place in class, we addressed the immediacy and ongoing nature of teachers' work as the action unfolds.

This is evident in these two snippets of a teacher's narrative that allowed her to challenge her own assumptions:

Because you are so used to using the teacher's guide when you plan your lesson plans and things like that. So you are very dependent on the teacher's guide given to you. And that was a very big challenge to me because I wasn't a BT (Beginning Teacher) when I started on knowledge-building practice. I was already considered as an experienced officer. So the fact that I had a teacher's guide in front of me but I don't really, you know right need to follow it because I'm supposed to use my students' ideas to come up with the lessons. That was a very difficult thing to do because I had to let go of something in order to be able to grab something. That was one big challenge but I think, I think I learned to let go of it slowly.

…we moved away from literally sticking to the teacher's guide from point 1 point 2 point 3 SIO 1 2 3 4 you must complete this for this lesson. And the magic about KB is when you end the entire theme of it, the entire topic, you would still finish all the SIOs you want to accomplish in the actual teacher's guide.

6.3.4   Engaging Teachers in Authentic KB

KB practice requires teachers to experience symmetry in knowledge building through the discussion and exchange of ideas. One example is a teacher who gains "a deeper understanding of photosynthesis and of why plants turn different colours through her involvement in the students' inquiries" (Scardamalia, 2002, p. 16). Teachers construct and explore their teaching problems as would their students in a KB lesson. The teachers in this study created and shared new knowledge about the practice in the form of teachers' KB data story and studying and analysing students' learning artefacts in their practice. Their knowledge about the practice and the content is refined and transformed through collaboration and discussion which subsequently translated into expertise and competencies for themselves within their community. Below is a snippet of a teacher reflecting on how the community has helped her refine her practice.

And then we saw how the different teachers actually conducted KB in their own classroom. Like bio[logy] strictly follow "no questions asked (by teachers)" that kind of thing, chemistry I think (student E) he had asked a few leading questions, and I think physics was also that way. But I thought that, although people will say 'how can you ask questions, you shouldn't be asking questions', but I felt that it was interesting because then the students' responses in that sense was kind of like a reference, so there was more structure in their KB approach. So I learnt, I mean I learnt different approaches when I saw all the three different subjects coming in and I think it's very interesting, I think that if we had like a KB PLT, I think we can learn more from different teachers because no teacher is alike in his or her approach. So as much as I can take a 100% KB thing and I can learn the 12 KB ground rules and all that, but as a teacher, my facilitation style will be very different from yours. And I think I can learn more from you.

6.3.5   Teachers Reflect on Their Trajectory

Teachers reviewed how their roles in class affected their engagement in communal discourse and the kind of knowledge they finally employed in their practice, as seen in the following snippet of a teacher's individual reflection.

When I started off KB, I can see that I have become…I'm not really the main person in the classroom. It is more of the child, the children are the main people the, there's so much they can learn from the other child. So I'm just a facilitator, I've become a facilitator. Previously, I'm a facilitator cum teacher cum you know I give a lot of information and things like that but now I, I give minimal information you know to the kids. They start to be able to catch from another child; build on another child. So that is, it has taken a very big shift. KB has taken a very big shift.

6.3.6   Co-Constructing the Knowledge of Practice

KB practice requires teachers to generate opportunistic and inventive procedures derived from the KB principles, a defining characteristic of the practice. In this project, teachers developed an understanding of a set of KB principles, and through teachers' efforts to apply these principles to their practice, we began to make sense of KB practice in Singapore classrooms. Teachers in these classrooms have to continually redesign activities and reformulate classroom procedures so as to support idea advancement (Scardamalia & Bereiter, 2006). It is important for them to be part of the effort in defining the practice cycle defining both teacher's and students' roles so that they could iterate with clear intention but at the same time allowing space for which to respond to new and unknown responses from students. Figure 6.4 represents the original phases of KB practice that sketched students' and teacher's roles in a KB classroom which has been continuously unpacked and simplified by teachers. Figure 6.5 shows an adopted frame designed by a KB teacher (Chan & Teo, 2017). Despite the initial positive reaction to the pedagogical frame, readers should not be surprised that it is the least referred to document in all the KB schools.

6.3.7   Teachers Evaluating the Impact of Practice

Finally, if we trust that the KB process changes the learning experience of our students and that it is not just an abstract learning theory, we would also trust the process of teachers' figuring out ways to consolidate the impact of KB practice so that they can move the innovation forward. Here we encouraged KB teachers to engage in their internal assessment and define their desired impact (refer to teacher's KB data story in Fig. 6.6). We posit that this would be more fine-tuned than any form of external assessment. It would also serve to increase teachers' ownership of their innovative practice. Some questions that we have used to help teachers identify and design ways to assess the impact of KB practice on their students are: Am I assessing beyond students' ability to state facts and apply some principles to answer questions? Do I emphasise students applying knowledge to a real-world context? Do I focus on assessment tasks that are integrative to my students' learning experience, such as investigations, reports, presentations, creative work, and other knowledge products? In the following snippet, we will read how a KB teacher developed
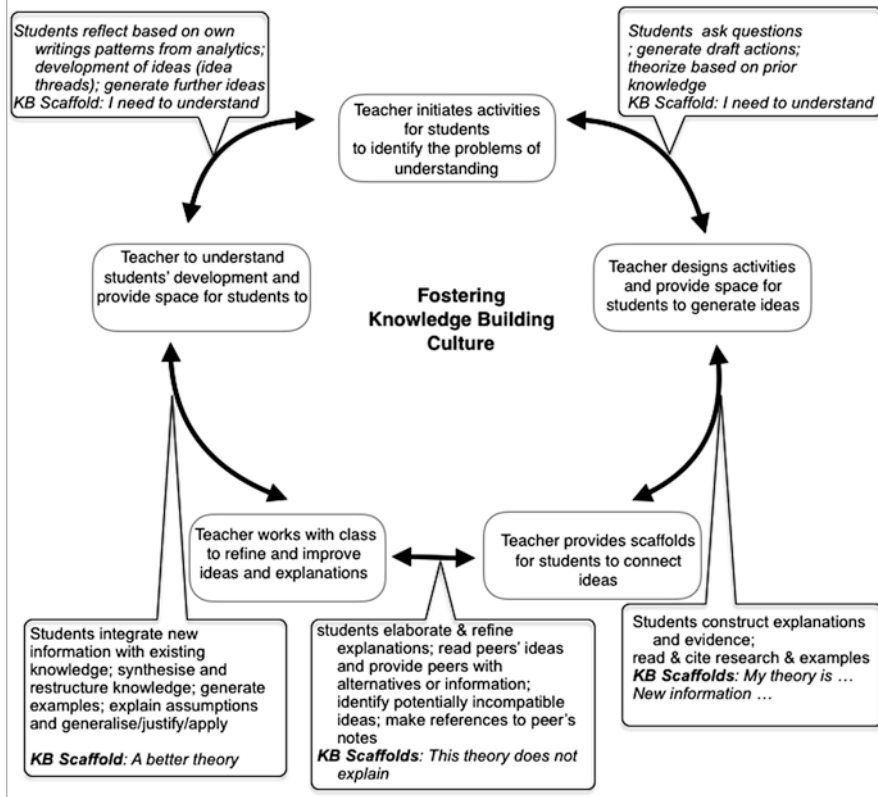
Fig. 6.4 Phases of KB practice defining the active role played by both teacher and students in class

Inquiry process defined in Syllabus	Sparking Curiosity		Gathering Evidence and Exercising Reasoning		Reflective Thinking
Teacher's pedagogical move	Start: Design for students to surface current/ intuitive understanding to the issue or theme	Seek: Design for students to formulate ideas/ questions relating to the issue or theme.	Spark: Design for students to read, exchange and craft online comments.	Stretch: Design for students to synthesize ideas based on peers' suggestions and craft "a better theory" note.	Scale: Design for students to reflect on their ways of learning and/ways of thinking
KB Activities designed by the teacher

(Stage 1: Pre-1819 Singapore) | Teacher facilitates whole class discussion through a class mind-map recording students' initial idea of Pre-1819 Singapore | Students post initial questions about pre-1819 Singapore. Next, there will be a whole-class discussion in deciding the overarching inquiry question. | Students, in pair, craft their initial stand to the overarching inquiry question then they read and comment on their peers' notes (using KF scaffolds).

The comments can be a disagreement, suggestions or areas of concern. | Students, in pair, review peers' comments.

They then make reference to these comments and synthesize information to formulate a "better theory" (KF scaffold) to the overarching inquiry question. | Students reflect on how they derive at the enhanced theory (KF notes).

They weigh which is the best enhanced theory. Teacher show students' historical growth through the KF analytical tools and observations. |

Fig. 6.5 Phases of KB practice defining the active role played by both teacher and students in class, contextualising to the pedagogy approach in the curriculum document. (Chan & Teo, 2017)
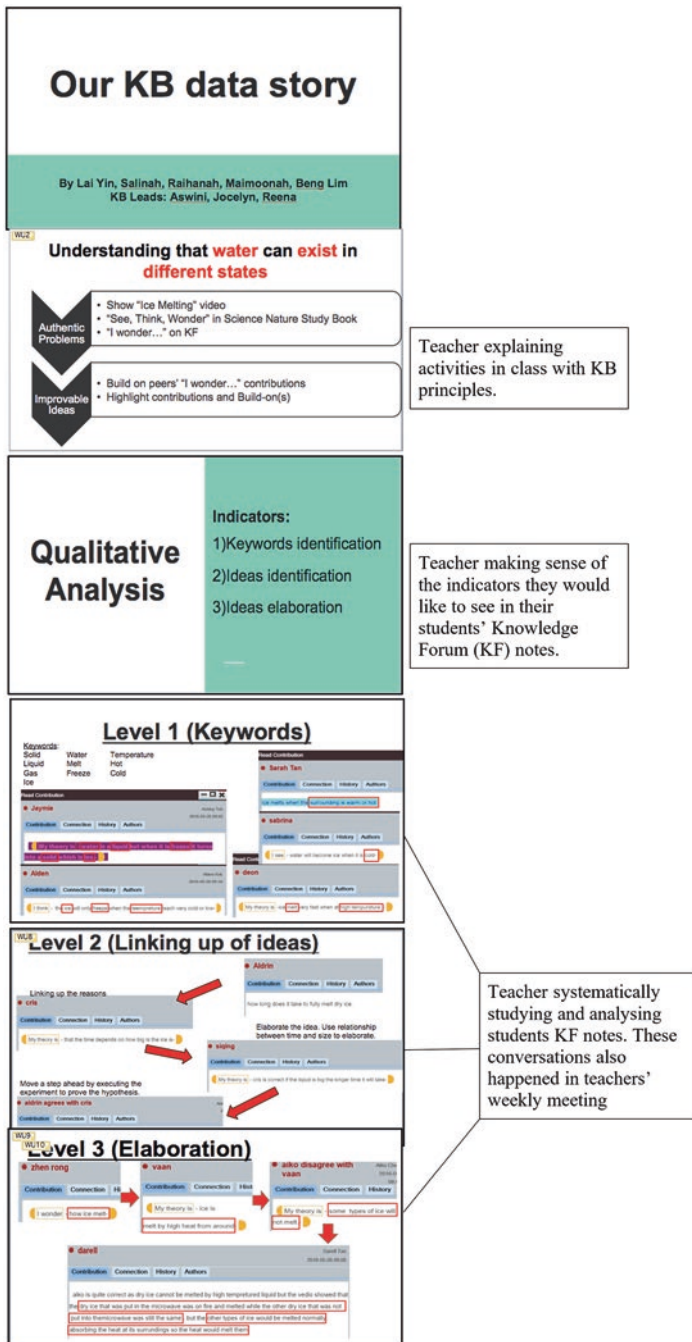
Fig. 6.6 Snapshots of teachers' KB data story

competencies to assess students' engagement in her lesson through the identification of promising ideas framed in relation to her intended goal of "The possibility of students curating their learning, be it as individuals or as a collective group" (lifted from the teacher's journal).

> I was curious and heartened at the same time to note the difference in the promising ideas identified between class 6/8 (Community A) and class 6/9 (Community B). Curious as to what could have influenced that difference? Was it the students' experience or level of thinking? Heartened as students had shown growth and progression in their discussions and thought processes. They took charge of their learning.

6.4   A School's KB Journey

We narrate an implementation journey that contextualises the considerations of the tensions and the design principles in practice. This narrative reflects the partnership from the researcher's lens more so than the school's lens.

We started the KB initiative in a secondary school as a small-scale project with just the science head of department and one science teacher assigned to work with the researcher (minimally two participants to assimilate a "community" at work). We worked closely with a secondary one class. The school viewed KB as more of an exploration of an innovative practice, and KB was just one of the many innovations adopted by the school. The researcher worked this perspective to our advantage by focusing the partnership on archiving the development and evolution of an idea-centred classroom from both teacher's and students' perspective. We explained how we could analyse students' notes to show students' development of subject-disciplinary thinking and twenty-first-century competencies and how we would track the school-based results; however, we would not be able to show direct impact within a short time. The intention at this stage was to create quality KB practice in the local context; we were not thinking about scaling and sustaining the practice.

The team worked closely with the teacher, corresponded online almost every other day, and traced the teacher's thinking as well as the ways in which the teacher acted out the lessons to capture the emergent nature of KB practice. We carefully archived both digital and non-digital teaching artefacts as well as students' notes to allow the teacher to practice evidence-based reflection. We were confident that the students' thinking captured as online notes on KB technology would influence the teacher in the way she understands her class. We knew we were on the right track when our teacher exclaimed at one of the meetings, "I never knew my students could think this way!" We termed this "aha" moment of the teacher's KB practice.

As the work with the teacher continued, the researchers met with the school leaders regularly and discussed progress reports in three areas: (i) quality of discourse in teachers' community on KB practice, (ii) teachers' pedagogical innovation, and (iii) students' development of scientific literacy and knowledge-building competencies. School leaders were sometimes engaged in discussions on details of students' posts on Knowledge Forum (KF). This reporting process allowed school leaders to have

an increasingly clearer vision of an idea-centred KB classroom as well as the design process entailed in creating such a classroom.

After 1 year of partnership, we cocreated the localised picture of KB practice in the school with the lead teacher and head of department. We invited all teachers involved to sit in to our presentation to the school team (the teachers, the heads, and the school leaders). We also explained the process in which the teacher accessed students' thinking – as represented by the ideas and questions students put up on the online KF – as well as how the teacher was responding more accurately to students' trajectory of learning. The teacher and HOD came in at different points of the presentation to elaborate with their unique experience and expertise. We were given the chance to use these findings to redesign the discussion happening in the school Professional Learning Team (PLT) weekly meeting.

The snapshots of students' outcome presented to the schools were rather impactful. More importantly, the increased engagement of students during KB lessons (triangulated by personal and informal observations of students in these classes) was sufficient reason for the school to look into integrating KB work into a Professional Learning Team (PLT). With the formation of a KB PLT, the number of teachers exploring the practice increased from two to eight. The researcher continued to engage teachers in making sense of the technical analytics and got the teachers to correlate the analysis to their practice (e.g. when the scaffold trackers on KF showed that the class did not use the scaffold "I need to understand" but the KF view was densely populated with students' explanations, the teacher suddenly realised that she was actually covering syllabus more than encouraging authentic inquiry).

In the following year, we continued to focus on getting teachers to create authentic KB experiences for students. This allowed us to present an increasingly clearer picture of students' outcomes at each progress report. The progress report includes two parts: (i) descriptions of teachers' pedagogical innovation in practice and (ii) analysis of data (such as learning artefacts and students' notes on KF) to show the evidence of KB on students' learning and development of the twenty-first-century competencies. There were also shifts happening across schools (e.g. a significant number of students who experienced the KB approach in elective subjects quickly opted for the same topic in secondary three). Students prompted other subject teachers to think about adopting the KB approach in their respective subjects when the students shared about their KB experience at the school's annual learning festival. Two other departments, Humanities and English, then decided to form a PLT to explore KB practice in the following year.

Over the next 1 year, the school expanded to three departments embarking on the KB journey. We provided just-in-time support for the two new departments and encouraged cross-department interaction. We were also intentional in remaining focused on codesigning KB practice with lead KB teachers and analysing the practice and the outcomes accordingly. This ensured that there was a strong "referenced" model in the school which remained genuine and robust to students' interest and learning. All design and enactment of KB classrooms were archived online for reflection purposes. Heads of departments and school leaders saw the excitement among students in these classes and started forming Professional Learning Teams

for groups of teachers to learn about the practice from the lead KB teacher. Due to the nature of the collaboration which focused on development and enacting, we did not conduct comparative studies to show the difference between the classes on KB and KB technology versus the classes which were not on KB and KB technology. However, the school was convinced of the way knowledge building has changed the way their students learn. The school built on the pocket of success to continue to provide leadership and structural support for the ongoing work.

By the end of the third year, we had started to work with the school leaders, HODs, and other key personnel to integrate KB into the school's Teaching and Learning Framework (TLF). School leaders, heads of departments, a group of teachers, and students shared their school's KB journey at different platforms. KB practice has since been adopted across three subjects and now involves close to 20 teachers from all three departments. The project is now into its sixth year of implementation, and we continue to see robust growth of the practice within the school.

6.5   Discussion

What we learned about the relationship of interactions among teachers, researchers, and school leaders in relation to the quality of the classroom practice raised important questions about how structure and process can both support and impede innovation such as knowledge-building practice. This complex interdependence is exemplified by the increased number of partnerships on classroom research focusing on the salient codesign process for innovative classroom practice. The key idea is captured in the prefix "co" as much as the word "design". It defines the kind of shared responsibility between partners that is needed to tackle the ill-structured problem space of innovative practice.

What we learned in our project illustrates one viable means of engaging researchers, teachers, and school leaders in knowledge-building discourse in ways that sustain the distribution of responsibility for learning and innovating. The project also illustrates the way to transform school practice by considering the backdrop of different cultural system across departments as well as in the bigger education context of Singapore, with different social norms, communication norms, and priorities. New issues are bound to emerge no matter how foolproof the scaling plan is. Thus, in all efforts to scale practice, there remains a strong need to focus on deepening the innovative practice while continually designing and managing the scaling mechanism.

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Chew Lee Teo started as a science teacher, and she has been exploring knowledge-building pedagogy and technology since her classroom days. She graduated with a PhD from Ontario Institute for Studies in Education, University of Toronto, where she studied teachers' problem space in designing and enacting knowledge-building classrooms. Since returning to Singapore in 2009, she has been working closely with local teachers to bring about knowledge-building practice into our local classroom in the capacity of a specialist in the Education Technology Division in Ministry of Education, Singapore. The network of knowledge-building practitioners have grown steadily over the years, and the network of practitioners continues to attract new teachers to create an idea-centred classroom.

Part III
Innovation and Change from the School View

Chapter 7
Negotiating Policy Meanings in School Administrative Practice: Practice, Professionalism, and High-Stakes Accountability in a Shifting Policy Environment

James Spillane and Lauren Anderson

Abstract Using a micro-sociological approach, this chapter examines how school leaders and teachers negotiate the meanings of emerging high-stakes accountability policy in formal school meetings. In doing so, the chapter examines how policy advanced at the macro level gets worked out at the micro level in school administrative practice. Exploring policy in school administrative practice, we uncover *how* school leaders work to advance the legitimacy of external policy, negotiate its meanings, and attempt to compel teachers' cooperation. School leaders in our study did so by deploying formal authority, as well as various tactics described in earlier theoretical work on social influence, such as invoking a shared in-group identity and/or underscoring moral worth. In deploying these social tactics, school leaders engaged not only in rhetorical *framing* but also rhetorical *footing* as they worked to convince teaching staff of policy's legitimacy and its meanings for classroom instruction. Our account demonstrates how these negotiations extended beyond the technical implications for instruction as school leaders and teachers renegotiated what it means to be a professional educator in a shifting policy environment, and who, or what holds authority on matters of teaching practice in particular.

J. Spillane (✉)
Northwestern University, Evanston, IL, USA
e-mail: j-spillane@northwestern.edu

L. Anderson
Connecticut College, New London, CT, USA

7.1   Introduction

Over a few decades, standards and high-stakes accountability tied to student performance on standardised tests have become commonplace in the United States (USA). While federal, state, and local governments increasingly exercise their political authority by crafting policies about instruction, school leaders and teachers are still the final policy brokers (McLaughlin, 1990; Schwille et al., 1983). They must make sense of policies—construct policy *meanings*—and implement (or not) those meanings in practice. Even in the case of prescriptive accountability policy, school leaders are left to negotiate with teachers a policy's particular meanings for local practice and to figure out how to compel them to comply. This negotiation is essential to how policy gets instantiated in practice.

In this chapter, we explore how government policy (macro level) about instruction gets taken up, negotiated, and used in practice in schools (micro level) by school leaders (e.g. principal, literacy coordinator, grade-level leader). Drawing on data from a longitudinal case study of one elementary school, we examine how school leaders work during formal meetings (e.g. grade-level meetings) to persuade others of policy's legitimacy and its meanings. Using a micro-sociological approach, we examine the tactics school leaders use to position government policy (macro level) as a legitimate source of direction about instruction, to justify proposed approaches for meeting accountability demands, and to convince teachers of particular policy meanings. In deploying these tactics, school leaders engage not only in rhetorical *framing*, by which they position *policy* in particular ways, but also in rhetorical *footing*. Rhetorical footing involves school leaders positioning and repositioning *themselves* vis-à-vis others as they work to persuade school staff of policy's legitimacy and its meanings.

7.2   Policy Implementation: A Problem of Legitimacy, Meaning, and Practice

High-stakes accountability policies, and their implications for classroom practice, figure prominently on school leaders' and teachers' radar screens (Clotfelter & Ladd, 1996; Firestone, Mayrowetz, & Fairman, 1998; Malen, 2003; Valli & Buese, 2007). This is to be expected considering policymakers' efforts over several decades to hold schools—and, increasingly, individual teachers and school leaders—accountable for student performance. Yet, research offers varied, and sometimes conflicting, accounts of the depth and breadth of government policies' reach inside the schoolhouse. Some accounts suggest that such policies strongly influence instruction, which, in turn, standardises practice, narrows the curriculum, and stifles creativity (Anagnostopoulos, 2003; Valli & Chambliss, 2007). Others suggest that school staff focus more on aligning surface aspects of practice with what they believe policies are asking of them (e.g. Booher-Jennings, 2005; Figlio & Getzler, 2002; Heiling & Darling-Hammond, 2008).

In light of these varied accounts, scholars have increasingly attended to how local agents make sense of government policy. From a sense-making perspective, local agents not only interpret but also author their environments by noticing some cues while ignoring others (Weber & Glynn, 2006; Weick, 1995). Applied to policy implementation, this perspective assumes that school leaders' and teachers' understandings of what policy *is* and *asks* of them will play a critical role in whether and how they respond by altering how they practice. Policy, then, warrants study not only as it is intended but also as it is *apprehended* day-to-day in schools (Ball, 1994; Coburn, 2005, 2006; Cohen, 1990; Spillane, 2004; Spillane, Reiser, & Reimer, 2002).

Yet, relatively few studies attend to how the meanings of policy emerge in practice (Anagnostopoulos, 2006; Anagnostopoulos & Rutledge, 2007; Coburn, 2005, 2006). Focused on micro-sociological processes, these works acknowledge that local agents not only make sense of policy *messages*; they make sense of *policy* itself, as well as other aspects of their environment, and the sense they make is negotiated in interactions with one another, shaped by formal structure (i.e. positional authority) and informal relations and critical to the enactment of future practice (Booher-Jennings, 2005, 2008; Coburn, 2001; Jennings, 2010; Louis, Febey, & Schroeder, 2005; Porac, Thomas, & Baden-Fuller, 1989; Trice & Beyer, 1993; Vaughan, 1996; Weick, 1995). School leaders are influential in these negotiations: How school leaders come to understand policy can influence teachers' sense-making, as school leaders work to focus teachers' attention on some aspects of policy rather than others, define the range of appropriate responses, and provide interpretive frameworks that teachers adopt and use as they construct understandings of policy and its meanings for practice (Anagnostopoulos & Rutledge, 2007; Coburn, 2005, 2006; Park, Daly, & Guerra, 2013). Thus, school leaders are sense-makers and sense-*givers* (Gioia & Chittipeddi, 1991).

Relatively little is known about the moves that school leaders make to give sense in order to mobilise others to act. Such moves are, we argue, of particular interest given the inherent tensions that arise as increasingly high-stakes and intrusive-to-instruction accountability policies collide with the norms of local control and teacher autonomy (Lortie, 1975, 2009). Indeed, the very idea of government policy as a legitimate source of direction for classroom practice represents a significant departure from schools' traditionally decoupled arrangements where teachers made decisions about instruction (Hallett, 2010)—a departure that may require particular kinds of sense-giving skill on the part of school leaders. Thus, whereas much of the sense-making literature dwells on how school leaders frame policy *ideas* about teaching, we explore how school leaders work to frame policy *itself* as a legitimate (or illegitimate) authority on classroom instruction.

Building on extant literature, we foreground school administrative practice as captured in the everyday interactions among school leaders and teachers in formal meetings, as it is in those interactions that policy becomes infused with meanings for local practice. Specifically, we ask: What happens when policy gets pulled into schools and more or less disrupts the social order by calling into question taken-for-granted ways of doing business? How are policies that press for such change in standard operating procedures in US schools made palatable on the ground? Most

of the education policy literature over the past three decades has focused on authority (e.g. state standards and accountability) and markets (e.g. school choice), with much less attention given to persuasion. We theorise the role of persuasion in education policy implementation (Lindblom, 1977).

7.3 A Micro-sociological Approach to Sense-Making

To anchor our analysis, we use three related constructs—*framing*, *footing*, and *social tactics*.

7.3.1 Framing

The concept of frame, for which Bateson (1972) offers a picture frame as metaphor, tells a viewer to focus on what is in the frame and to de-emphasise what lies beyond it. Frames direct attention, serving as vital tools for helping individuals decide what to select and what to neglect. Frames offer "principles of organisation which govern the subjective meanings we assign to social events" and provide methods of organisation that enable individuals to "locate, perceive, identify, and label a seemingly infinite number of occurrences" (Goffman, 1974, p. 11). In this sense, frames are about focus *and* formula, providing logics for categorisation and proposing logical relationships among categories (Goffman, 1974).

Frames are not only interactive in the sense that they layer on and laminate one another (Diehl & McFarland, 2010; Goffman, 1974); they are also interactive in the sense that they are used to attribute meaning in social interactions. Snow and Benford define framing, as distinct from frame, as "a set of dynamic, negotiated, and often contested processes" (2005, p. 206) involved in the "production of meaning" (1988, p. 198). Frames tell us not only what to separate but what to combine and equate; framing represents the process by which frames are established, mobilised, amended, and transformed. While framing practices are universal, which frames get used and *how* they get used are situation dependent, and issues of power, authority, and deference often factor in determining which frames prevail, collapse, or recede (Coburn, 2006; Fligstein, 2001; Goffman, 1956; Isabella, 1990; Park et al., 2013).

In education, much of the work examining the role of framing in policy implementation focuses on how local agents frame policy messages. Though not their focus, these works also suggest that leaders' efforts to generate meaning and catalyse cooperation often involve not only framing policy meanings but framing people in order to manage impressions (Goffman, 1956, 1959), as well as framing available roles (e.g. the role of teacher) in order to manage what others understand to be "appropriate and legitimate" enactments of a given role in a given situation (Diehl & McFarland, 2010; Goffman, 1974, p. 1744). Thus, we attend to the framing of what teachers should *do*, how teachers should *be* in a shifting policy environment, and where *legitimate authority* resides on instruction.

7.3.2 Footing

Footing is related to framing, for footing is what one must regain when thrust in new situations (Goffman, 1981). When people interact, they position themselves—through speech—in relation to one another and in relation to types of discourse. In taking such positions, people not only refer to the categories and labels at their disposal but separate, adjoin, and otherwise *constitute* such categories (Bateson, 1972; Irvine, 1996). Goffman referred to these positionings as "footings" or "shifts in alignment of speakers to hearers within a segment of speech" (1981, p. 127)—ways of organising interactions. One can imagine a school leader, for example, switching "feet" in conversation—speaking as a superior, a concerned parent, or a co-conspirator—depending upon the situation and the speech partners at hand. Changes in "footing" are "persistent" and "natural" parts of how people make sense of and communicate their reality through talk (Goffman, 1961, p. 128). They are also potentially strategic, selected in relation to the contours of the situation, the characteristics of speech partners, and the outcomes of interest—both for oneself and for one's school. We argue that footing, like framing, represents a critical dimension of social interaction, whereby school leaders work to position themselves in relation to others.

7.3.3 Social Tactics

With social tactics, we turn our attention to what school leaders actually say and do in order to give sense and compel cooperation. We conceptualise tactics as elements of social skill that are aimed at producing "shared meaning for others" (i.e. sensegiving) and "attaining cooperation" (Fligstein, 2001, p. 113). They are microfoundations of human agency—moves that actors make in their efforts to gain footing and advance frames in talk. Tactics are what school leaders do as they work to generate and communicate coherent interpretations and explanations of "what is going on here" and "what to do about it".

Such tactics have much to do with authority and persuasion, both of which are core mechanisms for social mobilisation, coordination, and control (Lindblom, 1977; Stone, 1997). Whereas authority, such as the power granted by formal position, depends upon individuals granting decision-making permission to the authority agent, persuasion—using ideas and language to influence others—typically involves nuanced social interaction around multiple, competing ideas (Lindblom, 1977; Weiss, 2000). Among mechanisms for coordinating behaviour, arguably "none is more pervasive, more complicated, or less well understood than persuasion" (Stone, 1997, p. 305).

Using the sociological literature on strategic social action (e.g. Gould, 1993; Lukes, 1974; Padgett & Ansell, 1992; Snow & Benford, 1992), Fligstein (2001) has theorised a range of tactics that "socially skilled actors" use to persuade others. These include capitalising on ambiguities and uncertainties, convincing others that

what was possible was preferable, joining groups to reorder preferences, and getting others to believe that they are in control (even if they are not). We apply and extend Fligstein's theorising concerning the role and content of social skill in our analysis, shifting our gaze from the macro-institutional or field level (of central concern to Fligstein) and taking a more micro-sociological approach.

7.4 Methods

Using transcripts of formal school meetings, supplemented by field notes, gathered over 4 years in an urban elementary school, we examine the tactics that school leaders employed as they worked to give teachers sense of policy and compel cooperation.

7.4.1 Study Context

The study was conducted over 4 years at the turn of this century (1999–2003). Data collection began 2 years *after* the introduction of the district's high-stakes accountability policy and 2 years *prior* to the enactment of No Child Left Behind (NCLB) policy. In 1996, leadership change in central office administration led to major policy initiatives that introduced high-stakes accountability and increased instructional standardisation in the district. First, the new administration designated schools as being on "probation" if 15% or fewer of their students were performing at or above grade level. Second, the administration required that students in third, sixth, and eighth grades meet certain scores on the Iowa Test of Basic Skills (ITBS) in order to move to the next grade, thus attempting to curtail social promotion practices district-wide. Third, in 2000 (a year into the study), district officials announced a reading initiative that prescribed a minimum of 2 hours of language arts instruction daily and specified expected types of instruction. High-stakes accountability was finding its way into state and local government policy but had not yet been formalised in federal policy. Things were unsettled, and clashes were emerging between the prevailing logics of local control and teacher autonomy and the new logics of government accountability policy (Hallett, 2010). Our study's timing enabled us to explore how emerging logics of accountability and standardisation, pressed initially by district and state policy and later by federal policy, were negotiated in the course of administrative practice.

7.4.2 Research Site

Adams, a K-8 neighbourhood school located on Chicago's South Side, served a population of between 900 and 1200 African-American students, with a student mobility rate of 35% and with 97% of its student body qualifying for free or reduced lunch. Like many similar schools in the district, Adams experienced declining standardised test scores in the late 1980s. Unlike many such schools, however, Adams also experienced some upswing in performance during the 1990s. Dr. Williams, who served as school principal for a decade prior to the start of the study and for the first 2 years of our data collection, chose to leave her position just before the start of the 2001–2002 academic year. The school's literacy coordinator and assistant principal, Ms. Richards, took her place as principal and promoted another teacher, Ms. Kelly, into the literacy coordinator position.

7.4.3 Data Collection

We purposefully sampled different school meetings (Creswell, 2009; Patton, 2001) including faculty, grade level, literacy committee, mathematics committee, and school improvement team meetings for observation, with the goal of accessing patterned administrative practice (Simon, 1976; Stene, 1940) (see Table 7.1). Meetings were selected for observation based on school leaders and teachers reporting them

Table 7.1 Data sources by year and routine

School Year	Number of sources	Routine type: description	Number of sources
1999–2000	3	*Faculty meeting:* meeting among all faculty, often addressing general school business	3
2000–2001	4	*Literacy meeting:* meeting focused on literacy curriculum and instruction	2
2001–2002	10	*Math meeting:* meeting focused on mathematics curriculum and instruction	3
2002–2003	5	*Annual kickoff meeting:* all-faculty meeting held at the start of the school year	4
		Breakfast Club meeting: meeting held monthly in the morning before school, led by teacher leaders, and involving staff discussion of assigned readings selected by teachers and linked to school-wide instructional goals/foci	5
		Grade-level meeting: meeting bringing together teachers at the same grade level(s)	4
		Grade-level coordinator meeting: meeting of teacher leaders who served as grade-level leaders and, thus, played a role in planning and facilitating grade-level meetings	1

as central to their work. Observations were conducted at different times during the school year (Fall, Winter, Spring) and on different days.

A subsample of meetings were audio-recorded and/or video-recorded and subsequently transcribed, forming the core of this dataset since transcript data allow for a fine-grained analysis of where and how policy gets invoked in practice. We supplement these transcripts with field notes.

7.4.4 Data Analysis

Our analysis focused on the policy-pertinent sense-making and sense-giving tactics of school leaders. We applied macrocodes for policy, framing, and footing. For tactics, we included a set of subcodes initially developed based on Fligstein's work (2001) and then amended to fit our data better; this process was iterative, as we transitioned from Fligstein's categories to other categories that emerged from our open coding and as we articulated or collapsed codes and subcodes (Miles & Huberman, 1994). We settled on seven categories of tactics, most encompassing a range of subcategories. We also coded all data according to participant/speaker, by group and by individual (see Appendix A).

We began by double-coding 10% of the dataset to ensure inter-rater reliability (Cohen's kappa of 0.7 or above) before applying codes across all data. Transcripts constituted our primary sources; field notes served as secondary sources, informing our thinking and analysis.

7.5 Findings

School staff negotiated the meanings of policy *in* practice and *for* practitioners in formal school meetings that were part of organisational routines designed and implemented by school leaders, in efforts aimed at recoupling government policy with both classroom instruction and school administrative practice. These organisational routines included Breakfast Club meetings, grade-level meetings, subject-specific committees, and so on (see Table 7.1).

We begin by looking inside those meetings and focusing on the contested content under negotiation. Next, we argue based on our analysis that in these meetings, school leaders not only appealed to *authority* but also used various other *tactics* to position policy as a legitimate source of authority on matters of instruction, to advance particular policy meanings, and to compel teachers to cooperate with the implications of those policy meanings for teaching practice. Exploring these tactics in school leaders' *sense-giving*, we show school leaders' *framing* of policy and its meanings involved, and at times depending upon *footing* as school leaders, positioning and repositioning themselves rhetorically vis-à-vis their audiences. School leaders' rhetorical footing involved shifting their alignment, framing themselves

differently in relation to teachers and policymakers, and, in so doing, communicating the kind of "good demeanour" associated with "discretion and sincerity; modesty in claims regarding self; … poise under pressure; and so forth" (Goffman, 1956). As school leaders used rhetorical footing to persuade teachers of their sense of policy entailments for instruction, they proffered prognostic frames about the appropriate spheres of influence for different entities and actors.

7.5.1 Negotiating Meaning During Unsettled Times

District and state policy figured prominently in interactions among school staff, as they negotiated the role that policy would and should play in decisions about teaching. Overall, policy was invoked 181 times across 20 of the 22 meetings, not surprising, as the threat of probation at Adams was real, permeating school administrative practice quickly and extensively. Our account also illustrates that implementation of high-stakes accountability was still ongoing 2 years after it was introduced, as school staff continued to negotiate its meaning. School staff, for example, regularly discussed the alignment (or lack thereof) between state assessments, standards, and curriculum materials as exemplified by the comments of Ms. Sunny, a third grade teacher and teacher leader, who noted during a mid-year mathematics committee meeting that "whatever it was they had on the International Students Admissions Test (ISAT), it was not on the math books that we had here" (01/18/01). Staff also referred to policy to justify the focus of instruction.

These discussions often involved explicit contestation concerning appropriate relations between policy and instructional practice as exemplified with the Five Week Assessment. The Five Week Assessment involved testing students every five weeks, in grades one to eight, in mathematics, reading, and writing. Based on an analysis of the ITBS, school leaders created benchmarks for student achievement and developed aligned assessments that mirrored the state tests in terms of format and assessed skills. School leaders used data generated by these assessments to focus on teachers' professional development, content coverage, reteaching, and attention to test-taking skills, enabling school leaders to invoke government policy indirectly, often without naming it, just by referencing the Five Week Assessment. In this way, the Five Week Assessment served as a "Trojan horse" for external government policy in school administrative practice.

Consider how Ms. Kelly, the literacy coordinator, framed and then reframed the Five Week Assessment's "purpose" during a grade-level meeting:

> It [the Five Week Assessment] is first of all so Miss Richards [the principal], Miss Andrews and Miss Wilmington [the Assistant Principals] can see how the school is doing in general. … And we get an idea of how we're gonna do on our [state] standardised test. But the main point of the assessments are for teachers; that's what they're really for. They're for you, so … you can see where the students seem to be struggling and you can think about what you need to do and discuss what you need to do to help them (11/01/02).

Ms. Kelly positioned the assessments as being primarily in the service of teachers rather than in the service of external government regulation. Thus, Ms. Kelly invoked the Five Week Assessment in ways that played up its local design and local ownership while playing down its genesis and ongoing connection to external policymakers. Indeed, government, as represented by the locally designed Five Week Assessment, was framed in the service of teachers' autonomy. Ms. Kelly's efforts to frame this locally designed assessment, as being in the service of teachers, rather than policymakers, are noteworthy considering teachers' resistance at times. Even as school leaders worked during unsettled times to advance a view of teacher professionalism that aligned with the demands of external policymakers, they sometimes failed to frame policy, and its relationship to practice, in consistent and/or compelling ways.

7.5.2   Tactics Documented

Implementing policy was not easy or effortless. School leaders had to persuade teachers to cooperate with policy meanings in practice. Our analysis uncovered seven tactics: appealing to authority; agenda setting (legitimating some topics but not others); invoking professionalism; asserting in-group identity; aligning policy messages with teachers' current practices, norms, and interests; narrating other people's speech and one's own neutrality; and engaging in public self-critique and ingratiating behaviour (Table 7.2).

Appealing to Authority   As expected, school leaders appealed to formal authority, the first face of power (Lukes, 1974), including their own or colleagues' positional authority and the authority of government agents and agencies (Scott & Davis,

Table 7.2 Tactics

	Number of meetings within which code was applied	Percentage of meetings within which code was applied	Number of coding instances total	Average codes per meeting
Aligning	19	86%	280	12.7
Invoking professionalism	19	86%	225	10.2
Other-oriented ingratiating	19	86%	199	9.1
Authority	18	82%	195	8.9
Agenda setting	19	86%	145	6.6
Asserting in-group identity	15	68%	92	4.2
Narrating others' speech and own neutrality	14	63%	74	3.4

2007; Stone, 1997). Of the 195 discrete coding references, roughly a quarter involved school leaders, especially the two principals, making decrees about compliance with accountability policies. During a school year kickoff meeting, for example, Principal Richards used her position to demand teachers' cooperation in general, such as when she remarked, "when I request something, I do expect to get it" (08/29/01). Later in the same meeting, she spoke again from a position of authority, invoking the logic and language of external accountability policy as she placed a series of demands on teachers.

> This year we're talking about accountability; everything you do you have to sign off for. When you attend a meeting, you're gonna have to sign. Grade-level meetings, I want an agenda, I want who attended, I want what was discussed, I want what was solved … (08/29/01).

Reminding teachers of her positional authority, Richards shared her expectation that Adams staff would comply with demands like not missing work and participating productively in grade-level meetings.

Yet, with an average of nine uses per routine, school leaders did not rely mostly on their own positional authority; they more frequently invoked the authority of government agents and agencies, often by directly referencing policy texts, programmes, and tests and by framing those as legitimate sources of instructional guidance. Such references included Mrs. Jones, a mathematics teacher leader, advising an inquiring colleague to consult "the IOWA test and the ISAT and the state goals [which] tell you exactly what should be mastered by each grade level" (01/11/02), and Ms. Richards (the principal) reminding all staff to bring to a scheduled staff retreat "your state standard books… because whatever we do it has to compliment these standards" (05/20/03). School leaders framed *state* policy documents as legitimate sources of guidance on instruction and, in doing so, advanced expectations that teachers adhere to those policy documents in practice.

School leaders also appealed to the authority of *district* policies and curricular programmes as they worked to persuade teachers of their sense of the entailments of accountability policy for instructional practice. During a mathematics meeting, for example, Ms. Jones drew on the district's probationary policy to justify a new set of demands that she and other teacher leaders were placing on teachers.

> Now last year our math scores went down. And so this year we are gonna be held accountable. I have on here a schedule. I met with Mrs. Sunny, Mrs. Walters, this summer and we put this together… It shows you … what should be taught during that, it shows you what week… It also shows what chapters are going to be covered… It says at the bottom … a problem solving, open-ended question will be given every five weeks. You have to turn those in (08/31/01).

Ms. Jones explained that, while teacher leaders at Adams may not have previously held their colleagues accountable to teaching a structured mathematics curriculum, the school's past performance in relation to policy targets necessitated their current move to do so. In this way, school leaders invoked the formal authority of state and district agencies to rationalise and to advance *their own* more structured mathematics curriculum, one that prescribed content coverage by week and repre-

sented a substantial break from business-as-usual at Adams. At times school leaders also invoked government authority by referencing specific policymakers. The district's Chief Academic Officer (CAO), a well-known and respected former teacher and principal, figured especially prominently in school leaders' efforts to compel others to cooperate with their sense of policies. In this way, school leaders worked to augment the formal authority of the district and its policies by associating that authority with particular and preferred people. While invoking the authority of state and district entities or policymakers arguably served to advance the proposed courses of action supported and/or designed by school leaders, such invocations also involved framing accountability policies in ways that extend, explicitly or tacitly, the sphere of legitimate authority on instruction afforded to the state and the district.

Appealing to authority, school leaders often positioned themselves with the education system, a system that was pressing dramatic shifts in business-as-usual in schools. Positioning themselves in this way, school leaders ran the risk of alienating teachers, especially veteran teachers who expressed concerns about the implications of high-stakes accountability for instructional practice. To establish or regain their footing with teachers, school leaders had to rely on means other than formal authority. Though "authority is the essential backdrop to all policy interventions, it is not necessarily the mechanism that gets the job done" (Weiss, 2000, p. 88).

Narrating Others' Speech and One's Own Neutrality Related to, but distinct from, invoking authority, school leaders also leveraged their structural positioning to revoice the speech of others. We found 74 instances involving school leaders recounting for teachers the desires, demands, and warnings of other people, often external policymakers, while positioning themselves as mostly neutral, concerned bearers of the "message". This was the case, for example, when Ms. Kelly remarked during a grade-level meeting:

> The state this year is looking into severe measures … if our school is not improving on the ISAT test. They're looking for improvement. If they don't see it, if we go down … she said that she's not sure what they're gonna do but we can only imagine what severe would mean … they could have someone come into our school and say 'this is what you're gonna do. We wanna get rid of this, we're gonna put this in here. This is the curriculum you're gonna go by'. And we just definitely don't want that to happen. And they are serious this year because in the past years they've felt like the ISAT was a new test and so they didn't grade it as intensely; … And they don't think it's new anymore …We should be teaching towards those standards; …we wanna make sure that whatever we're doing in our classroom is related to … what they're gonna be tested on (01/11/02).

Ms. Kelly framed accountability policies as presenting significant, impending threats to school work norms, positioning herself alongside threatened school staff, even as she encouraged colleagues to heed policy demands. Specifically, she leveraged the uncertainty and ambiguity of the situation ("looking into severe measures") *and* the ambiguous reported speech of a respected district leader ("she's not sure on what they're gonna do… we can only imagine") to encourage teachers' cooperation on implementing standards-based instruction. In this way, school leaders found a

way to affirm and call into question policy messages and to position themselves alongside multiple constituencies simultaneously. This tactic distinguishes itself from appealing to authority because it involves reporting the speech of others in positions of authority while *also* cultivating and leveraging a neutrality vis-à-vis the content of that reported speech.

Agenda Setting We coded 145 instances of agenda setting, the second face of power (Lukes, 1974), wherein school leaders worked to define parameters for legitimate meeting discussions, including some topics while excluding others (Kingdon, 1984). School leaders engaged in agenda setting in a few core ways. First, they constructed agendas for meetings and then held staff to them. Second, they selected and assigned articles that teachers were expected to read and present, thereby setting parameters for participation within certain meetings and then moving discussion along with interjections like "next article please" (10/28/99). Third, they honed the discussion so that it aligned with, and also further specified, the official agenda.

School leaders also engaged in more dynamic agenda setting, shaping the flow of discussion. During a Breakfast Club meeting, Ms. Grovenor, a literacy teacher leader, controlled conversation by selecting individuals to speak, based on her knowledge of their instructional practices, stating explicitly "I'm calling on teachers who I know are using this" (02/14/01). School leaders also worked to shape discussion in relation to the agenda by attempting to engage particular people, such as when Ms. Holmes, a math teacher leader, remarked at another Breakfast Club meeting, "I'm sure there are others back there that have things to say (gestures toward two circular tables)" (11/14/00). Usually, agenda setting was transparent and clear, whether advanced by administrators or teacher leaders, such as when Principal Richards outlined the goal for a grade-level coordinators' meeting by noting:

> What I wanna talk about this morning is common planning time. And I guess I'm relying on the grade-level chairperson of the group a little bit more here. What are you doing during your common planning time? Are you actually taking advantage of your common planning time? Because that is very crucial (01/09/02).

In this excerpt, Richards established a focus (i.e. common planning time) for conversation, designated certain attendees (i.e. grade-level chairpersons) as preferred participants, articulated an agenda *for* the chairperson role (i.e. "taking advantage of common planning time"), and signalled to staff that the "very critical" value of common planning time, during which teachers were expected to collaborate in ways that aligned with accountability policies, was not up for debate. She directed participants' attention, suggesting not only which roles were available and legitimate but also which persons were eligible for which roles (Diehl & McFarland, 2010).

Aligning School leaders also played up alignment between (a) their framing of policy and its implications for instruction and (b) teachers' current practices, interests, values, norms, and goals. These alignment efforts involved emphasising the ways that policy compliance complemented, rather than challenged, prevailing practice and norms. We found 280 instances of aligning.

School leaders appealed to "common sense" and familiar practices in framing policy and its entailments. At a faculty meeting, Principal Richards aligned policy compliance with housekeeping, "so when somebody knocks on the door I don't have to go move the stuff", and encouraged teachers to "keep your house clean" and "keep everything in place" should external district accountability entities visit (08/28/02). At an another faculty meeting, she promised to show teachers video footage of a district meeting that she had attended, "just to let you get a feel of what we are in for", but then reassured them: "Adams, don't you ever, don't break out in any sweat, because we've been doing these things all along. Only thing we have to do is implement and keep doing what we've been doing and make sure that it's working" (08/29/01). Here leaders' efforts to persuade teachers to comply with district policies included arguing that the entailments of these policies were similar to what was already happening at their school. Indeed, by arguing that Adams staff just needed to "keep doing what we've been doing", Richards was "constructing coherence" between district policy and current practice at Adams (Coburn & Woulfin, 2012), which in turn advanced the legitimacy of policy via a connection to established local practice. By framing the novel as familiar, school leaders positioned existing practice as consistent with external policy, positioned themselves with teachers, and advanced a less threatening view of policy. At the same time, school leaders risked giving teachers the impression that they were already teaching in ways that were consistent with policy and thus did not need to change their current practice (Spillane, 2006).

School leaders' alignment efforts went beyond appeals to established instructional practice; in their efforts to persuade teachers, they also appealed to shared values and norms such as norms of egalitarianism (Lortie, 1975). Ms. Jones, for example, took pains to frame decisions to require teachers to follow a structured curriculum framework and publicly post classroom-by-classroom test scores in ways that would allay anxieties and sync these decisions up with shared values and goals:

> I know it's gonna be difficult with all these new things because all new things are difficult. But I think if we adhere to it and follow by it and please don't get offended when I post these scores because they will be in graph form. So please don't get offended. It's just to make us better and look good and I want us to come back up to where we were before. That's why I included Kindergarten; I don't wanna overlook anyone. I wanted everybody on the same page and know where we are (08/31/01).

Ms. Jones appealed to values of inclusiveness, transparency, and teamwork, deflecting attention away from any restrictive and evaluative dimensions of these decisions and playing up connections between these decisions and shared goals related to instructional improvement, thus reversing declines in test scores and restoring Adams' reputation for teaching excellence. In doing so, she also deflected attention away from the regulatory functions of state assessments and, instead, framed aspects of these policies as viable mechanisms for working towards shared goals and as useful tools in pursuing those goals.

Indeed, at times school leaders worked at persuading teachers by arguing that heeding and adhering to instruction-related policy requirements would enable them

to maintain and preserve cherished norms, especially their instructional autonomy as teachers. At a fourth grade meeting, for example, Ms. Kelly worked to persuade staff to cooperate with district accountability requirements by aligning them with a professional norm (i.e. teachers' autonomy in drawing on their own expertise to inform classroom practice). Arguing that adherence to accountability policy will ultimately protect teacher autonomy; she framed policy compliance as *not* necessarily undermining teachers' identities as autonomous professionals, but rather as being *potentially* consistent with them and with ensuring their autonomy in the classroom. At the same time, she positioned herself *with* teachers as the guardian of their autonomy and, simultaneously, as a willing, or at least passive, participant in top-down accountability.

Asserting In-Group Identity School leaders also used the tactic of asserting in-group identity to position themselves with teachers, as captured in 92 segments. Consider Principal Richards' remarks:

Please people, please be to work on time. … When I was in the classroom, and I'm not far removed, because I can go back to the classroom any day … because I love it… but when I … wasn't here early enough to plan, my whole day was just messed up. Get here early so you'll have time… Try it. (laughs) (08/29/01).

Richards communicated to staff the importance of coming to school on time, asserting her co-membership by reminding teachers of her classroom experience and using her proximity to classroom practice to legitimate her claim to "knowing". Asserting in-group school leaders positioned themselves with teachers, dislodging from the school system bureaucratic hierarchy so that they could use frames that implicated teachers' efforts, practices, and/or professionalism and that might function most compellingly when marshalled between co-members of the teaching profession.

Self-Critique and Ingratiating School leaders also framed policy messages as not being driven by or connected to their own self-interest but by their concerns for others as they leveraged teacher cooperation. We found 199 such instances of school leaders adopting a self-critical approach and admitting their own limitations, struggles, and areas for growth, in framing policy entailments for teachers. Principal Richards, for example, offered comments that acknowledged her own shortcomings, like that she, too, needed to be open to critique and self-improvement: "even though I'm working my tail off there still may be some things that you can identify that I need to do; that I, you know, in my busyness may have kind of pushed aside or may not have seen" (03/19/03). Teacher leaders used a similar approach, implicating themselves in what might otherwise seem arrogant or accusatory.

Another way that school leaders framed policy, and themselves, in other-oriented ways, involved emphasising to staff that they were in control—at times, even when they were not. In multiple excerpts, leaders like Ms. Kelly deployed this tactic when framing tests as "for you [teachers] firsthand", when framing teachers as possessing unique and critical knowledge that placed them in a position of relative power concerning instructional decision-making (e.g. "only you know your students") and

when framing the Five Week Assessment and her role in relation to it as democratic and teacher-centred (e.g. "We can do whatever you wanna do… I don't wanna dictate…"). At one point, a collaborating external consultant went so far as to suggest that the assessment, given its "local" nature and purpose, was not actually about implementing external policy: "It's for *our* purposes and we're not trying to meet any state mandate here, alright? Ultimately we have to but this, *this* is for us to use to improve" (11/02/01). Finally, as school leaders worked to frame their sense of policy and/or themselves as other-oriented and not self-interested, tactics also involved strategic uses of overt praise. Sometimes praise was used to open meetings, especially meetings in which leaders ran the risk of seeming authoritative and/or policy-focused rather than teacher- and student-centred, as well as meetings with an emphasis on strategies for improving students' performance on tests.

Invoking Professionalism   Related to invocations of "good" teaching, school leaders and teachers often invoked notions of professionalism—225 times across the 22 meetings—as they negotiated policy meanings and, in so doing, opened up dialogue about the appropriate ways of being for teachers, school leaders, and policymakers in a shifting institutional environment. Consider an excerpt from a November 1999 Breakfast Club meeting, when Ms. James, a first grade teacher, led a discussion about an assigned reading on effective reading instruction. Addressing her colleagues from the front of the room, she first drew connections between the focal article's points and the specific reading programme ("the Cunningham Structure") in place at Adams and then shifted attention to questions of policy and practice relations.

> *Ms James:* …So if everyday we follow the Cunningham Structure and we use the multiple methods that we as skilled beginning reading teachers know, and if we have assessed our children, then each child will be taught what he or she needs to learn. (chuckles) It's like oh, this is really wonderful. So by the time I got down to question number four: What methods are available? I thought, "We know those…" It seems like this bottom part is a big controversy… who should decide what methods? …the teachers should be the ones deciding. That is my beginning, my opening statement. (chuckles) And I think we can discuss it.
> *Ms Hanes, a leader in charge of home/school connections, raises her hand.*
> *Ms James:* Yes?
> *Ms Hanes:* I like the fact that they [the authors] do give us credit as being professionals and us having the decisions that are made for our children instead of those being handed down…I had a question about the Read Write Well programme that the [school] board has instituted…Is that a mandate or is that just a guideline?
> *Teachers begin to discuss; most say it's mandated.*
> *Ms Hanes:* Mandated.
> *Ms James:* And the new booklets, well not booklets but notebooks that we got, the white notebooks [associated with the Read Write Well programme], I think are a good example of how we should make sure that we are defining ourselves as skilled beginning reading teachers as professionals. Because if we don't define ourselves as professionals who know how to assess our children and who adjust the balance and methods and our children are taught to, somebody will think we are *not* professionals and will not uh… I mean they will say that white notebook [sic] is what we should be following which is not uh… I'm not criticising it. I'm just saying that I think there's more (11/03/99).

In this excerpt, Ms. James opened by asserting teachers' knowledge as "skilled beginning reading teachers" and then labelled the tension between policy and teacher autonomy—namely, "who should decide" instructional methods—as a "big controversy". Taking up the issue of "who should decide", Ms. Hanes argued that "being professionals" involves teachers making such decisions based on knowledge of students, rather than having such decisions "handed down". She also raised a specific district initiative that could be seen as encroaching on teachers' instructional autonomy and therefore their professionalism. Seizing on this example, Ms. James then argued that teachers' own professionalism in the eyes of others largely depended upon teachers being able to define *themselves* as capable of skilfully making instructional decisions.

Negotiations invoked, and at times challenged, underlying assumptions about the appropriate spheres of influence for different actors. Ms. James framed policy as a potential threat to teachers' professional autonomy and used that threat and the threat of teachers ending up simply following scripts defined by external policymakers, to advance a view of professionalism grounded in teachers' expertise. While Ms. James, Ms. Hanes, and Ms. Walters all positioned themselves *as* and *with* teachers (a tactic we discuss in more detail below) and praised those who viewed teachers as professionals with the requisite knowledge for sound instructional decision-making, Ms. Walters challenged policymakers' knowledge and legitimacy in defining parameters for instruction.

Over the 4 years of our study, references to professionalism diminished in frequency as indicated by the average number of coding references per meeting for each academic year, which dropped from 19 in the first year of the study (1999–2000) to just under 6 in the fourth year (2002–2003). At the same time, they became increasingly intertwined with references to policy; whereas just over 20% of the transcript data coded as policy were also coded as professionalism for the 1999–2000 school year, that overlap increased to over 50% for the 2002–2003 school year. These references also increasingly framed policy and professionalism as complementary rather than oppositional to or threatening of teachers' professional autonomy. During a grade-level meeting in January of 2002, 3 years into the study, for example, when a teacher challenged the Five Week Assessment practice, it was another teacher—rather than a school leader—who chimed in to frame the assessment as diagnostic (i.e. "It's not a test for them to fail. It's a test for us to see…"), praised the Five Week Assessment for offering teachers "information about what [students] know and what they don't", and explained that this information helped her decide "what to teach" and how to maximise instructional time.

7.6   Discussion

Our account builds on and extends prior work on the micro-sociological processes of policy implementation inside schools, in particular work on the role of sense-making and sense-giving in policy implementation (Anagnostopoulos & Rutledge, 2007; Coburn, 2004, 2005, 2006; Spillane, 2006). Getting inside the black box of

policy implementation at the micro level, we extend previous work in several ways. First, we make an important analytic distinction, which is that when we study policy implementation, we must explore school leaders' efforts to compel others to adopt and act on particular policy meanings, *and* we must also explore their efforts to try, even more fundamentally, to compel others to regard government policies as legitimate sources of authority on instruction. This is especially important when government actors decide to regulate matters that they have not traditionally regulated, calling into question established spheres of influence.

Second, we illustrate how school-level micro negotiations about policy meanings go beyond ideas about instruction to encompass matters of professional identity. In negotiating the meanings of policy for instruction, school leaders and teachers also negotiate the *appropriate* spheres of influence associated with different positions in the education field (e.g. teacher, policymaker). Our account captures how dramatic shifts in the education policy environment get negotiated inside schools. During school meetings, school staff engaged with questions about who ought to have responsibility for what aspects of instruction and what it means—and who ought to determine what it means—to be a "good" teacher in a shifting policy environment. In this way, linking policy and professionalism through administrative practice served as both a mechanism and context for "continued redrafting of an emerging story"—in our account, an evolving story about what it means to be a professional educator—so that the story "becomes more comprehensive …and is more resilient in the face of criticism" (Weick, Sutcliffe, & Obstfeld, 2005, p. 415).

Third, in unpacking how school leaders frame policy meanings and meanings about instruction and professionalism, our account suggests that sense-making and sense-giving are also fundamentally about, and at times contingent upon, *rhetorical footing*, as school leaders organise interactions with staff by positioning themselves through speech in relation to one another and types of discourse (Goffman, 1981). We show how school leaders switch "feet" in conversation—speaking as monitors, fellow educators, co-conspirators, neutral reporters, and so on—depending upon the situation and speech partners at hand. While such footing represents persistent and natural features of social interaction, we find that they also appear selectively in relation to the contours of the situation, the characteristics of speech partners, and the outcomes of interest. Moving beyond its theoretical grounding, footing captures the ongoing positioning and repositioning vis-à-vis policymakers and teachers that school leaders engaged in as they worked to convince teachers of their sense of policy and its entailments. Footing then, like framing, emerges as a critical dimension of sense-making and foregrounds the micropolitics of the policy implementation process.

Fourth, while our account confirms prior research findings about the central role of the school principal in the sense-making processes (Anagnostopoulos & Rutledge, 2007; Coburn, 2005, 2006), it also points to the important role of *other* school leaders. While principals were critical in local negotiations about policy meanings at Adams, they were not the only school leaders engaged in sense-giving. Other formal leaders, including part-time leaders who worked as full-time teachers, were key actors in the sense-giving process about policy, its legitimacy, meanings, and entailments. In fact, looking at tactics by speaker category, teachers who held leadership roles accounted for 40% of the coded content (calculated by word) compared to

37.2% for principals and other administrators, 12.3% for other teachers, and 7.6% for other participants (e.g. external consultants). Our analysis thus underscores that principals are not the only school leaders that work to persuade teachers to comply with particular framings of policy meanings (see also Coburn & Woulfin, 2012). Further, we show that these leaders are not passive receivers and transmitters of policy; they are not "cultural dopes" (Giddens, 1984), but rather actively advancing particular policy meanings in their daily interactions with staff and, in doing so, repositioning themselves vis-à-vis policymakers and teachers.

Finally, our account sheds light on *ho*w school leaders work at convincing teachers to view policy as a legitimate source of guidance on instruction and to attend to and comply with particular policy meanings. Specifically, while school leaders appealed to formal authority, the first face of power, they also used several other tactics in their efforts to convince teachers about the legitimacy of particular policy meanings. Our account identifies and elaborates the *tactics* school leaders used in an effort to attain teachers' cooperation with these policy meanings. In doing so, we theorise persuasion, the least well understood of the three core mechanisms of control—namely, authority, markets, and persuasion—in political systems and policy implementation (Lindblom, 1977; Majone, 1989; Stone, 1997; Weiss, 2000). Our paper not only brings the complexities of persuasion, which is not limited to any one source (e.g. the state) and relies on individual interactions (Weiss, 2000), back into the conversation about education policy implementation in this era of standards and accountability; it also unpacks *how* persuasion operates at that micro level in the service of macro-level policies and control mechanisms (i.e. authority).

7.7   Conclusion

As policymakers incorporate and press radically "new" ideas, they produce uncertainty, puzzles, and ambiguity for those who are charged with implementing policy (micro level) in practice. The resulting uncertainties, puzzles, and ambiguities trigger sense-making and create a need for skilled sense-givers who can negotiate not only the meanings of policy for practice but also the very legitimacy of policy itself. School leaders, we argue, have been left to manage in the middle between teachers and policymakers with different expectations and norms about what it means to be a professional educator. Leaders in our study deployed a constellation of tactics as they attempted to advance the legitimacy of accountability policy, to frame (and reframe) policy messages, to position (and reposition) themselves vis-à-vis external policymakers and school staff, and to direct teachers' attention in ways that privileged particular ideas about instruction and teacher professionalism. What our study allows us to demonstrate in a theoretically generalisable manner is that during unsettled times, when logics are in contestation, school leaders at the micro level may be left (by default) to do the "heavy lifting" when it comes to giving others a sense of policy's legitimacy and its meanings and compelling others' cooperation in putting those meanings into practice. This heavy lifting is work that those making policy and supporting school leaders should take into account.

Appendix A: Codes and Examples of Coded Content

Macrocode/ subcode	Definition/usage	Coded content example *Additional subcodes (not exhaustive) and examples of coded content*
Policy	Here we code direct and indirect references to district, state, and federal policy; in other words, any instance when policy is invoked	They went to a meeting in Washington regarding this No Child Left Behind, which means if a school is not performing up to standards, the parent has the option to choose a school to send their child to a school that is a well-performing school…
Framing	Here we code any speech/tactic used in a way that appears intended to frame/reframe an issue/group/ person	And I agree with this but it's not, I don't feel it's the teacher's fault. I think the school districts as a whole you know they cut out art, they cut out music, they cut out you know, there's only gym one day a week. So students who have those other intelligences it's hard…
Footing	Here we code any speech/tactic used in a way that appears intended to gain footing with a constituent group or involves code-switching/ signalling the "move" to take up a new position in relation to those being spoken to/about	Please don't feel intimidated by it… we did that with National Board because we sat down together as a team and we critiqued each other's… we were harder on ourselves than the other people who were looking at us. But it made me grow as an individual because I'm thinking I had a smoking lesson. When I go back and look at myself… (group chuckles) …I'm like "Ooh, I did that?" or "I did that?" or "This could've been better" or…
Tactics/*agenda setting*	Setting parameters of discussion	This is a planning party; putting together strategic plans for next year…whatever we do it has to complement these standards. Bring them.
Tactics/*authority*	Drawing on direct, official authority to require/mandate something of others	They will say that white book is what we should be following…

Macrocode/ subcode	Definition/usage	Coded content example
		Additional subcodes (not exhaustive) and examples of coded content
Tactics/*invoking professionalism*	Referencing what it means or involves to be a professional or "good" teacher and/or referencing notions/norms of professionalism (e.g. caring about kids, returning graded work promptly, sharing ideas with colleagues, teaching to standards, etc.)	But if we don't define ourselves as professionals who know how to assess our children and who know, who adjust the balance and methods and our children are taught to, somebody will think we are not professionals…
		We as teachers have to be good listeners...
		We just cannot deal with the academics; we have to meet all of their needs…
Tactics/*asserting in-group identity*	Finding ways to join or express co-membership with groups in order to reorder preferences and develop new collective identities from "inside"	When I was in the classroom… I'm not far removed because I can go back to the classroom any day and I don't have a problem with it because I love it.
Tactics/*narrating others' speech/own neutrality*	Presenting oneself as a neutral reporter or informant and reporting the opinions, statements, and/or predictions of others; see additional subcodes ➔	(i) *Reporting someone else's speech:* Accountability was in here…And I'm just gonna read some of the comments that they made.
		(ii) *Associating policies with specific people*: [the CAO] is partnering up with [a scholar]…to put in place a city wide reading programme.
		(iii) *Leveraging uncertainty and unpredictable actors:* We might have people coming in, they might re-do our whole curriculum, they might…

Macrocode/ subcode	Definition/usage	Coded content example *Additional subcodes (not exhaustive) and examples of coded content*
Tactics/*aligning*	Asserting alignment of some kind of aligning, including appealing to common values or convincing others that what will occur (or needs to occur) is consistent with their identities and interests in some way; see additional subcodes ➜	(i) *Aligning with "common sense":* How many of you housekeep?… Teachers, keep your house clean. So that whoever comes in this building, if they ask for it, here it is...
		(ii) *Aligning something new with something familiar/already done:* Adams, don't you ever, don't break out in any sweat. Because we've been doing these things all along…
		(iii) *Aligning adherence with maintaining cherished norms/ideals/ autonomies:* …because who wants anyone to come in our school and tell us then how to teach...
		(iv) *Appealing to common value(s) or shared goal(s):* We keep talking about raising test scores. We cannot raise test scores if our children are at home…
Tactics/*other-oriented ingratiating*	Expressing appreciation and concern for others, their needs and desires, and not being wedded to any personal course of action; see additional subcodes ➜	(i) *Being modest or self-critical, emphasising own failings or struggles:* Patience is one of the things that we really need to work on… I should say in a lot of cases I need to work on.
		(ii) *Starting with flattery:* Many teachers throughout the system are hardworking teachers, we're all good teachers, but…
		(iii) *Emphasising to others that they are in control:* These are your assessments, you developed them, you know best…
		(iv) *Using self-deprecating humour or deflecting attention from oneself and/or one's expertise or authority:* Do I know everything? Heck no. Don't even come probably 1/3 of knowing everything…

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James Spillane is the Spencer T and Ann W Olin Professor in Learning and Organizational Change at the School of Education and Social Policy at Northwestern University. He is also professor of Human Development and Social Policy, professor of Learning Sciences, professor (by courtesy) of Management and Organizations, and faculty associate at Northwestern's Institute for Policy Research. James's interest is organisational leadership and change and in the policy implementation process at the state, school district, school, and classroom levels, focusing on intergovernmental and policy-practice relations.

Lauren Anderson is an associate professor of Education at Connecticut College. She was previously an Assistant Professor of Education at the University of Southern California's Rossier School of Education and a Post-Doctoral Fellow at the School of Education and Social Policy at Northwestern University. Her research interests are situated at the intersections of education policy, teacher education, and K-12 school and classroom practice. In particular, she explores how teachers and school leaders make sense of and mediate federal, state, and local policy in the context of their daily work.

Chapter 8
School Orientation to Teacher Learning and the Cultivation of Ecologies for Innovation: A National Study of Teachers in England

David Pedder and V. Darleen Opfer

Abstract   In this chapter, we discuss the importance of school orientation to teacher learning for cultivating ecologies of innovation. A supportive ecology is one where the relationships between school practices for organisational and teacher learning and teachers' values on those practices are a focus of a school's critical self-evaluation and double-loop learning processes. Through factor analysis of 1126 teacher survey responses about their perceptions of school practices and their values, 4 underlying dimensions of school orientation were identified: "providing formal systems and supports for professional learning", "performance management", "social capital conditions for learning" and "supporting collaboration and networking". Overall, values and practices were in closest alignment for "performance management" and "social capital conditions". More marked patterns of values-practice dissonance were recorded for "providing formal systems and supports for professional learning" and "supporting collaboration and networking". These dimensions of school orientation to learning were used as the basis for cluster analysis. Through cluster analysis, four distinctive groupings of teachers were identified, each reflecting a distinctive combination of teachers' perceptions of school practices and values related to their school's orientation to learning: highly supportive; supportive but under-networked; complacent; and underdeveloped and dissonant. We developed this new typology of school orientation to learning on perhaps the largest and most extensive national survey of teachers in England conducted to date. We conclude that schools in England tend to experience difficulty in leveraging dissonances between school practices for teacher learning and what teachers value in order to create policies and strategies for establishing a supportive ecology for innovation.

D. Pedder (✉)
Emirates College for Advanced Education, Abu Dhabi, United Arab Emirates
e-mail: David.Pedder@ecae.ac.ae

V. D. Opfer
RAND Education, Pittsburgh, PA, USA

8.1   Introduction

In this chapter we return to and extend our analysis of perhaps the largest representative national English survey of teachers about their professional learning carried out to date—the Schools and Continuing Professional Development (CPD) in England, State of the Nation Study (SoNS) (Pedder, Storey, Opfer, & McCormick, 2008). We want to argue that if schools are to be a productive part of the cultivation of new supportive ecologies for innovation, then their first challenge is to embed and sustain cultures, orientations, routines and systems for teacher professional learning. Pedagogic innovation can only happen at scale within and between schools if schools themselves recognise the significance of the professional challenge faced by teachers in changing their practice. School leadership teams need then to take seriously the importance of establishing school conditions and cultures in which processes of professional learning can thrive and grow as the basis for genuine practice change at scale (e.g. Opfer, Pedder, & Lavicza, 2011; Pedder, 2006; Pedder & MacBeath, 2008; Pedder & Opfer, 2013).

This chapter focuses attention on what we refer to as a school's orientation to learning—those facets of school conditions, leadership and culture geared towards the promotion of teachers' professional learning that is intrinsic to the cultivation of new supportive ecologies for pedagogic innovation within and between schools. For the purposes of the analysis reported here, we operationalise the notion of school orientation to learning by measuring teachers' and leaders' values and practices related to school leadership, culture and professional learning.

There is now a great deal of evidence that the practices, structures and norms of schools enable or constrain teachers (Galloway, Parkhurst, Boswell, Boswell, & Green, 1982; Imants, 2002; Mortimore, Sammons, Stoll, Lewis, & Ecob, 1988; Pollard, 1985; Rutter, Maughan, Mortimore, & Ouston, 1979; Woods, Jeffery, Troman, & Boyle, 1997). Few studies, however, have attempted to understand the influence of the school specifically on teacher professional learning. This chapter presents some of the findings from SoNS (Pedder et al., 2008) as they relate to school orientation to learning. In light of its important influence on teacher professional learning, disentangling the key elements of school orientation to learning will help clarify the kinds of strategies schools can adopt to ensure their collective school orientations to learning align well with the professional learning needs of teachers as a basis for fostering dispositions and practices of innovation.

Findings from SoNS (Opfer et al., 2011) recognise the overwhelmingly multi-causal, multidimensional and multi-correlational dynamics of teacher learning and its impact on teachers' classroom practices. The overall aim of SoNS was to investigate the range and kinds of support that schools in England provide for teacher professional learning as well as the range and kinds of CPD activity which teachers are able to access (for full discussion of the overall aims of the study, see Pedder, Opfer, McCormick, & Storey, 2010). The particular focus of this chapter is on one part of these complex professional learning processes—those aspects related to the learning orientations of schools. More specifically, in developing our analysis, we

assume that just as teachers in a school vary considerably in their professional learning orientations (Opfer et al., 2011; Pedder & Opfer, 2013), there is likely to be at least some, if not, considerable variation in how school orientations to learning are embodied in the practices and values of different groups of teachers. This variation is the focus of analysis presented later in the chapter.

Our assumption that school-level characteristics and conditions influence teacher professional learning and change is supported by a growing body of research evidence. Pedder (2006) concluded from his analysis of survey data from 1212 teachers as part of the Learning How to Learn (LHTL) study (James et al., 2007) the need for schools to cultivate and embed processes and practices of organisational learning if they are to optimise and sustain the quantity, quality and distribution of teachers' and students' learning opportunities. More specifically, Pedder and MacBeath (2008) argue that central to the conception of the learning school is systematic support for teacher learning; teacher learning, they argue, is central to school self-evaluation premised on principles and practices of organisational learning. Consistent with this line of analysis and argument, Opfer et al. (2011) emphasise teacher learning as a dynamic process that is best understood as embedded within rather than separated from the environments in which teachers work and learn.

These arguments contrast with linear understandings of teacher learning which propose that participation in a learning activity leads to change in belief, change in practice and then change in student learning (Desimone, 2009; Guskey, 2002). We want to argue, in line with our earlier work (Opfer et al., 2011), that how and to what extent teachers engage in professional learning activities and then experience professional change is influenced by the orientations of their schools—the values and practices realised collectively and individually by members of staff that characterise the organisational culture, leadership and learning systems of their schools. Little empirical research has been undertaken with a primary focus on the professional learningcultures and systems of schools, a theme we pursue in this chapter.

In the following sections of this chapter, we consider insights and findings from an international body of research in relation to the nature and characteristics of teachers' values and practices as they relate to and serve to clarify a school's orientation to learning. We see school orientation to learning as a core element within professional learning cultures and systems of schools and as a key precondition to a school's cultivation of rich ecologies for innovation. We go on to present aspects of our research design related to the development of our survey instruments, sampling methods and data analysis procedures. We then present our findings in relation to variations in school orientation to learning as reflected in teachers' perceptions of their school's practices for promoting professional learning and the values teachers place on those school practices. In light of this analysis, we go on to consider the validity and usefulness of construing a school's orientation to learning in uniform, monochrome terms. We then go on to discuss the challenges and implications for school policy and leadership for developing strategies that optimise a school's orientation to learning, especially with regard to the needs and perspectives of different groups of teachers. We finally consider implications arising from our findings for

school policy and practice for developing ecologies for supporting and sustaining educational innovation and change.

8.2 School Orientation to Learning

The assumptions guiding the research reported in this chapter are that a school's orientation to learning consists of the collective values and practices of teachers and leaders about the school's leadership, culture and systems for promoting teachers' learning. Our research suggests that a school's orientation to learning influences both whether teachers learn and whether they change their practice as a result of their learning (Opfer et al., 2011).

8.2.1 The Influence of the School on Teacher Professional Learning

Recent research on organisations and learning provides sufficient grounds for assuming that schools influence whether or not teachers learn. For example, Hollingworth's (1999) longitudinal study of primary mathematics teachers' professional development reported that lack of school coordination and leadership, lack of collegial activity and no explicit school commitment to professional development in mathematics underpinned difficulties teachers encountered in implementing new learning in their classrooms.

Pedder (2006) investigated school-level factors that supported teachers' learning as part of the LHTL study. His survey of 1212 teachers in England identified four organisational factors that accounted for 55.6% of the variation on teachers' responses about their learning. These factors included the involvement of teachers in decision-making; development of a clear vision and sense of direction; supports for professional learning (via provision of cover to allow teachers joint planning time, formal training opportunities, encouragement of experimentation, etc.); and auditing expertise and supporting networking of teachers' know-how. Pedder's (2006) study reported a statistically significant relationship between the school-level factors—developing a clear sense of direction, support for professional learning and auditing expertise and supporting networking—and levels of teachers' classroom research, experimentation and learning. He concluded that "If schools are to embody the conditions that optimise and sustain the quality of teachers' and pupils' learning, they need to develop the processes and practices of learning organisations" (Pedder, 2006, p. 175).

A substantial body of literature on the characteristics of schools as learning organisations appears to have reached some consensus on the processes and practices that promote organisational and individual learning including:

- Nurturing a learning environment across all levels of the school (Hopkins, West, & Ainscow, 1996; Senge, 2000).
- Using self-evaluation as a way of promoting learning (MacBeath, 1999; MacBeath & Mortimore, 2001; MacGilchrist, Myers, & Reed, 2004).
- Critically examining core and implicit values and assumptions underpinning institutional practices via introspection and reflection (Argyris, 1993; Argyris & Schön, 1978, 1996; Senge, 1990).
- Creating systems of knowledge management that leverage resources, core capabilities and expertise of staff and pupils (Hargreaves, 1999; Nickols, 2000; Nonaka & Takeuchi, 1995; Zack, 2000).

MacGilchrist et al. (2004) encapsulate the connection between organisational learning of schools and teacher learning well when they argue that "A culture of inquiry and reflection pervades the intelligent school and support for teachers' own learning is fundamental to this culture" (p. 94).

8.2.2 The Influence of School-Level Beliefs and Values on Teachers' Learning

In addition to this work on school systems and practices that support teachers' learning, research also identifies school-level beliefs and values about learning as some of the most important school-level influences on teachers' learning. Organisational values affect teachers' individual and collective practices by establishing norms of action (Sampson, Morenoff, & Earls, 1999). An example of this can be found in Coleman's (1985, 1987, 1990) work on the social theory of normative control which confirmed that a group of teachers would sanction an individual teacher's practice when that practice violates group pedagogical values and beliefs. New or inexperienced teachers are especially vulnerable to adapting their practice to fit with collective pedagogical values and beliefs (Chester & Beaudin, 1996; Woolfolk Hoy & Burke Spero, 2005). Thus, while individual teachers have their own values and practices about teaching and learning (e.g. Pedder & Opfer, 2013), schools collectively also have values and practices about teaching and learning (Opfer et al., 2011).

As well as their collective pedagogical norms, expectations and practices, schools also have collective awareness of their capacity for learning and growth. Goddard (2003) states that "teachers have not only self-referent efficacy perceptions but also beliefs about the conjoint capability of a school faculty" (p. 184). Bandura (1997) argues that "an organisation's beliefs about its efficacy to produce results are undoubtedly an important feature of its operative culture" (p. 476). This collective sense of capacity directly affects the diligence and resolve with which a school chooses to pursue its goals.

8.2.3   Coherence, Coordination and Dissonance: The Capacity for Organisational Learning in Schools

Schools face many difficulties in developing systems, supports and norms that encourage both individual teacher and collective organisational learning. Pedder and MacBeath (2008) caution that schools "struggle internally in developing systems and processes for identifying expertise among staff, supporting the articulation and sharing of knowledge, and using the know-how to improve practices among colleagues" (p. 221). In a similar vein, much of the variation reported by Desimone, Porter, Garet, Yoon and Birman (2002) from the Eisenhower professional development studies in the United States occurred between teachers within a school rather than between teachers in different schools. This led them to observe that "schools generally do not have a coherent, coordinated approach to professional development and instruction, at least not an approach that is effective in building consistency among their teachers" (Desimone et al., 2002, p. 105).

Furthermore, schools are not always willing or lack leadership capacity to leverage dissonance between teachers' beliefs, values and practices for optimising the school as a learning environment for teachers. Argyris and Schön's (1996) work on "theories of action" conceptualises dissonance as a catalyst for schools to attempt to change their environment in ways that better support learning. Their distinction between "espoused theories" (i.e. ideals) and "theories in use" (i.e. practices) illustrates the possibility that beliefs and practices at school level may not align (1996, p. 13). Senge (1990) terms this misalignment "organisational learning disabilities" when schools lack the tools, strategies and/or mindset to address the contradictions, are simply unaware of them or choose to live with the dissonance between them.

However, when the mismatch between values and practices is detected and taken seriously, it serves as an impetus for change. This happens when schools bring to the surface and articulate shared mental models, collective beliefs and norms through examination of core values and assumptions (Argyris, 1993; Argyris & Schön, 1978, 1996) and by being prepared to acknowledge "defensive routines" that are resistant to change (Argyris, 1993). This is a precondition to creating a climate of openness and a willingness to critically reflect and respond (Senge, 1990). This form of deep self-evaluative activity allows teachers and students to see, as through a new lens, routinised behaviour, assumed priorities and forms of "successes" which simply reinforce uncritical single-loop learning. It brings to the surface discrepancies between "espoused theories" and "theories in use". Disconnecting from unproductive defensive routines and habits often entails "creative forgetting" or "intentional unlearning" (Hedberg, 1981; Nystrom & Starbuck, 1984). Cousins (1996) argues that this is essential to fundamental organisational restructuring and reorientation rooted in critically reflexive double-loop learning.

8.2.4 School Orientation to Teacher Learning

In light of this discussion of research on schools and organisational learning, we can conclude that schools can play a substantial role in supporting the kinds of organisational and teacher learning that are intrinsic to fruitful ecologies for practice innovation. Those schools that support learning create continuous learning opportunities, promote enquiry and dialogue, encourage collaboration and team-learning and establish systems to capture and share learning—all of which improve the learning of individuals and also the school itself. Nevertheless, creating these systems is difficult, and many schools fail to provide the systems and supports necessary for teachers to engage in effective professional learning and practice change. School-level elements constituting the school orientation to teacher learning thus include values about learning, teacher learning practices, systems and supports for teacher learning, a collective capacity for learning and creative and critical engagement with dissonance as a catalyst for change when teachers' practices and values do not align. These elements of the school orientation to learning also show evidence of reciprocity. That is, school practices can and do enable teachers' collective values and beliefs, while collective values and beliefs can also result in more enabling school-level practices and structures. In this way, the collective capacity of the school impacts collective goals and enabling structures for organisational growth that impact, and are impacted by, collective norms and practices. How these different elements of a school's orientation to learning are held in balance in different school contexts and under different school conditions, and how policy imperatives shape the nature of schools' ecologies of innovation.

8.3 The Study

Given the importance of school learning orientation for improving teachers' active engagement in effective learning and for building rich ecologies for sustainable innovation, we wanted to explore in further detail the characteristics of school learning orientation—the collective values and practices held by teachers and degrees of alignment or dissonance between them. The following research questions shaped this part of our analysis:

1. How consistent with their personally held values are teachers' perceptions of the collective learning practices of the school?
2. Do different groups of teachers reflect different school learning orientations in the perceptions of their school's practices and the values they place on those practices?
3. If so, what variation is there in the mix of teachers within and between schools in terms of their perceptions of their schools' learning orientations?

8.3.1   Sample

We analysed data from the survey responses of 1126 teachers. The data were collected from a national sample of teachers in England as part of the SoNS research. A sample of 388 schools (329 primary and 59 secondary) were randomly selected from England's National Foundation for Educational Research (NFER) database of schools to be representative of the whole of England's school population in terms of region of the country, school type, location (rural versus non-rural), achievement band of school and proportion of pupils eligible for free school meals. Independent schools were not included in the sample, and academies were oversampled due to their small number at that time, in order to ensure inclusion of teachers from this school type. The NFER database of schools is the most complete listing of schools available in England. No population list of teachers is available for England or even by school from which to sample teachers. As a result, sampled schools were asked to have all their teachers complete the surveys. The lack of a national population list of teachers and school-specific staff lists means that an accurate return rate for teachers cannot be established.

The return rate at the school level was 39% overall, with 36% of primary schools and 56% of secondary schools surveyed responding. While a 39% response rate is not considered statistically generalisable, it is at the high end of the range of response rates reported in recent literature. The response rate from secondary schools of 56% is approaching statistical generalisability—50% is considered adequate, and 60% is considered good for conducting analyses which assume generalisability. The secondary schools' response rate is especially high in the current research context. For a further detailed discussion of bias and response by region, location, school and teacher characteristics, see the full TDA (Training and Development Agency for Schools) survey report (Opfer, Pedder, & Lavicza, 2008, pp. 21–31).

Questionnaires were deleted from the sample if less than 80% of the items were complete and are therefore not included in the response rates or findings presented. All missing data accounted for less than 1% for all variables and for the survey as a whole. Responses from 1126 teachers in these schools are included in the analyses presented in this paper.

The sample size for this study is significantly larger than previous studies of teacher professional development in England and proportional in size to similar studies conducted in the United States. The response rate for large, national surveys is becoming more and more of an issue for conducting research of this kind. In spite of attempts to increase response rates with a variety of techniques, Groves, Dillman, Eltinge and Little (2001) suggest that response rates for all kinds of surveys have been declining since the early 1990s. This tendency especially accelerated after the emergence of web questionnaires. People are receiving an increasing number of solicitations to participate in research studies or marketing research, and they are becoming less likely to respond. A meta-study of 68 surveys in 49 studies by Cook, Heath and Thompson (2000) found an average 39.6% response rate among these

studies. Similarly, Schonlau, Fricker and Elliott (2002) reviewed studies and examined their response rates and found that they ranged from 7% to 44%.

The response fatigue discussed as a reason for decreases in response rates is particularly applicable to developed countries such as the United Kingdom and the United States, where people are frequently asked to complete various questionnaires. With recent increases in testing and accountability reporting requirements, teachers and schools more generally are, perhaps, particularly susceptible to response fatigue. Despite these issues, low response rates may not always suggest bias in the result, and researchers can apply a variety of techniques to deal with non-response (Dey, 1997; Groves et al., 2001).

At the school level, responding schools mirrored schools in the country as a whole within plus or minus 3% on school level, school type, location (whether a school is located in a rural or non-rural area), achievement band (the band categories were designations used by the NFER in the school data that they provided for us: lowest, second lowest, middle, second highest and highest) and proportion of pupils qualifying for free school meals. There was some deviation from expected proportional response by region with 15% more responses received from the northeast and 18% more responses from southeast regions. Comparing the demographics of responding teachers to national population estimates, we found that responding teachers match national proportions within plus or minus 2% on ethnicity, gender, school level of employment, position type, career stage and years of experience.

A closer look at teacher ethnicity provides a good example of the closeness of our achieved respondents to the population. According to the Department for Education and Skills statistics (2005), 91% of teachers identified themselves as White British, 2% as Asian, 1.5% as Black and 0.05% as mixed. Of teachers responding to our survey, 91% identified themselves as White British, 1.5% as Asian, 1.1% as Black and 0.04% as mixed.

With such close matches between respondents and population estimates at both the school and teacher level of our sample, we feel confident that the study presented here does represent national patterns of teacher learning in England.

8.3.2 Survey Instrument

The survey of teachers in the larger study involved four sections: individual learning beliefs and practices, school-level learning beliefs and practices, features of the learning activities in which teachers participated in the previous 12 months and demographics. In this paper, we report findings and analyses from the third section of the survey—Section C—that focused on school-level learning practices and beliefs for professional learning. Teachers were asked to make two kinds of responses to 24 questions. The first response focused on learning practices and supports for learning present in the school. Staff could choose from the following response categories: not true, rarely true, often true and mostly true. The second response in Section C focused on teachers' values and beliefs, indicating how

ABOUT YOUR SCHOOL How often is this true for your school now?				Section C	ABOUT YOUR VALUES How important are these practices for creating opportunities for you to learn?			
Not true	Rarely true	Often True	Mostly true		Not important	Of limited importance	Important	Crucial
				School systems encourage impact evaluation of professional development activities.				

Fig. 8.1 Example of dual scale format questions for Section C of teacher survey

important they felt a particular learning practice or support was for them (see Fig. 8.1 for an example of this dual format). The response categories were not important, of limited importance, important or crucial.

The dual scale format of Section C described above takes into account our understanding of the methods literature on ensuring reliability of teacher self-report. Self-reports of pedagogical practice have generally been found to be consistent with other measures such as observation and classroom artefacts when teachers' descriptions are linked to specific practices and activities (Burstein et al., 1995; Mayer, 1999; Rowan & Correnti, 2009; Smithson & Porter, 1994). Teachers' self-reports tend to be less reliable when they are asked to provide quality judgments about practices or when they are asked about pedagogical concerns not tied to specific practices. Thus, the format tying teacher values about a practice to a specific description of a practice should result in more reliable estimates of teachers' beliefs than questions that ask them about their values in the absence of practice.

8.3.2.1   Survey Data Collection Procedures

In administering the survey, we identified a member of the senior leadership team at each of our sampled schools to act as school contact for the project. Surveys were mailed to these contacts who had responsibility for administering and collection of the completed questionnaires. The local school coordinator then mailed the package of completed questionnaires back in a postage-paid envelope, and the responses were entered by scanning. Combining posted letters, postcards, telephone calls, faxes and emails, we maintained a regular focused communication strategy with schools through a series of repeated contacts to encourage response. An honorarium of £100 was also offered to participating schools in order to optimise response.

Survey responses from teachers were entered and analysed originally in Statistical Package for Social Sciences (SPSS). SPSS was used to calculate means, standard deviations, reliability coefficients (Cronbach's alpha) and correlation coefficients. Responses were aggregated to the school level for all school-level influence

measures. Mean score imputation was used for all missing data since missing data accounted for less than 1% for all variables and the survey as a whole.

8.4   Data Analysis

Two stages of analysis were involved in developing teachers' profiles reflecting their perceptions of their schools' learning practices and the values they place on those school learning practices. The first stage involved identifying factors reflecting the underlying dimensions of school learning orientation. Exploratory and confirmatory factor analysis procedures enabled us to group together similar responses to individual questionnaire items. In this way, a smaller, more manageable set of underlying dimensions of school learning orientation was developed. These dimensions formed the basis for comparing teachers' perceptions of their schools' learning practices and the values they place on them.

The second stage of analysis involved using cluster analysis to group together individual teacher respondents to find out if they clustered in distinct groups according to their perceptions of school learning practices and their values. Through cluster analysis, we were interested in finding out if there were identifiable groups (or clusters) of teachers that each shared similar perceptions of their schools' learning orientations in terms of the underlying dimensions of their perceptions of school practices and values we had identified through factor analysis.

8.4.1   Analysis Stage 1: Identifying Underlying Dimensions of School Learning Orientations Through Factor Analysis

Through exploratory and confirmatory factor analyses, we identified a number of underlying factors (or dimensions) of school orientation to learning based on teachers' perceptions of school practices and the values they placed on those school practices. Items from Section C of the survey on individual teachers' perceptions of their school's practices related to supporting teachers' professional learning were analysed through exploratory factor analysis procedures. The decision about the number of factors which could be reliably identified involved repeatedly going between tables of eigenvalues and scree plots for different factor solutions. Items were included in a factor if they had a factor loading above 0.4 and excluded if they had a loading of more than 0.4 on more than one factor or if they had a loading of less than 0.4 on any factor.

Decisions about factor development also involved consideration of the facets of school learning that we thought (a) were consistent with modes of school learning identified in the research literature and (b) represented important dimensions as a

basis for distinguishing between perceptions of their schools' learning orientations held by different groups of teachers and schools. These exploratory factor analysis procedures were then applied to teachers' values responses, and this produced very similar factors. The same exploratory factor analysis was also carried out with a random sample of 50% of cases for teachers' practice and values responses separately, and again, very similar factors were generated. Finally, factors were used in a structural equation model (SEM) and found to fit the data well, thus confirming decisions made about the construction of factors reported here. See Opfer et al. (2011) for further detailed discussion of procedures for confirmatory factor analysis and construct validation. For example, refinements were made to each factor in order to improve both the factor and model fit overall. Individual items in each factor were deleted if they had high covariation across factors, if they harmed construct validity or if they negatively impacted model fit.

8.4.1.1   Results: School Orientation to Learning

To measure teachers' perceptions of school learning practices, teachers were asked to evaluate, on a four-point scale, how true a practice was for their school. They were then asked how important they believed this particular practice to be for their professional learning. Four constructs were identified through processes of exploratory and then confirmatory factor analysis referred to above: (factor 1) providing formal systems and supports for professional learning", (factor 2) performance management", (factor 3) "social capital conditions for learning" and (factor 4) "supportingcollaboration and networking".

We interpreted the five items in factor 1 as sharing an emphasis on commitment to the school and formal school systems and supports for teachers' professional learning. The items in factor 2 all relate to connections between performance management and professionalism and professional learning. We understood the items in factor 3 as reflecting informal relations of trust, openness and collaboration among teachers without reference to formal school systems. Factor 4 combines items related to school support for teacher collaboration and networking within and between schools. Together, these four factors reflect four distinct but essential facets of a school's orientation to learning that we believe are essential conditions for the growth of a fruitful school ecology for innovation and change. These factors show considerable overlap with factors developed from the LHTL survey (Pedder, 2006; Pedder & MacBeath, 2008), for example, "developing a sense of where we are going" (LHTL) and "providing formal systems and supports for professional learning"; "building social capital" (LHTL) and "social capital conditions for organisational learning"; and "auditing expertise and supporting networking" (LHTL) and "supporting collaboration and networking".

In order to compare teachers' mean practice and values scores, a paired samples *t*-test was conducted for all respondents. Raw scores for each of the four factors were computed to a common scale of 0–100 to allow for direct comparisons between factors consisting of different numbers of items. Table 8.1 shows means for factor

Table 8.1 Means, standard deviations, scale reliabilities, significance of difference and effect sizes for school orientation to learning

School orientation to learning	Values			Practices			Differences
	Mean	*SD*	N/α	Mean	*SD*	N/α	Two-tailed *t* sig. Cohen's *d*
Providing formal systems and supports forprofessional learning	**80.95**	**12.54**	**1056/0.81**	**74.34**	**19.82**	**1053/0.72**	**0.000 0.40**
The senior leadership team promotes commitment among staff to the whole school as well as to the department, key stage or year group	3.46	0.58		3.29	0.78		
Members of staff see the school improvement plan as relevant and useful to teaching and learning	3.12	0.65		2.95	0.84		
Staff development time is used effectively to realise school improvement priorities	3.28	0.58		3.08	0.80		
Formal training provides opportunities for staff to develop professionally	3.24	0.52		3.23	0.68		
Teachers are helped to develop skills to assess pupils' work in ways that move their pupils on in their learning	3.38	0.55		3.19	0.73		
Performance management	**70.91**	**22.58**	**1073/0.89**	**68.57**	**26.80**	**1075/0.89**	**0.001 0.09**
Performance management processes help teachers become more aware of professional standards	3.01	0.67		3.02	0.79		
Performance management processes help teachers to see how their personal professional learning goals relate to school improvement priorities	2.97	0.68		2.99	0.81		
Performance management processes help teachers achieve their professional learning goals	3.05	0.66		2.97	0.80		
Social capital conditions for learning	**81.15**	**12.00**	**1062/0.67**	**78.54**	**17.09**	**1057/0.80**	**0.000 0.18**

(continued)

Table 8.1 (continued)

School orientation to learning	Values			Practices			Differences
	Mean	*SD*	N/α	Mean	*SD*	N/α	Two-tailed *t* sig. Cohen's *d*
Staff offer one another reassurance and support	3.63	0.50		3.59	0.59		
Teachers make collective agreements with colleagues to test out new ideas	3.07	0.54		2.96	0.73		
Teachers discuss openly with colleagues what and how they are learning	3.10	0.59		2.98	0.76		
Staff frequently use informal opportunities to discuss how pupils learn	3.26	0.59		3.33	0.70		
Teachers suggest ideas or approaches for colleagues to try in class	3.31	0.54		3.31	0.67		
Supporting collaborationand networking	**74.62**	**14.52**	**1033/0.56**	**60.77**	**22.78**	**1056/0.60**	**0.000 0.73**
The school provides staff joint planning time	3.21	0.69		2.69	1.06		
School leaders support teachers in sharing practices with other schools through networking	2.85	0.65		2.48	0.89		
Teacher-initiated networking is an integral element of staff development	2.87	0.64		2.65	0.83		

scores in bold (on a scale of 0–100), means for individual items in normal font (on a scale of 1–4), standard deviations, scale reliabilities (Cronbach's alpha, α), significance of difference (two-tailed *t*) and effect sizes (Cohen's *d*) for the values and practice factor scores.

Teachers tended to record higher *values* about learning than their estimation of school-level *practices* (see Table 8.1). Teachers typically placed highest value on social capital conditions for organisational learning ($M = 81.15$) as well as to formal systems and supports for professional learning ($M = 80.95$). Teachers also placed high value on school support for collaboration and networking ($M = 74.62$). Teachers recorded lowest value for performance management ($M = 70.91$). Teachers' perceptions of school practices for social capital conditions were slightly lower than the high value they placed on them ($M = 78.54$). Their perceptions of school practices

for formal systems and supports for professional learning were somewhat below the values they recorded ($M = 74.34$). Teachers tended to perceive school support for collaboration and networking at levels considerably below their values ($M = 60.77$). In fact, teachers recorded their lowest practice scores for this dimension of a school's orientation to learning. Perceptions of performance management practices ($M = 68.57$) were in broad alignment with teachers' recorded values.

As Table 8.1 shows, mean differences between values and practices were significant for all four dimensions of school orientation to learning. Nevertheless, the effect sizes for these differences varied greatly. The effect size difference between values and practices for supporting collaboration and networking was large (Cohen's $d = 0.73$); for providing formal systems and supports for professional learning, the effect size was moderate (Cohen's $d = 0.40$); and for performance management (Cohen's $d = 0.09$) and social capital conditions for learning (Cohen's $d = 0.18$), the effect sizes were small.

8.4.2 Analysis Stage 2: Identifying Groupings of Teachers Through Cluster Analysis

The second stage of the analysis was to group together individual teachers who recorded similar practice scores on the four school learning orientation factors summarised above. Cluster analysis is a statistical procedure for determining whether individuals are similar enough to fall into groups or clusters (e.g. Hair, Anderson, Tatham, & Black, 1998). People are divided up into groups with the intention of ensuring that members of any one cluster share more in common with each other than they do with members of other clusters. Interpretation of cluster analysis results is required at several points.

An important question for us was how many groups might be usefully identified. The smaller the size of groups, the more members of each group will share in common with each other. But, at the same time, the more groups there are, the more difficult it might be to discern patterns of difference between groups. Too few (larger) groups and the risk is an insufficiently refined summary of the data. Too many (smaller) groups and the risk is a level of differentiation that impedes identification of coherent patterns. Our analysis needed to help us identify the optimal number of groups, that is, the number of groups that would provide a sufficiently good fit with the data while at the same time retaining a level of precision helpful for clarifying important differences between groupings of teachers according to the practice and values scores they recorded for their schools' learning orientation.

In order to identify clusters, we used hierarchical clustering procedures using Ward's method. The diagnostic statistics suggested that there were several possible cluster solutions, which could be seen as "signals" in the process of identifying the optimal number and therefore size of groups. There are obvious trade-offs in coming to these judgements. For our data, the "signals" occurred at the six-cluster, four-

cluster and three-cluster stages. We decided that the four-cluster solution was the most useful basis for representing key patterns of difference between groups of teachers in terms of their school orientation to learning.

While the cluster analysis procedure we followed is objective, it does require interpretation at a number of points. The diagnostic statistics generated through cluster analysis procedures provide statistical "advice" to inform decisions about how many groups there are in a given dataset. Although a technical solution to the question of the number of groups is provided, cluster analysis does not comment on whether or not the technical solution is meaningful. The responsibility for interpreting the most meaningful cluster solution is the researchers keeping in mind salient differences between the various groups and the context of previous research.

Each of the four clusters is formed based on the practices and values scores the teachers placed on the school orientations to learning. Each cluster has a distinctive profile in terms of the four school orientation to learning identified through factor analysis. Table 8.7 in Appendix provides descriptive statistics and analysis of variance for the clusters based on practice and values factor scores, respectively. The profiles presented in the section below are based on those descriptive statistics.

8.4.2.1   Results of Cluster Analysis: School Orientation to Learning Profiles

Figure 8.2 represents the profiles of the four teacher clusters in relation to their practice and values scores for each of the four school orientation to learning factors: "providing formal systems and supports for professional learning support", "performance management", "social capital conditions for organisational learning" and "supporting collaboration and networking". The charts feature mean practice and values scores and the gaps between teachers' practices and values for each cluster. Some of the clusters reveal larger gaps between values and practices for certain factors than others.

This study shows that the majority of teachers in schools in England tend to learn and work in contexts of values-practice dissonance. Individually and/or collectively, they may simply choose to live with the dissonance between what they value and their estimations across a spectrum of school and leadership practices. Alternatively, as discussed earlier, conflict between values and perceptions of school practices can prompt leaders to re-examine the range of values held by their staff in relation to their perceptions of practice and to work towards a collective reappraisal of current practices in order to bring practices and values into closer alignment. Collective awareness of dissonance between values and practices by leaders and teachers at school can become a very powerful catalyst for school self-evaluation, organisational learning, innovation and change. To use the terminology of Woolfolk Hoy, Hoy and Davis (2009), awareness of dissonance can result in change-provoking disequilibrium. Indeed, we had found that feeding back values-practice gap data to schools in the context of the LHTL project in the United Kingdom often acted as a powerful resource for organisational learning, school self-evaluation and change.

This kind of data feedback supported school leadership teams in developing more penetrating, critical and reflective understandings of current patterns of practices and values among teaching staff, feeding through in some cases to school improvement planning (Pedder & MacBeath, 2008).

A number of general observations can be made initially with respect to the results of the cluster analysis. First, the most prominent gaps between values and perceptions of school practices are recorded for "supporting collaboration and networking". Second, values and perceived school practices for "supporting collaboration and networking" tend to be low or fairly low for three of the four clusters. Third, perceived practices for "performance management" are the lowest for two of the four clusters.

Beyond these general points, a number of more specific observations can be made about the school orientation profiles for each of the four clusters of teachers illustrated in the charts in Fig. 8.2 and summarised in Table 8.2 and Table 8.7 in Appendix.

The first group we identified through cluster analysis appeared to embody the practices and values consistent with a highly supportive school orientation to learning. As Fig. 8.2 shows, teachers in this cluster recorded high levels of perceived school practices and values for all four school orientation factors or dimensions. Their scores for all factors were above or well above the sample mean (see Table 8.2). Furthermore, their perceptions of school practices were in close alignment with the high value they placed on those practices. Teachers' high levels of values across the wide range of formal and informal supports they perceive to prevail at similar high levels at their schools suggests they experience their school cultures and orientations to learning as well-integrated, multi-faceted, and highly supportive.

The second group seemed to us to reflect a supportive but under-networked school orientation to learning. Teachers in this group recorded mainly high levels of perceived school practices and values for three of the four dimensions of school orientation to learning with practices lagging behind values for each dimension. Their scores on these dimensions were close to the sample mean (see Table 8.2). By contrast, however, what stops us short of characterising school cultures and orientations to learning as well-integrated, on the basis of the perceptions of practice and values of this group, are the low levels of practice ($M = 38.4$) recorded for supporting collaboration and networking. Their levels of values recorded for this dimension ($M = 64.1$) are below the sample mean and markedly lower than values recorded for the other three dimensions. This is why we have understood these teachers' experiences of their schools' cultures and orientations to learning as supportive but under-networked.

We referred to the third group's values and practices as expressing a complacent school orientation to learning. On all four dimensions, teachers in this group recorded perceptions of practice as well as values that were below the sample mean. Perceptions of practice for "performance management" and "supporting collaboration and networking" are markedly below the sample mean. Although values tend to exceed perceptions of practice, the values-practice gaps tend to be quite small, except for the "supporting collaboration and networking" factor with fairly low lev-
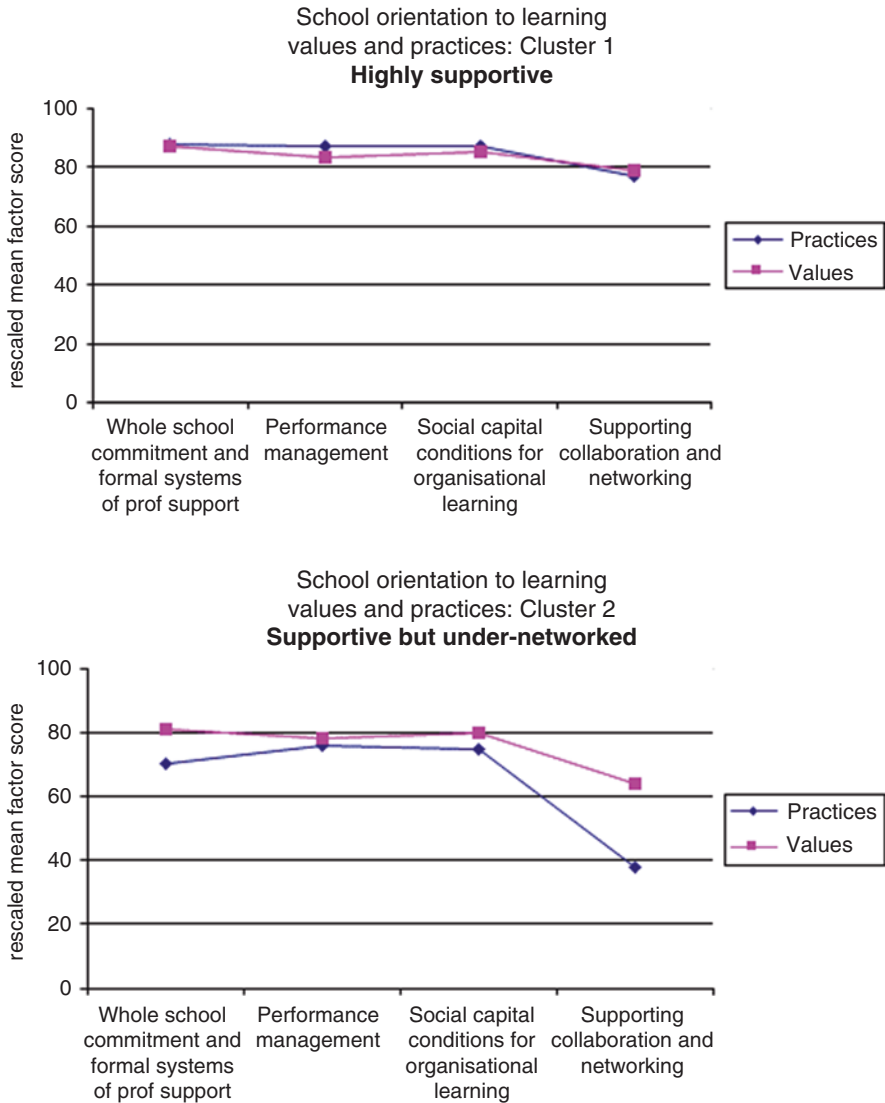
Fig. 8.2 Comparisons of the four clusters of teachers: mean values and practice scores for "providing formal systems and supports for professional learning", "performance management", "social capital conditions for organisational learning" and "supporting collaboration and networking"

els of value ($M = 57.9$) and even lower levels of perceived practice ($M = 41.1$). The small gaps at fairly low levels of practice and values lead us to think that members of this group do not aspire to change the school orientation to learning they experience at their schools. There is a mark of complacency in the responses they recorded.

School orientation to learning
values and practices: Cluster 3
Complacent

School orientation to learning
values and practices: Cluster 4
Under-developed and dissonant
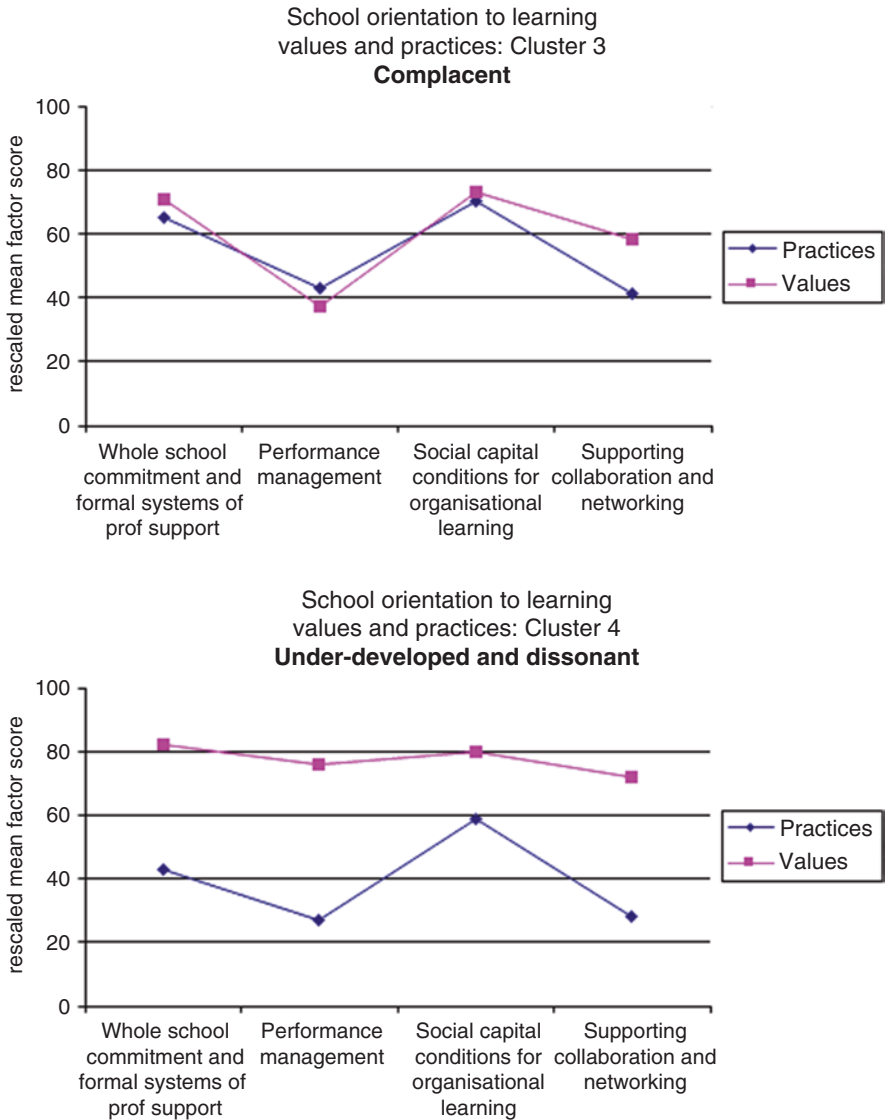
Fig. 8.2 (continued)

The fourth group reflects an underdeveloped and dissonant school orientation to learning. As evidenced in their practice scores, teachers in this group tend to experience the lowest levels of formal and informal school supports for learning of all the four clusters we have identified. Their practice scores were all well below the sample mean (see Table 8.2). In respect of such low levels of perceived practices, we interpreted the orientations to learning of these teachers' schools as underdeveloped. In contrast to the low and very low levels of school support these teachers

Table 8.2 Relative positions of the four clusters in relation to whole sample mean scores for each school orientation to learning factor

Clusters					
Factors		Highly supportive (*n* = 394)	Supportive but under-networked (*n* = 289)	Complacent (*n* = 208)	Underdeveloped and dissonant (*n* = 101)
Providing formal systems and supports for professional learning	Practices	Well above average	Slightly below average	Below average	Well below average
	Values	Above average	Slightly below average	Below average	Slightly above average
Performance management	Practices	Well above average	Above average	Well below average	Well below average
	Values	Well above average	Above average	Well below average	Above average
Social capital conditions for organisational learning	Practices	Above average	Slightly below average	Below average	Well below average
	Values	Above average	Slightly below average	Below average	Slightly below average
Supporting collaboration and networking	Practices	Well above average	Well below average	Well below average	Well below average
	Values	Above average	Below average	Well below average	Slightly below average

Note: For the purposes of presentation, the statistics have been put in the form of word descriptions. Further details are provided in Table 8.7 in Appendix.

experience, members of this group recorded much higher values for all four dimensions of school orientation to learning—either close to the sample mean or above the sample mean (see Table 8.2). They clearly have a strong sense of the importance of all facets of their school's orientation to learning but do not experience the benefits of such support in practice. The values-practice gaps for this group are the largest for all the groups we identified, and hence we have described the orientation to learning of their schools as dissonant as well as underdeveloped.

8.4.2.2 Comparisons in the Cluster Memberships of Primary and Secondary School Teachers

In Table 8.3, the number of members in each cluster is given in brackets in column one. The proportion of all teachers in each cluster is presented in column two. Taking our sample as a whole, the largest proportions of teachers reflect highly supportive (40%) and supportive but under-networked school orientations to learning. The remaining 31% of teachers reflect complacent or underdeveloped and dissonant school orientations to learning. The proportions of primary and secondary school teachers in each cluster are compared in columns three and four.

Table 8.3 Incidence of school orientation clusters by school sector

School orientation to learning clusters	All (%)	Primary (%)	Secondary (%)
1. Highly supportive ($n = 394$)	40	52	21
2. Supportive but under-networked ($n = 289$)	29	28	31
3. Complacent ($n = 208$)	21	16	29
4. Underdeveloped and dissonant ($n = 101$)	10	4	19
Total	100	100	100

Note: χ^2 test indicates there is a significant association between school orientation to learning profiles and school sector ($\chi^2 = 128.355$, $p < 0.001$, $n = 992$)

Table 8.3 shows some interesting comparisons between school orientation to learning in primary and secondary schools. Interestingly, the proportion of primary teachers (52%) who reflect a highly supportive school orientation is much higher than the proportion of secondary teachers (21%). There are higher proportions of secondary teachers who reflect complacent or underdeveloped and dissonant school orientations to learning.

8.4.2.3 Variation Across Schools

Table 8.4 shows the extent to which schools differ in terms of the mix of school orientation profiles (cluster memberships) among their staff. To do this, we ranked schools according to the percentage of their staff members in each cluster, and then we compared the percentage of staff at the school at the upper and the lower quartile and at the median for each cluster group.

A school at the upper quartile is the school at the cut-off point where 25% of schools have a higher percentage of staff in a given cluster and where 75% of staff have a lower percentage of staff in the given cluster. A school at the lower quartile is a school at the cut-off point where 75% of schools have a higher percentage of staff in the cluster and where 25% of schools have a lower percentage of staff in a given cluster. A school at the median is in the middle of the ranking for any particular cluster, 50% of schools having a higher percentage of staff in a given cluster and 50% of schools having a lower percentage of staff in the cluster.

Table 8.4a shows differences between primary and secondary schools combined; Table 8.4b shows differences between primary schools, and Table 8.4c shows differences between secondary schools. Comparing schools at the upper and lower quartiles provides an indication of the differences between schools in terms of the mix of teacher learning cluster memberships among their respective members of staff.

Some caution is needed in interpreting some of the percentages because, for smaller primary schools, they are based on small numbers of staff. The small size of primary schools may exaggerate differences because a small number of teachers can represent a high percentage of staff in a small school. Nonetheless, there appears to be considerable variation in the mix of different school learning orientation profiles reflected in teachers' perceptions of practice and their personal professional values

Table 8.4 Incidence of school orientation clusters across schools

School orientation to learning clusters	School at upper quartile (% of staff)	School at median (% of staff)	School at lower quartile (% of staff)
(a) Primary and secondary schools combined			
1. Highly supportive	75	50	30
2. Supportive but under-networked	60	38	25
3. Complacent	50	29	20
4. Underdeveloped and dissonant	43	25	20
(b) Primary schools only			
1. Highly supportive	83	56	33
2. Supportive but under-networked	54	33	22
3. Complacent	40	25	14
4. Underdeveloped and dissonant	33	20	12
(c) Secondary schools only			
1. Highly supportive	31	27	22
2. Supportive but under-networked	41	33	21
3. Complacent	40	31	24
4. Underdeveloped and dissonant	32	25	18

Note: χ^2 test indicates there is a significant association between teacher learning profiles and school sector ($\chi^2 = 24.564$, $p < 0.001$, $n = 1076$)

at different schools. This suggests that different schools can face rather different challenges in engaging different groups of teachers for the purpose of developing school orientations that effectively support and promote teachers' professional learning.

For example, the proportion of teachers who reflect a highly supportive school orientation in their practice and values responses varies considerably across all schools. If we focus on primary and secondary schools combined (Table 8.4a), schools at the upper and lower quartile differed by more than 40%. That is to say, 75% of teachers at the upper quartile schools reflected a highly supportive school orientation in their questionnaire responses, whereas only 30% of staff at the lower quartile schools reflected the same orientation in theirs. Similarly, if we focus on primary schools (Table 8.4b), the proportion of staff who reflected a highly supportive orientation (83%) at the upper quartile school is considerably higher than the proportion at the lower quartile school (33%). Comparisons of the proportion of staff at the upper and lower quartile schools in each of the clusters suggest considerably less variation overall in secondary than primary school orientations to learning.

Interestingly, if we take all schools combined (Table 8.4a) and primary schools (Table 8.4b), we can see that there is most variation between schools in relation to

highly supportive and supportive but under-networked school orientations to learning. Least variation is recorded for complacent and underdeveloped and dissonant school orientations to learning.

8.4.2.4 Comparisons of the Cluster Memberships of Different Categories of Teachers

The school orientation to learning profiles varied significantly by leadership responsibility and by gender. Variation of profiles by location and achievement band were also considered and found not to be significant. In this section, we consider comparisons of school orientation to learning profiles by leadership responsibility and by gender.

8.4.2.5 Leadership Responsibility

Table 8.5 reports variation in school orientation to learning profiles by leadership responsibility. A marked pattern of difference here is the higher proportions of senior (58%) and middle leaders (46%) than teachers with no leadership responsibility in the highly supportive cluster. Lower percentages of senior leaders are members of complacent or underdeveloped and dissonant clusters than middle leaders and teachers with no leadership responsibility. A little more than a quarter of middle and senior leaders are included in the supportive but under-networked cluster compared with a little over a third of teachers with no leadership responsibility.

8.4.2.6 Gender

Table 8.6 reports variation in school orientation to learning profiles by gender. Our data shows a higher proportion of female than male teachers in the highly supportive cluster and a higher proportion of male than female teachers in the complacent cluster.

Table 8.5 Incidence of school orientation clusters by leadership responsibility

School orientation to learning clusters	No responsibility (%)	Middle leaders (%)	Senior leaders (%)
1. Highly supportive	27	46	58
2. Supportive but under-networked	34	26	26
3. Complacent	26	18	14
4. Underdeveloped and dissonant	13	10	1
Total	100	100	99

Note: χ^2 test indicates there is a significant association between school orientation to learning profiles and leadership responsibility ($\chi^2 = 45.127$, $p < 0.001$, $n = 975$)

Table 8.6 Incidence of school orientation to learning clusters by gender

School orientation to learning clusters	Female (%)	Male (%)
1. Highly supportive	42	31
2. Supportive but under-networked .	30	27
3. Complacent .	18	31
4. Underdeveloped and dissonant .	10	11
Total	100	100

Note: χ^2 test indicates there is a significant association between school orientation to learning profiles and gender ($\chi^2 = 15.827$, $p < 0.001$, $n = 979$)

8.5 Discussion

In this chapter, we have defined and discussed the value of school orientation to teacher learning. Teacher learning is key to initiating and sustaining innovative practices. It is useful to understand the factors that enable schools to create a supportive ecology for innovation. A supportive ecology is one where relationships between school practices for organisational and teacher learning and teachers' values on those practices are a focus of a school's critical self-evaluation and double-loop learning processes. A supportive ecology enables both individual and collective teacher learning and organisational learning. However, schools find it difficult to leveragedissonances between school practices for teacher learning and what teachers' values to create policies and strategies for establishing a supportive ecology for innovation.

We presented a new typology of school orientations related to patterns of alignment and dissonance between school practices for teacher learning and the values teachers place on them. We developed this typology on perhaps the largest and most extensive national survey of teachers in England conducted in the field to date.

8.5.1 Dimensions of School Orientation to Learning

A central thread running through the research is the importance of school orientations to learning for nurturing teachers' professional learning as an embedded feature of pedagogic change processes and thereby for cultivating ecologies of innovation. We identified four dimensions of school orientation to learning through factor analysis procedures: "providing formal systems and supports for professional learning", "performance management", "social capital conditions for learning" and "supporting collaboration and networking". We have argued that a school's orientation to learning is reflected in teachers' perceptions of school practices for teacher learning, the values they place on those practices and the degrees of dissonance or alignment between such practices and values.

We went on to argue that how schools understand and respond to patterns of dissonance or alignment is important for understanding organisational dispositions and readiness of different schools for supporting teacher learning and so for promoting ecologies for innovation and pedagogic change. School practices on which teachers place high values are practices that are more likely to be successfully implemented or at least more likely to be prioritised by teachers in practice. And as such, these highly valued practices are more likely to be incorporated as sustained and embedded features of school and classroom life. Conversely, school practices that are not valued by teachers are more likely to encounter challenges in their implementation because they are less likely to be prioritised by teachers and therefore less likely to be sustained and embedded.

Taking our sample of teachers together, analysis of our data (summarised in Table 8.1) suggests that schools in England sustained high levels of well-aligned practices and values for social capital conditions for learning in terms of, for example, mutual reassurance and support among teachers, open discussion about learning and habits of sharing ideas and resources. Similarly, high values tended to be recorded for schools' more formal systems and supports for learning, accompanied by fairly high practices in terms of staff commitment to the whole school, their perceptions of the relevance of the school's improvement plan to teaching and learning, formal training opportunities and the like. Performance management practices and values were focused on links between performance management and professional learning and between professional learning and school improvement priorities. Practices and values for this dimension of a school's orientation to learning were well-aligned but at lower levels than those recorded for social capital conditions and formal systems of professional support. Our fourth dimension of school orientation to learning, supporting collaboration and networking, focused on school provision for joint planning time, school support for networking with other schools and teacher-initiated networking. Teachers tended to place quite high values on these practices, but their perceived levels of practices were very much lower.

8.5.2   Typology of Teachers Based on Their School Orientation to Learning

Through cluster analysis, we went on to introduce a new typology of teachers based on school orientation to learning (summarised in Fig. 8.1. and Table 8.2.). We did this by developing profiles of teachers based on their values and practices in relation to each of the four dimensions of school orientation to learning. It is important to remember that these are not profiles of schools but of teachers at different schools in England. We identified four main groupings of the 992 teachers included in the cluster analysis. They reflected, in their perceptions of school practices and their values, school orientations to learning that were highly supportive ($n = 394$), supportive but under-networked ($n = 289$), complacent ($n = 208$) and underdeveloped

and dissonant ($n = 101$). Encouragingly, the largest group of teachers reflected a highly supportive school orientation to learning, and the majority of teachers (683 teachers from a total of 992) were in the two groups characterised by what we considered to be the most fruitful school orientations to learning for developing teacher professional learning—highly supportive and supportive but under-networked.

A significant minority of teachers ($n = 309$) reflected less positive school orientations. These 309 teachers were divided into two groups that we identified as complacent on one hand and underdeveloped and dissonant on the other. Both groups shared perceptions of practice for each of the four dimensions that were lower than the other two groups and below the sample mean; however, their values profiles were markedly different from one another. The complacent group's values were in alignment with their perceptions of fairly low or low levels of practice. The underdeveloped and dissonant group held values that were considerably higher than their perceptions of low levels of practice; indeed, the values of this group were either close to the sample mean or well above it, while practices were well below the sample mean for all four dimensions of school orientation to learning.

The most prominent source of values-practice dissonance in our findings relates to the "supporting collaboration and networking" facet of a school's orientation to learning. Our cluster analysis showed that 598 teachers out of the total of 992 teachers included in the cluster analysis reflected large gaps between their perceptions of low levels of practice and the much higher values they placed on "supporting collaboration and networking". These 598 teachers were members of the supportive but under-networked, complacent and underdeveloped and dissonant groupings. It was only the 394 teachers of the highly supportive group who exhibited high levels of school support for collaboration and networking in line with their similarly high values. These data reflect the difficulty that most schools appear to have in developing the cultures, systems and supports conducive to rich ecologies for innovation. In other words, most schools struggle to create systems of support for teachers to work together to develop more collaborative approaches to planning, evaluation, research and the collective generation of ideas and expertise and their mobilisation through networks within and between schools. School cultures, systems and supports for these kinds of collective learning, practice generation and network are vital if teachers are to be properly supported to learn together and to develop innovative solutions to an increasingly complex range of pedagogic problems they encounter in classroom lessons.

8.5.3   Variation in School Orientation to Learning Within and Between Schools

The next step in the research was to move to an analysis of within and between school variations in school orientations. We analysed the mix of different orientations within schools (summarised in Tables 8.3, 8.4, 8.5 and 8.6) and between different schools (see Table 8.4) as reflected in teachers' values-practice profiles. A

much higher proportion of primary than secondary school teachers reflected a highly supportive school orientation. Conversely, a higher proportion of secondary than primary teachers reflected complacent and underdeveloped and dissonant school orientations (see Table 8.3). Our findings also suggest considerable variation between schools, especially between primary schools (see Table 8.4).

Further research is needed to understand more about the different opportunities and constraints that influence the contrasting school orientations to learning in primary compared to secondary schools. If it is a matter of scale and size, through what processes do size and scale influence school orientation to learning and thereby a school's ecology for innovation? Are there more inclusive systems of support and trust, stronger collective norms and more constructive forms of collegiality in primary schools than in secondary schools that underpin more supportive school orientations to learning? If so, how are these more inclusive and constructive forms of collegiality established and sustained? If it is a matter of gender balance in different school sectors (primary schools tend to have much higher proportions of female than male teachers than secondary schools, and female teachers tend to reflect more supportive school orientations than male teachers), are there systematically distinctive gender-related characteristics that can explain this? We are cautious about these conclusions because the small size of some of the primary schools in our sample may exaggerate differences because a small number of teachers can represent a high percentage of staff in a small school.

Our findings also suggest considerable variation in the mix of orientations within schools. Distinctive school learning orientation profiles were recorded by teachers, particularly in relation to gender and leadership responsibility. Higher proportions of senior leaders than middle leaders and teachers with no leadership responsibility recorded practices and values that reflected a highly supportive school orientation to learning. And higher proportions of middle leaders than teachers with no leadership responsibility recorded a highly supportive school orientation to learning in their responses. Conversely, a higher proportion of teachers with no leadership responsibility than middle and senior leaders recorded a complacent school orientation to learning. Our findings also suggest that male and female teachers' perceptions of school practices and their values on those school practices tend to vary. A higher proportion of female teachers reflected a highly supportive school orientation to learning, and a higher proportion of male than female teachers reflected a complacent school orientation to learning.

8.5.4   Leveraging Values-Practice Dissonance and Alignment for Creating Policies and Strategies for Building a Supportive Ecology for Innovation

Overall, our analysis of the incidence of school orientation to learning clusters of teachers within schools supports a view of school orientation to learning as multivoiced, heterogeneous and plural. This points to the inadequacy of single labels for

capturing this aspect (and perhaps any aspect) of a school's culture. Alongside this plurality of school orientation to learning, the concepts of dissonance and alignment are very strong themes that run through our analysis and findings. In any school, values-practice dissonance or alignment can act as liminal spaces in which transformational learning, including the organisational learning of schools, can take place in ways that are relevant to and generative of the development and establishment of supportive ecologies for nurturing pedagogic innovation in schools. Underpinning this argument is the idea that awareness among school leadership teams of conflicting interplay between teachers' perceptions of school practices and their values can result in a "change-provoking disequilibrium" (Woolfolk Hoy et al., 2009).

A strategy of feeding back the values and estimates of organisational and leadership practices of a school's staff to those schools individually reflects principles of school self-evaluation (e.g. MacBeath, 1999) as a continuing process of organisational learning embedded in the day-to-day life of classrooms and schools (Pedder & MacBeath, 2008). Here an ecology of innovation begins to grow through the collective interpretive work of the school teachers and leaders who supplied the data in their questionnaire responses. Through the sense-making that is achieved during reflective conversations among school staff, the full richness and school relevance of the data become apparent and more nuanced. James et al. (2007) reported from their LHTL research that asking teachers and leaders to make sense of gaps between teachers' perceptions of school practices and the values they place on those practices was a useful means for leadership teams and groups of staff to develop more penetrating, critical and reflective understandings of current organisational practices at their schools (Pedder & MacBeath, 2008).

Schools differed however in how their leadership teams interpreted and engaged with change-provoking disequilibria reflected in gaps between teachers' perceptions of school practices and their values. Some leadership teams were disposed to a single-loop learning and mindset (Argyris & Schön, 1978, 1996). They not only avoided development of rigorous self-evaluation processes that make such disequilibria and their underpinning values-practice dissonance visible, but in some cases they also construed the possibility of such disequilibria as a risk, jeopardising what they viewed as a stable state of prevailing operational efficiency. Such schools might be simply unaware of contradictions and disequilibria, or they might simply choose to live with the underpinning values-practice dissonance. The problem arises when school staff act on the basis of different and unexpressed values-practice perspectives in relation to key purposes of a school's life; then discontinuities and conflicts can solidify into forms of systemic incompetence (Pedder & MacBeath, 2008). Such schools are disabled from growing ecologies of innovation, unable to support fruitful change. Indeed, in some cases they resist further change, preferring instead to cultivate and hide behind organisational learning disabilities (Senge, 1990) and

defensive routines (Argyris, 1993; Argyris & Schön, 1978, 1996) that inhibit development of the mindset, tools and strategies for constructively and critically engaging with values-practice dissonance as a resource and growth point for a school's ecology for innovation. It is in the more critical second loop penetration towards a school's underpinning values that organisational learning deepens, becoming genuinely transformative (Argyris & Schön, 1978, 1996). In this way, a school's ecology for innovation is replenished by embracing a more critical reflection and introspection on the values and practices of school staff as the basis for planning future action and change.

    In the context of the research reported in this chapter, schools that adopt double-loop learning strategies are prepared to face up comfortably or uncomfortably to the challenges of learning individually and collectively about themselves, and this raises the question of how do we as a school organisation learn? Engaging critically with this question is a necessary stage in the growth of an ecology for innovation. More specifically, and in the light of the research reported in this chapter, this challenges a school to see itself less in terms of a tidy, conveniently homogenous school orientation to learning that is easily managed. Instead, our research suggests that schools should be prepared to see themselves in terms of a far less convenient complex of multiple contrasting orientations to learning reflected in distinctive values-practice profiles of different groupings of teachers. Schools willing to learn and grow with a double-loop critical approach are willing to adapt and develop strategies that enable distinctive groupings of teachers among their staff to be recognised and heard. Such schools have evolved systems, cultures and a mindset for embracing multiple perspectives of teachers and leaders as a resource for developing more differentiated policy directed at catering to a diverse range of professional learning needs within and between schools. A school's differentiated strategy for professional learning and change needs to articulate with and respond to the specific mix of orientations of particular groups of teachers in its particular organisational learning culture and ecology. Using a dual scale format survey instrument, such as the one used in this study, as part of a school's self-evaluation processes is one useful strategy for enabling schools to develop diagnostic data as a basis for developing such more differentiated and responsive strategies of professional learning supports. This provides arguably the best scope in which schools and networks of schools may nurture supportive ecologies for innovation well suited to the particular range of their orientations to learning.

Appendix

Table 8.7 Descriptive statistics for each cluster

Clusters		Factors							
		"Promoting commitment to whole school and providing formal systems of professional support"		"Performance management"		"Social capital conditions for organisational learning"		"Supporting collaboration and networking"	
		Practices	Values	Practices	Values	Practices	Values	Practices	Values
1. Highly supportive	Mean	88.4	86.6	86.7	82.9	86.9	84.9	77.5	78.6
	SD	10.4	10.2	13.9	12.3	11.5	10.1	15.8	12.7
2. Supportive but under-networked	Mean	70.5	80.9	76.3	78.3	75.5	80.2	38.4	64.2
	SD	17.1	9.6	14.3	9.8	16.7	11.2	17.0	18.2
3. Complacent	Mean	65.2	71.5	43.5	36.5	70.1	72.7	41.1	57.9
	SD	19.1	13.3	23.4	19.7	17.8	14.5	22.6	20.1
4. Underdeveloped and dissonant	Mean	43.4	82.0	26.6	76.1	59.2	79.5	27.9	72.4
	SD	17.8	10.1	13.6	13.2	23.0	12.6	20.4	15.5

Note: ANOVA confirms that the mean scores on each factor differed significantly ($p < 0.01$) by cluster except for the following:
Values scores: Promoting commitment to whole school and providing formal systems of professional support— Clusters 2 and 4 ($p = 1.00$); Performance management—Clusters 2 and 4 ($p = 0.97$)
Social capital conditions for organisational learning—Clusters 2 and 4 ($p = 1.00$)
Practice scores: Supporting collaboration and networking—Clusters 2 and 3 ($p = 0.58$)

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David Pedder is Deputy Vice Chancellor - Academic at Emirates College for Advanced Education. His teaching and research interests include pedagogy and pedagogic innovation, teacher professional learning, organisational learning and educational leadership and school improvement. He has completed large- and small-scale funded research projects in the United Kingdom and overseas related to teacher professional learning, pupil voice, learning how to learn and activity-based learning.

V. Darleen Opfer has served as a Director of RAND Education since 2011; she also holds the Distinguished Chair in Education Policy. From 2005 to 2011, she was a Director of Research and Senior Lecturer in research methods and school improvement at the University of Cambridge's (England) Faculty of Education. Her research work utilises large-scale surveys and other methods to understand the conditions that impact outcomes for teachers. She currently leads the TALIS Video Study funded by the OECD—a study using video observation, surveys and student achievement tests to explore the association between teaching practices and student outcomes in eight countries. In 2015, the Helmsley Trust funded her to conduct a 3-year national, longitudinal study of teachers' implementation of new state standards. With Brian Stecher, she launched RAND's American Teacher Panel and American School Leader Panel in 2014 which are two nationally representative longitudinal panels of teachers and school leaders in the United States who respond to surveys three to four times per year to track impacts of education policies. She was also selected as a Thomas J. Alexander Fellow by the OECD in 2014 where she used TALIS 2013 data to explore conditions that support teacher professional development in TALIS-participating countries. Her research has also included studies of teacher professional development conducted in England, Turkey and the United States as well as studies of teacher recruitment and retention in Scotland and the United States.

Chapter 9
Seeding Change: Growing and Sustaining a School's Culture of Innovativeness

Shu-Shing Lee, Peter Seow, and David Hung

Abstract The twenty-first century compels schools to shift towards dialogic, student-centred learning orientations. This change involves developing teachers' capacities to innovatively balance teacher-directed and student-centred approaches to provide students with quality learning experiences. This chapter describes a Singapore school's change journey in which teachers were encouraged to engage in ICT-mediated curricular innovations and grow a culture of innovativeness. We postulate that change involves interactions and alignments at multiple levels (school, district, and national) of the education system. We appropriate theoretical understandings of change and leadership informed by a systems and complexity viewpoint to unpack the tenets of change which shape a school's culture of innovativeness in the Singapore context. Findings describe structures and processes for change that the school leader created by initiating curriculum innovations, developing teachers' capacities to balance teacher-centred with student-centred approaches, and sustaining the school's culture of innovativeness. Findings are discussed to understand the directives from the education system and the mechanisms that school leaders create to catalyse change from a top-down approach, as well as the synergies within and across levels of the education system which school leaders address so as to encourage bottom-up efforts and stakeholders' ownership to spread and sustain cultures within and across schools.

9.1 Introduction

Globalisation and fluid interconnections in the twenty-first century mean schools need to change (Freidman, 2006; Kay, 2010) and to innovate and move away from didactic to dialogic, student-centred practices (Dimmock & Goh, 2011). As the twenty-first century demands students to be knowledge creators and problem-solvers, old ways of learning are insufficient for the twenty-first-century

S.-S. Lee (✉) · P. Seow · D. Hung
National Institute of Education, Nanyang Technological University, Singapore, Singapore
e-mail: shushing.lee@nie.edu.sg

competencies needed in complex workforce situations (Voogt & Roblin, 2012). Twenty-first-century learning requires a "demand and pull" model. Basic academic skills are important, but dispositions such as problem solving and adaptivity are more essential (Herr, 1993; Nevins & Stumpf, 1999).

The Singapore education system emphasises academic achievements (Organisation for Economic Cooperation and Development, 2011). The routine instructional regime stresses teacher talk and academic rigour to ensure successes (Hogan, 2014; Mourshed, Chijioke, & Barber, 2010). Moving forward, the Singapore Ministry of Education (MOE) recognises curriculum innovations as common interventions for change towards twenty-first-century, student-centred teaching and learning (Mourshed et al., 2010).

Curriculum innovations shape change in individuals, cultural, and social systems (Mourshed et al., 2010; Priestley, 2005). They develop innovativeness in teachers, students, and the education system. The challenge is to innovatively balance student-centred practices and its extent of use while maintaining quality learning experiences and outcomes. Other constraints include aligning policies and standards while innovating within the existing educational frame and historical and cultural contexts (Gopinathan, Wong & Tang, 2008; Ng, 2008). This sets the backdrop for understanding change and the external forces that shape how schools develop a culture of innovativeness for twenty-first-century, student-centred learning. The issue is to understand how schools work within this milieu while creating enabling structures and processes that encourage teachers to change and initiate curriculum innovations.

This chapter describes a case study of a school's change journey. It considers this research question, "What are the key tenets of change that shape and sustain a culture of innovativeness?" We draw on theoretical understandings of change and leadership informed by a systems and complexity viewpoint to unpack structures and processes that the school leader creates to initiate change and a culture of innovativeness. This chapter informs tenets of change that are nuanced to the Singapore education landscape by understanding change at the school level of analysis. Findings describe mechanisms that the school leader creates to strategically seed change through ICT-mediated curriculum innovations and grow a culture of innovativeness that balances teacher-centred practices with dialogic, student-centred practices.

The chapter postulates that change involves interactions and alignments at multiple levels (schools, district, and national) of the education system. Further contributions include teasing out directives from the education system and mechanisms that school leaders leverage to trigger change from a top-down approach, as well as alignments from bottom-up efforts that make change meaningful for stakeholders. Findings discuss school leaders' roles in catalysing change and creating synergies to spread and sustain cultures within and across schools.

9.2   Literature Review

9.2.1   *Understanding Change from the Systems and Complexity Viewpoint*

In a competitive twenty-first-century milieu, organisations are managing change. This is no different for schools and education systems. Change relates to changing mindsets about education and creating a shared vision that propels stakeholders (Jenlink, Reigeluth, Carr, Nelson, 2010). Schools are part of the education system comprising schools, districts, and national levels. "A system is a set of two or more elements where the behaviours of each element have an effect on the behaviour of the whole; the behaviour of the elements and their effects on the whole are interdependent…" (Amagoh, 2008, p. 2). Schools are therefore continuously interacting in the education system through complex relationships between stakeholders and factors that may be beyond their control (Mason, 2007).

Schools' ability to change depends on their intra- and interrelationships with others in the education system. Change is unpredictable and non-linear. It unfolds based on dynamic interactions amongst these relationships (Fullan, 2003; Reigeluth & Garfinkle, 1994). From a systems and complexity perspective, schools functioning as complex adaptive systems learn from the external environment to change its internal structures and processes. Consequently, schools are living systems where chaos and threats are appreciated as opportunities for fresh ideas. Equilibrium is less desired. It makes living systems unresponsive to its environment (Morrison, 2008).

Schools as complex adaptive systems operate near the edge of chaos. Schools exhibit adaptivity and autocatalysis where new relationships are continuously formed with internal and external environments to collectively and orderly move the system in a certain direction (Amagoh, 2008; Fullan, 2003). There are no central controls. Parts are constantly driving disequilibrium, so the system improves (Kauffman, 1993, p. 47; Sherif, 2006, p. 75). Amongst the randomness and changes are patterns known as "attractors". Attractors maintain order, alignments, and coexist with forces that push change (Amagoh, 2008; Fullan, 2003).

The systems and complexity viewpoint enables one to appreciate the education ecology (Bronfenbrenner, 1992) and how each subsystem (school, district, and national) interplays to shape change. It enables school leaders to plan change by understanding how structures and processes which situate within and beyond schools influence change. Although literature provides conceptual understandings of change from the systems and complexity viewpoint, the challenge for schools and leaders is to design change that approximates the desired outcome while aligning with the broader education context. The problem for schools is not the absence of innovations but many piecemeal changes with additional burdens of policies and innovations cascading down from state bureaucracies (Adelman & Taylor, 2003; Fullan 1993). Consequently, school leaders need to design productive disturbances and coherences within and across levels of the education system in order to initiate and sustain change.

Leadership from the middle (Fullan, 2009) suggests school leaders are key in designing conditions, structures, and processes that enable curriculum innovations for twenty-first-century cultures of learning and create butterfly effects within and across schools. School leaders play critical roles in enacting activities that change cultures and improve schools, such as (1) setting directions through vision building, (2) developing people through individualised support, (3) organising structures to motivate stakeholders towards a moral imperative, and (4) building relationships with the local community (Harris, 2002).

This chapter addresses gaps in literature by sharing insights of how change from a systems and complexity viewpoint is useful to describe a Singapore school's change journey. In particular, we address the importance of school leaders in leveraging disturbances in the Singapore education landscape to trigger change and the roles which school leaders play in forming intra- and interschool alignments for spreading and sustaining change.

9.2.2   Understanding the Change Process and Role of School Leadership

The systems and complexityperspective describes rapid, non-linear change and how chaos energises schools. This perspective does not elaborate the change process, particularly how school leaders plan and enact change to develop innovativeness in schools (i.e. a balance of teacher-centred and student-centred learning).

Fullan (1993, 2014) stresses that seeding change is less about initiating innovations. It is not enough to have good ideas. More importantly, it is to grow and sustain a culture of innovativeness. School leaders need to engage teachers in innovations so that there are depth and coherence towards a vision and moral purpose. The vision needs to excite, so teachers become committed to developing capacities and participating in innovations. Change arouses emotions. School leaders need to empathise and redefine teachers' resistance to innovations. Ways to overcome fears involve building relationships, communities, and capacities amongst teachers. Resisters create dynamics that help schools traverse chaos and seek coherences which create learning moments for teachers. Deep change is about re-culturing practices. It is rarely a checklist of steps.

Discussions above imply that given the intricacies of change, school leadership is critical in cultivating a culture of innovativeness. Change is less about strategy and more about strategising. School leadership is key in mobilising people and tackling challenges. Leadership that drives change is a combination of leadership styles and strategies (e.g. Hall & Hord, 2014; Hallinger, 2003). "Motion leadership" (Fullan, 2013) is useful to understand how school leaders navigate the education terrain by describing approaches and synergies across school, district, and national levels that school leaders consider to manage and sustain change.

Fullan (2014) suggests that good leadership is internalised through doing, understanding strategies, and reflecting decisions for different circumstances. Motion leaders recognise the collective power. They constantly create push and pull and nudge forces to generate momentum for change. Motion leadership articulates the complexity of school leadership as a combination of change, implementation, and sustainability stances in a strategising process (Fullan, 2013).

9.3 The Conceptual Framework

While literature provides conceptual understandings and case studies of how school leadership and change are enacted, different contexts exert varying forces so different strategies are needed. This chapter provides nuanced insights of a Singapore school's tenets of change. Guided by literature on change and leadership from the systems and complexity viewpoint, Fig. 9.1 shows the conceptual framework and postulations made where transformations in schools involve interactions and alignments across national, district, and school levels of the education system. Schools cannot expect change in classrooms without creating disturbances and catalysts by drawing on interrelationships and leveraging top-down approaches. Yet, school leaders play key roles in making changes meaningful by establishing synergies across the education system and forming intra-relationships for bottom-up approaches to help teachers make sense of and develop ownership of change in their respective contexts. For example, schools may experience pressures for change through interrelationships with national directives. Yet, schools need to form intra-relationships within to make change meaningful for teachers and align to its niche areas. Schools may further leverage spaces for ICT-mediated curriculum

Motion leadership = leadership from the middle
School leaders use multiple strategies and stances to design structures, processes, and seek alignments to manage, spread and sustain change
Schools are **complex adaptive systems**. They leverage inter and intra relationships as ways to catalyze and adapt to change

Complexity as involving multiple stakeholders, structures and processes. Inter and intra relationships within and across levels
Change is complex. It is unpredictable, non-linear, and involves catalysts and alignments within and across levels to trigger and manage change.

System as nested layers involving national, district and school levels

National

District

School

Inter relationships and synergies across levels
Top-down efforts for change

Intra relationships and synergies within levels
Bottom-up efforts for change

Fig. 9.1 Conceptual framework

innovations and form interrelationships at the district level to spread cultures and share experiences across schools.

The conceptual model contributes to literature by leveraging systems and complexity viewpoints to emphasise the role school leaders play in managing change. School leaders contribute to change by understanding directives from the education system and creating mechanisms that enable change from the top down. School leaders also build alignments within and across schools to facilitate bottom-up efforts where stakeholders take ownership of innovations and generate momentum for change.

The conceptual framework in Fig. 9.1 guides this study and elicits structures and processes that school leaders create to transform the school towards a culture of innovativeness. This culture relates to seeding ICT-mediated curriculum innovations that balance teacher-directed and student-centred pedagogies. Findings discuss disturbances that the school leader strategises to trigger change from the top-down and synergies made to enable bottom-up efforts to spread and sustain cultures within and across schools.

The subsequent sections describe the research context and methodology used for the case study. The school context and methodology is useful to help scholars understand the extent findings are applicable to other situations. In qualitative research, transferability is exercised where "it is not up to the researcher to speculate how… findings can be applied… it is up to the consumer of the research" (Merriam, 1995, p. 51).

9.4   Research Context

The Singapore education system is committed to seeding curriculum innovations and education research as it tries to balance teacher-centred and twenty-first-century, student-centred pedagogies (Hogan, 2014). Multiple strategies are employed. One of them is the role given by MOE to the Office of Education Research (OER) at the National Institute of Education (NIE) to seed curriculum innovations and spearhead education research. Some of OER's mandates are to understand school practices and change and to study the tenets of change that focus on structures and processes schools establish to enable a culture of innovativeness.

History and sociocultural context shape teaching and learning. Literature about Singapore's success suggests that teachers face difficulties in not "teaching to the test" (Hogan et al., 2013; Hogan, 2014; Teh, 2014). Our conjecture is that change in the Singapore education system may be challenging the deeply rooted examination mindset by initiating curriculum innovations that balance twenty-first-century learning with teacher-centred approaches. We conjecture that teachers may have mastered the didactic, teacher-centred approaches and less on twenty-first-century, student-centred pedagogies. Schools need to appropriate policy directives, encourage teachers to seed curriculum innovations, and grow a culture of innovativeness.

This study occurred in a secondary School N. This is a young school with about 20 years of history. School N is recognised for its technology-mediated curriculum innovations. It is locally recognised as a Centre of Excellence (COE) for Information and Communications Technology (ICT) and a FutureSchools@Singapore[1] with responsibilities to lead and mentor schools at the district level to use ICT innovatively for teaching and learning. School N is also internationally recognised as one of the Pathfinder Schools and Mentor Schools in Microsoft's Partners in Learning programme. The expectation is to foster a culture of innovativeness by advancing teaching and learning with technology and deliver quality learning experiences for the twenty-first century.

School leadership is instrumental in leading and planning a culture of innovativeness. This case study unpacks change tenets that the school leader establishes to create opportunities for ICT-mediated curriculum innovations. He recognises awards and partnerships as ways of motivating teachers and creating authentic opportunities that develop teachers' capacities for student-centred pedagogies. He hoped that through continuous seeding of ICT-mediated curriculum innovations, a culture of innovativeness is sustained.

9.5   Methodology

This case study describes School N's change journey where teachers were encouraged to initiate ICT-mediated curriculum innovations. A case study methodology (Yin, 2003) provides rich descriptions and understandings of change tenets, including enabling structures and processes that shape change and the school's culture of innovativeness. Data sources including interviews, archival data, observations, and field notes are gathered to establish a chain of evidence.

We conducted five interviews with these informants: school principal, two Heads of Department (HOD), senior teacher, and subject head. Each discussion was guided by customised open-ended questions. Two or three researchers facilitated each interview, which lasted between 45 and 90 min. The interviews were digitally recorded and transcribed verbatim. Archival data, including the school's public website and presentation slides when hosting visitors in 2016, provided details such as the school's strategic thrusts, partnerships, and programmes. Classroom observations, documented as field notes, described teachers' innovative practices and the school's culture of innovativeness. Other observations and field notes documented school leader's meetings with teachers to get buy-in, communicate strategic directions, and understand the progress of ICT-mediated curriculum innovations. Observations lasted approximately 60–90 min and provided insights about informants' practices and interactions in naturalist settings. Interviews, observations, and field notes co-informed each other. Data from interviews substantiated contextual insights from observations and field notes.

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[1] These schools are selected to be trailblazers for the meaningful use of information and communication technology for teaching and learning.

Data analysis was guided by thematic analyses (Yin, 2003). Interview transcripts, archival data, observations, and field notes were analysed by researchers, and subthemes were surfaced according to the research question. The subthemes were discussed and categorised into broader themes.

9.6 Findings

Findings present three themes describing change tenets, including structures and processes, that the school leader emphasises to (1) drive change through a planned top-down, bottom-up approach, (2) cultivate teachers' capacities and professional pride to transform practices, and (3) build a culture of innovativeness to sustain change.

9.6.1 Theme 1: School Leadership Drives Change Through a Planned Top-Down, Bottom-Up Approach

9.6.1.1 Aligning School's Impetus for Change with Its System-Level Mandates

Principal A leverages the school's national mandate as COE for ICT to develop three strategic thrusts and create a compelling vision for teachers to harness ICT for student-centred learning. Teacher L shares:

> As a Centre of Excellence for ICT, I think Mr A (school leader) took on this. As our new outcome… we do strategic planning… our strategic thrust, O1, O2, O3, outcomes 1, 2, and 3. Outcome 1 is to spur (School N) as a leading school in (the innovative and effective use of) ICT.... O2 is students (developing all-rounded students through an innovative use of ICT), O3 is… (creating a first-class ICT-proficient teaching force).

These thrusts form relationships between school, district, and national levels to create impetus and buy-in for change. School N is a COE for ICT and FutureSchools@ Singapore with mandates to spread innovations at the district and national levels, respectively. These structures enable change because they are created beyond the school level for teachers to seed ICT-mediated innovations. The strategic thrusts harness stakeholders' energies, within and beyond the school community, on the importance of ICT for teaching and learning, for example, developing teachers' professional capacity, students' twenty-first-century skills, and the school as a role model for sharing innovative uses of ICT.

9.6.1.2 Teachers Trailblazing Innovations and Obtaining Small Successes

Principal A (see excerpt below) recognises that it is important to embed innovations into the school culture by setting boundaries and encouraging teachers to lead innovations.

> As long as you do not damage the school… as long as the students benefit…it is aligned to the syllabus…. Those are the non-negotiable(s)…. My fear is that if you play too much on those non-negotiable (that is, impose more accountability and targets for innovations)… you stifle innovation…. My message is… can do, just do….

Principal A communicates from the top that teachers are given spaces to be trailblazers as long as it aligns with the strategic thrusts and pedagogical framework. Although these are the school leader's deliberate attempts, from the teachers' perspective, teachers are given autonomy to seed innovations and claim ownership. Principal A further shares:

> Nobody likes to follow an idea… and then (it is) not called theirs…. And one small group of people cannot form the critical mass for change…. Buy-in is not from the top. The top can only present (ideas) but the user (teacher) experience is… how they experience the process of innovation…. They must be… the ones spreading…. That is how culture is built…. I have never changed… the pedagogical framework that we use… So there are some things that I will not change for the sake of innovation.

Findings suggest that the school attempts to establish top-down structures and processes so as to seek alignments and encourage bottom-up efforts for change. A teacher (Teacher AL) describes below how Principal A balances top-down directives with bottom-up approaches that encourages teachers to lead change. Principal A deliberately identifies early champions and puts teachers to work collaboratively to obtain and spread small successes. Champions are purposively selected because senior teachers and HODs have leverages to influence more teachers.

> I have a passion for using ICT in my personal life and in the classroom. So (Principal A), he was very supportive…. He gives me the space and room and provided me (with) resources to innovate… because he believes in leading by example and motivate(s) others to follow, so myself, teacher L, our ex-HOD (for) Science, together with him (Principal A), co-wrote the paper.

Additionally, the school establishes a think tank comprising energetic teachers who are savvy with technology, so as to seed interdepartmental ideas. Teacher AL further describes how innovations are intently created through collaborations and sharing.

> A small team called the ICT team (think tank)… consists of members from various departments…. Members are usually young ones… more savvy in technology…. We will explore what are the emerging technologies… that are effective for teaching and learning…. We will meet and then share (the curriculum innovation) among ourselves first…. And then… each representative will cascade down to their department.

These attempts create opportunities for teachers to make change meaningful by trailblazing innovations, obtaining successes, and driving a culture of innovativeness.

9.6.1.3 Partnerships and Redesigning Learning Spaces for Innovative Practices

Principal A acknowledges that infrastructure and resources are critical for change. He finds timely opportunities to resign physical spaces and form partnerships with stakeholders in the Singapore education landscape. These interrelationships bring resources and opportunities to drive change. Principal A believes that to transform practices towards twenty-first century and student-centred orientations, physical spaces need to change accordingly. The school synergises with policy directives for upgrading infrastructures and challenges teachers to rethink practices. Figure 9.2 shows redesigned learning spaces that transformed teaching and learning.

Partnerships with institutes of higher learning, agencies, and industries, also bring with them resources to create alignments within the school and support teachers in transforming practices. These include (but are not limited to) portable devices, expertise to design tools, and research support. Teacher D says:

> Keith (researcher), is a team member, myself (HOD) and my teachers… we looked at what is the traditional… Structured Academic Controversy (a cooperative learning strategy), what are the steps involved, and how would it translate to an ICT tool…. I think his (Keith's) role will come in when we… embark on the research aspect. So we will see how this ICT (tool) enhances… teaching and learning.

Fig. 9.2 Redesigned spaces to transform teaching and learning practices. (Copyright [2018] by P. Seow. Reprinted with permission)

Findings in this theme show that aligning a school's change initiatives with the education landscape is not easy. Principal A's excerpt below shows constant tensions and negotiations.

> My journey as a leader is… a process of rapid prototyping…. Rapid prototyping is small pockets of change…. It might sound small… a teacher will have different touch points with students… so what the students experience are… many teachers' innovations…. The learning experience is very different…. I worry that I come up with too many innovations that might not be sustainable…. I mitigate that… I never change the curriculum framework we use.

Appropriating policies and making innovations meaningful for teachers and students require trial and error. Structures and processes need to align school's change initiatives within the broader landscape. While top-down approaches are useful, spaces for bottom-up efforts encourage teachers to lead and own innovations. Innovations need to align with school's curriculum framework to be sustainable.

9.6.2   Theme 2: Cultivating Teacher's Capacity and Professional Pride to Transform Practices

9.6.2.1   Develop Understandings of Concepts and Constraints to Inform Innovations

School leadership recognises teachers' capacities as ways of helping teachers seek alignments by understanding affordances of technology and identifying opportunities for innovations. As Teachers AL and Z, respectively, describe below, technology provides a "high touch" approach because teachers engage students beyond classrooms and use multimodal ways to construct understandings.

> We shouldn't use technology for the sake of technology; pedagogy must lead technology.

> Two values add (for using technology)… you (students) are not just restricted to a classroom exercise…. You can practise this skill of taking different perspectives… coming to a consensus out of the classroom.... Second thing is that (without technology) you (students) are likely… restricted to (paper-based resources), you (are) not likely to use video as your resources.

School leadership sees capacity building as ways of synergising change into teachers' practices and ensuring that innovations do not compromise students' learning. As Principal A highlights below, it is important for teachers to understand the pedagogical rationale underpinning the use of technology.

> The pedagogical framework… has always been Teaching for Understanding…. There are some things that I will not change for the sake of innovation... there are certain pedagogical principles that anchors our work.

Pedagogy drives technology. In this school, Teaching for Understanding (TFU) is the framework that guides the infusion of technology and ensures the alignment

of innovations with the school's strategic thrust. Teachers go through courses developing understandings of TFU. This ensures innovations do not disrupt students' learning.

School leadership drives change from the top-down because it recognises the role of technology for developing students' twenty-first-century skills. However, it also acknowledges that ICT-mediated practices require more time for implementation. The following excerpts by Principal A and Teacher D, respectively, illustrate the extent of ICT-mediated practices implemented and the constraints faced.

> (A visitor once asked) how much time did you think your teachers use ICT in the classroom. So I said 50 (per cent) or less…. Your teachers say 25 to 30.
>   ... I think the challenge is we cannot do (student-centred learning) repeatedly … because we need to cover content.... So the hope is… ICT-based (practices) will allow them to use it more (develop 21st century skills).

School leadership acknowledges that teacher-directed practices are efficient, but student-centred practices enable twenty-first-century skills. It is important to be realistic and balance demands of covering content with limited curriculum space for innovations.

9.6.2.2 Align School-Based Supports with System-Level Efforts for Capacity Building

In designing capacity building as processes to perturb practices and enact change, the school seeks synergies with national initiatives for professional learning communities (PLCs). Time is provided for teachers to engage in professional dialogue and redesign ICT-mediated curriculum innovations. Teacher L shares:

> Every alternative Wednesday, we have professional learning communities, PLC…. It is a nation-wide thing…. In our school, there is also PLC for every department. Every alternative week they are supposed to... convert units of our lesson… into TFU. And…we emphasise on technology as well.

The school is also ready to provide multiple professional development supports, as Teacher AL describes:

> If you have any ideas, just go to him (principal). He will support us with… any resources that we need.... He is very supportive of us... doing research and then presenting (our innovations in conferences).

These supports enable alignments and the development of teachers' capacities for innovations. Other supports that build professional capacity include mentoring by pairing experienced teachers with junior teachers and teaming ICT think tank members with PLCs to complement strengths and weaknesses. The rationale is that experienced teachers and PLCs are knowledgeable about pedagogy, while junior teachers and ICT think tank address the technological aspects. Teachers Z and AL, respectively, share:

> He (Principal A) always pairs a senior teacher with a new teacher. That's how they tried to get more teachers to have exposure (of ICT-mediated innovative practices).

> They can just come to me (member of ICT think tank) for help or… observe the lesson. Or ask me "Have you used this tool? How could they use it?"

Figure 9.3 shows teachers' ICT competencies; this was adapted from the school's PowerPoint presentation to other schools. As can be seen, Principal A keeps track of teachers' competencies as checks and balances for refining capacity building strategies.

9.6.2.3 Complement Top-Down Efforts with a Focus on Teachers' Professionalism

School N complements top-down approaches with bottom-up efforts to develop teachers' professionalism. The excerpt below shows how Principal A works on the affective, "bottom-up" aspects of capacity building.

> I think inspiration comes when you dare to do… and you are exposed to… externalities, the ideas. You… must not underestimate…. When you give them the professional pride, they will go very far.

While attempts for capacity building are top down, the overall intention is for teachers to develop professionalism and pride for innovation and research. Principal A (see excerpt below) adopts a top-down, bottom-up approach by creating opportunities and trusting teachers to take ownership of and contribute to their professional growth.
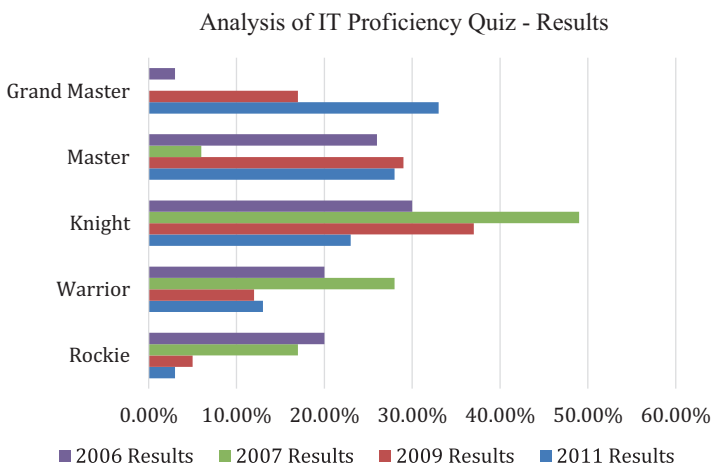
Fig. 9.3 Teachers' ICT competencies. (Adapted from the school's PowerPoint slides)

I trust my teachers.... (My teachers' mindset is) I need to… prove to my boss that I was there (at the conference). Evidence. I tell them… you come back there is evidence… you have to share with the rest…. My teachers have to pay (some percentage of the conference)…. I feel it is important that there is ownership because they get something out from there. It is their own personal growth.

Principal A recognises teachers' attending of conferences and getting accreditations and awards as ways of building professional pride (see excerpt below by Teacher Z).

Each department is encouraged to come out with an innovative project every year…. We submit projects for Innergy (Award) and then QCC (Quality Control Circle Award)…. They come from Science, Math, Art…. The… incentives… if you have something good, if you… submit a conference paper, you will… go overseas and present and learn.

In return, he expects teachers to share their learning with others to enable more capacity building within the school.

9.6.3 Theme 3: Building a Culture of Innovativeness to Sustain Change

9.6.3.1 Slogans Create a Vision of Expected Behaviours

School leadership understands the limits of taking a top-down approach of change. Principal A explains:

Leadership transition is always the biggest … most critical point for sustainability and practices.

Sustained change requires bottom-upculture building. Culture is a soft concept that creates alignments within the school for managing change. It tackles teachers' collective norms and behaviours. In School N, the culture of innovativeness relates to teachers developing understandings of how to balance teacher-centred practices with student-centred, ICT-mediated practices.

The school creates a sense of urgency and a safe environment for trying and failing through slogans, such as "Ready Shoot Aim" and "Failing Forward". The excerpts below show how slogans help Principal A use an analogy of night shooting to create a vision of expected behaviours, as shown below.

What the tracer round does is when you fire the first round at night (shooting), it lights up the target.... You know the target is there.... Then… you adjust. …We …do a lot of adjusting. We shoot first. Roughly we …see a silhouette… it will guide the way…. So we… get ready. We do not really aim a lot. We just shoot first… after that we adjust our aim…. So you (teachers can) scrub, scrub… (the innovation) until the cows come home…. Rapid prototyping (is important)… know what they are, where they fall short… know where they need improvement. I think that is a spirit of failing forward. You must not worry.... You must have the guts to confront if things are not working. So… culture of no blame... very important.

Teacher Z adds:

> He (Principal A) keeps saying that it's okay to try and fail…. He did not advocate… a blame culture…. It was a very safe environment.

Teachers are encouraged to innovate as long as they know the goals and are open to feedback. The school encourages teachers to try, innovate or "shoot" when they are ready and make adjustments later. He creates a safe environment for bottom-up experimentations where "failing forward" is key.

9.6.3.2 Rituals Spread a Culture of Innovativeness Within the School

Rituals provide routines which School N uses to reinforce its culture of innovativeness. Professional sharing is a ritual that aligns teachers' behaviours within the school. It plays a role in building the school's reputation for innovations and influences teachers to seed innovations. As illustrated below by Principal A and Teacher AL, respectively, whenever teachers go to conferences, they are expected to hang pictures in the staff lounge and create buzz by sharing their experiences and ideas.

> Everything… you got every conference photo (conferences that teachers attended) on the wall.

> I remember, International Conference in Computer Aided Learning…. What did I bring back to the school? Hmm… I have more ideas… to implement and… share to other teachers (in School N) how things can be done.

Another ritual that focuses on professional sharing is within-school seminars. The excerpts below by Principal A and Teacher Z, respectively, suggest that seminars in the middle and end of the year are ways of spreading the culture of innovativeness and align teachers' understandings. During these seminars, teachers share their takeaways from conferences and innovations in different subjects.

> We also realise(d) that you need to spread the culture…. Every staff seminar… in mid-year, end of the year, we… make sure any project that is at its prototype stage (gets shared)…. There will be… round robin conference concurrent sessions. So I think that information about what people are doing, if you keep it within your school and keep feeding the information in the system, you will generate …buzz… you get people picking up on different things…. And then they begin to appreciate what other people are doing.

> Mid-year or end-year seminars, that's when they (teachers) share their learnings from the various conferences.

In a way, these rituals are efforts to energise the school's reputation and culture for innovations in a bottom-up manner. Culture is embedded as ways of documenting innovations, celebrating successes, and building positive innovation experiences that are passed from teacher to teacher.

9.6.3.3 Leverage Other Stakeholders to Fuel the Culture of Innovation

School N recognises the benefits of intra- and interrelationships within and beyond the school for sustaining its culture of innovativeness. Partnerships and "word-of-mouth" occasions are opportunities for building interrelationships and sharing innovation experiences with local and overseas schools. In its national role as COE for ICT, School N holds events like the "ICT Extravaganza" to share ICT-mediated innovations with schools at the zonal/district level. The excerpts below by Teachers L and AL, respectively, suggest that such sharing builds interrelationships so School N can mentor and share experiences with teachers locally and internationally.

> COE ICT (Centre of Excellence for ICT) extravaganza is our bedrock…It is like a conference, School N takes the lead to rally all schools in the school district to create a culture of sharing of innovative projects…. I think Ministry's initiative is all COE… have the prerogative to level up the zone.

> Regularly, we have overseas schools coming (to visit School N)…. We will also host cluster school (schools in the same zone)…. Through word of mouth… they (other schools) know about our innovations… facilities. They… write in and request to sit in to… look at our school facilities…. That is how they know about (our innovations)…. School K is one (a local school that has asked School N to share their innovation).

Besides engaging teachers in such events, School N makes this culture more pervasive by developing students' mindsets for innovations. Teacher L in the following excerpt describes:

> I&E (Innovation & Enterprise) is a (subject) department, they also have been coming up (with different programmes) to make sure that this pervasiveness (culture of innovativeness) reaches out to the students. So i-Challenge is one of those platform that students are encouraged to create innovative projects, (be) mentored by a teacher…. The idea is very simple, to create a culture of innovation... among the students.

Findings in this theme suggest that School N creates synergies that drive the school's culture of innovativeness across multiple levels of the education system. School N seeks alignments and forms interrelationships with other schools by leveraging its national mandate as a COE for ICT. Events such as the ICT Extravaganza are platforms for School N to champion and share innovative practices to other schools in the district. These activities create opportunities where the school's role at the system and national level indirectly energises School N's culture of innovativeness. Introducing Innovation and Enterprise (I&E) as a subject also reinforces synergies and intra-relationships at the school level by aligning students' and teachers' mindsets for innovations. This synergy may create opportunities for students and teachers to co-influence each other and make the culture of innovativeness more entrenched to sustain ICT-mediated curriculum innovations in School N.

9.7 Discussion

9.7.1 Disturbances and Coherences Drive Change

Our findings unpack tenets of change from the systems and complexity stance, where schools are part of the Singapore education ecology, and each subsystem (school, district, and national) works in harmony with the others to shape change. Literature on systems and complexity theories provide conceptual insights on change (Amagoh, 2008; Mason, 2007). Our findings, informed by our conceptual framework (see Fig. 9.4), value-add to existing literature by illustrating the role that school leaders play in designing structures and processes to create disturbances via top-down efforts and interrelationships across subsystems. In tandem, school leaders maintain synergies through bottom-up efforts and intra-relationships within subsystems to facilitate change.

Figure 9.4 illustrates how each theme creates disturbances in a top-down approach to trigger change and how school leadership actively designs for the desired outcome by seeking alignments with the broader education context to its advantage. While themes embrace top-down and bottom-up aspects, the emphasis of these aspects differ. For example, theme 1 displays more top-down aspects than themes 2 and 3.

Scholars, like Adelman and Taylor (2003) and Fullan (1993), emphasise that schools experience burdens as policies and innovations cascade down from state bureaucracies. Our findings contribute by showing how school leaders in the Singapore context may lead from the middle (Fullan, 2009) by designing productive disturbances and coherences within and across the education system. In this case
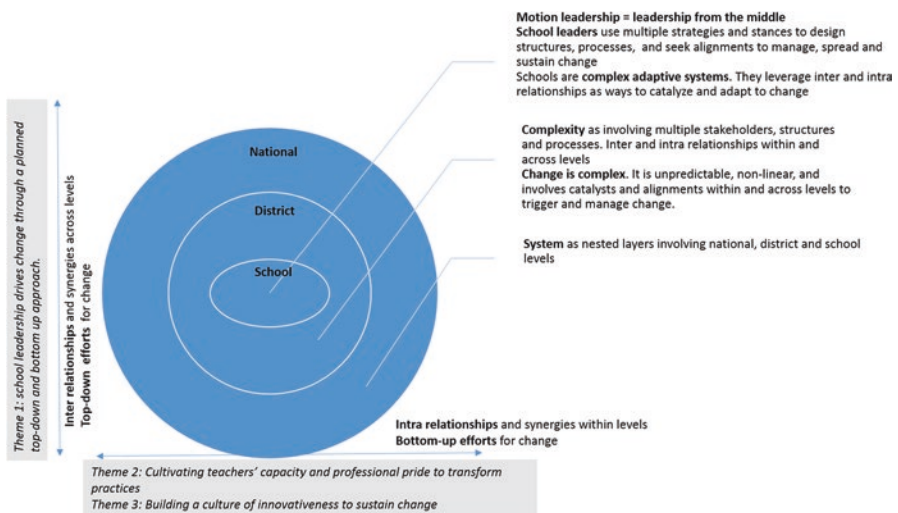
Fig. 9.4 Aligning themes and its contribution to the conceptual framework

study, the disturbances and coherences that the school leader created were crucial in building relationships within and across the school and national (MOE) levels.

Researchers from system and complexity viewpoints (e.g. Amagoh, 2008; Fullan, 2003; Reigeluth & Garfinkle, 1994) emphasise that change is unpredictable because it unfolds based on new relationships between internal and external environments to collectively and orderly move the school. Our findings contribute to suggest how school leadership takes a top-down, bottom-up approach by building inter- and intra-relationships to drive change. The school builds interrelationships by aligning school's strategic thrusts with its national mandate as a role model of ICT-mediated practices to gather buy-in. Interrelationships beyond the school, such as networks and partnerships with external stakeholders, are intentionally created to perturb change by providing new perspectives. These relationships create alignments internally by providing resources to address weaknesses and inform ICT-mediated curriculum innovations. Opportunities are also created to host local and overseas schools as ways to share innovation experiences, create more synergies, and energise the school's culture and identity of innovativeness.

Intra-relationships within the school create alignments to make change engrained. While the school leader in School N takes a top-down approach to provide directives and mechanisms for change, spaces are provided for bottom-up efforts where teachers lead innovations. Professional development efforts build teachers' capacities to transform practices and develop intra-relationships internally. Consequently, these efforts create interrelationships with the external environment because teachers are able to align innovations with policy directives of forming PLCs within schools. Intra-relationships also help teachers take ownership of change to collaboratively lead innovations, share successes, and generate buzz for ICT-mediated curriculum innovations. School N creates other opportunities as well, such as attending conferences and courses, to develop teachers' capacities for seeding innovations. These efforts focus on teachers' conceptual understandings that underpin innovations and affective dimensions that stress teachers' professionalism and pride. A new subject, I&E, is created to align teachers' and students' innovative mindsets and make the culture of innovativeness more pervasive within the school.

According to Hopkins (2003), schools experiencing change need to balance maintenance and developmental activities. Maintenance activities are routine practices, while developmental activities create disturbances that drive changes. The ways schools balance these activities differ according to context. Findings suggest that schools form inter- and intra-relationships within and across subsystems to create developmental and maintenance opportunities for change, respectively. School N leverages its national mandate as COE for ICT as a developmental stimulus to perturb practices and promote a culture of innovativeness. The school seeks coherences with existing practices by getting teachers to balance innovations with teacher-directed practices. Teachers innovate within traditional practices to ensure they cover required content and achieve academic outcomes.

Enacting change at the school level involves synergies across levels of the education system, for example, aligning policy initiatives with school's strategic thrusts to help teachers understand change and balance existing practices with ICT-mediated

curriculum innovations. Findings illustrate how schools may harness teachers' energies for developmental activities by highlighting disturbances between existing (teacher-directed) and desired (student-centred) practices. For example, the school redesigns spaces as disturbances to create top-down expectations of innovative practices. These disturbances are weaved into maintenance activities by aligning school's change efforts with School N's national expectation as COE for ICT to spread innovations across schools at district level. As schools create developmental activities by designing conditions, structures, and processes to enable change, they remain mindful of maintenance activities which create coherences across levels (school, district, and national) of the education ecology. Although developmental activities create top-down disturbances that catalyse change and seed innovations, maintenance activities are important for the creation of bottom-up coherences and underpinnings for sustaining innovations. In School N, innovations are always underpinned by pedagogy and the curriculum framework.

9.7.2 Role of Planning and Growing a Culture for Sustaining Change

The above discussion unpacks how disturbances and synergies from a system and complexity stance may energise change. Figure 9.4 shows our contributions in how school leaders design structures and processes from a top-down perspective to nudge change. Yet, alignments are established within the school to provide spaces for teachers' bottom-up efforts in order to make change meaningful and drive a culture of innovativeness.

Another contribution of our findings in Fig. 9.4 relates to the school level of analysis which illustrates how school leaders develop cultures by altering processes in attempts to tighten synergies and entrench change. Efforts to develop culture include addressing teachers' mindsets by creating new norms, beliefs, and assumptions about student learning and supports for professional development (Harris, 2002). For School N, the desired culture of innovativeness involves teachers seeding technology-mediated curriculum innovations and balancing teacher-centred with student-centred learning. Fullan (1993, 2014) stresses that seeding change is not solely about good innovations. Deep change is about re-culturing practices. School leadership is essential in growing and sustaining a culture of innovativeness.

This chapter informs literature by illustrating motion leadership (Fullan, 2013) in the Singapore context. While the three themes align somewhat with the change, implementation, and sustainability stances of motion leadership, findings contribute by unpacking the top-down and bottom-up approaches that create the impetus, human capacities, and cultures for change. Top-down approaches emphasise directives and synergies across school, district, and national levels that the school leader creates to facilitate change. Bottom-up approaches are strategies that focus on culture building and allow teachers to build professionalism, pride, and ownership of innovations. These approaches are evident throughout the themes in the change journey.

Theme 1 emphasises the change stance where structures and imperatives for change are designed. The contribution here relates to how School N aligns its motivation for change with its existing strengths and system mandates. The school leader takes a top-down approach using the school's strategic thrusts and mandate as COE for ICT to communicate a vision for change. New partnerships and infrastructures are created as resources to transform practices. Spaces are afforded for bottom-up efforts where school leadership works with change agents to trailblaze innovations and obtain successes for the change process.

Theme 2 describes the implementation aspects of how the school leader combines top-down and bottom-up approaches to enact change. School leadership employs a top-down approach by cultivating internal capacity and professional pride in teachers to help them implement ICT-mediated curriculum innovations and establish external and internal synergies. External synergies align school level PLC structures with system, national level PLC directives. Internal synergies focus on affective efforts that develop teachers' professionalism and pride for innovations, for example, getting teachers to showcase achievements in conferences and receive accreditations. Teachers are empowered to seed innovations as long as they align with the school's curriculum and pedagogical framework without compromising students' learning.

Theme 3 value-adds to the theme of sustainability of change by unpacking the school leader's top-down and bottom-up efforts in addressing teachers' collective norms and behaviours to maintain a culture of innovativeness. Slogans are created to communicate expected behaviours in a top-down fashion. Rituals in the form of professional sharing, storytelling, and seminars are established to encourage teachers to lead and spread the culture of innovativeness within the school. These slogans and rituals help to entrench the school's culture and identity of innovativeness. Alignments are made with other stakeholders to indirectly shape the school's culture and project its identity for innovativeness at district and national levels of the education system. Examples include School N hosting local and overseas schools as means of role modelling and sharing ways to effectively use ICT for teaching and learning.

While literature provides conceptual understandings of change, different contexts exert varying forces and imply different strategies for change. Collectively the three themes illustrate a combination of change, implementation, and sustainability stances for motion leadership and growing a school's culture of innovativeness. This combination of stances emphasises top-down and bottom-up strategies which are indigenous to the Singapore education context. In Singapore, school leadership transition generally occurs every 6–7 years. Sustainability is a key issue, and deliberate efforts are needed to encourage bottom-up efforts and ensure continuity when school leaders leave. In this case study, efforts focused on developing a pervasive culture of innovativeness amongst teachers and students, coupled with interactions beyond the school to ensure it remains innovative.

The three themes illustrate that transformations may not occur in isolation without interactions and alignments at national, district, and school levels of the education system. Schools cannot expect changes without synergies across multiple levels. This suggests that top-down and bottom-up approaches need to work in tandem. Directives through structures, processes, and synergies are useful, but spaces are needed for bottom-up approaches to build culture and sustain change. For example, schools interpret state directives and appropriate it in purposeful ways so teachers can balance innovative practices with teacher-centred practices.

Besides the within-school context, this case study contributes to show how motion leadership, with a systems and complexity viewpoint, may enable schools spread curriculum innovations and cultures of innovativeness to other schools through alignments at district and national levels. Sharing and mentoring ICT-mediated curriculum innovations with other schools are ways of spreading student-centred practices to a wider scale. In this case study, efforts seem to focus on providing structures and processes to encourage individual teachers to seed ICT-mediated innovations, as well as on growing teachers as champions to lead and guide others in the change journey. By populating the school with innovations, the school leader hopes to develop a culture that continues to energise more innovations and shape the school's identity of innovativeness. Although School N tries to spread its culture of innovativeness to other schools, these efforts are nascent as existing efforts focus more on within-school innovations and culture building. More concerted efforts are needed to mentor and scaffold other schools in developing structures, processes, and capacities for ICT-mediated curriculum innovations.

9.8   Conclusion

This chapter unpacks tenets of change at the school level of analyses. Underpinned by change from the systems and complexity viewpoint, findings elicit structures and processes that school leadership designs to transform the school's culture of innovativeness. This culture relates to seeding ICT-mediated curriculum innovations which balance teacher-directed and student-centred approaches. Findings describe the complementary top-down and bottom-up approaches that school leadership employs to create structures and processes that trigger change, develop capacities to enact change, and nurture culture for sustaining change. Discussions emphasise how disturbances motivate change and synergies across levels (school, district, and national) of the education system to become leverages in the school's change journey. Future work may extend this case study beyond the within-school level to investigate the tenets of change for seeding ICT-mediated curriculum innovations and spreading cultures of innovativeness across schools to the district and national levels of the education landscape.

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Shu-Shing Lee is a Research Scientist at the Centre for Research in Pedagogy and Practice, National Institute of Education, Singapore. Her research interests include teacher learning as well as understanding contextual factors and leverages for spreading and sustaining ICT-mediated educational innovations. Shu-Shing has published book chapters, journal papers, and served as a reviewer for Social Sciences Citation Indexed journals. She is coeditor of the book *Adaptivity as a Transformative Disposition for Learning in the 21st century*.

Peter Seow is a Research Scientist in the Learning Sciences Lab, National Institute of Education. Peter's research in education focuses on studying the implementation of curriculum innovations and educational technologies in the classroom. He works closely with school leaders and teachers in designing curriculum innovations for enactment and technology-enabled learning environments in the classroom. With his Computer Science background, Peter is working with teachers in designing and implementing new pedagogies for teaching Computing and Computational Thinking in the school curriculum.

David Hung is a Dean of Education Research at the National Institute of Education, Singapore. He has served as Contributing Editor and Associate Editor for several well-read international academic publications in the learning sciences field and appointed as journal reviewer for various well-established international academic journals. His research interests are in learning and instructional technologies; constructivism, in particular, social constructivism; social cultural orientations to cognition; and communities of practice.

Chapter 10
Diffusing Innovative Pedagogies in Schools in Singapore: Case Studies on School Leaders' Diffusion Approaches and Their Rationalisations

Jun Song Huang

Abstract The scaling and diffusion of innovations has been widely studied with regard to the characteristics of innovations and factors influencing teachers' decision-making for adoption. However, little has been explored on why school leaders take a top-down or a bottom-up approach to diffusion. Through multiple case studies in Singapore, this paper identifies metaphors and repertoires that school leaders use to elaborate and rationalise their diffusion approaches. It establishes an empirical understanding of how school leaders in Singapore diffuse innovations and why they often take a top-down approach to diffusion. Findings suggest a need to help school leaders understand the diffusion of innovations as a process and the need to integrate top-down and bottom-up approaches.

10.1 Introduction

Studies show that innovations in areas such as Information and Communication Technologies (ICT), coupled with necessary pedagogical strategies, may engage students in deep learning (Jonassen & Carr, 2000; Koh, Huang, Lim, Chen, & Hung, 2008; Looi, Hung, Bopry, & Koh, 2004). In education research, innovating new pedagogical strategies has traditionally been the main focus, whereas the sustainable and scalable adoption of such innovations is only recently gaining attention (Christensen, Horn, & Johnson, 2008; Lim, Hung, & Huang, 2011; Toh, 2016).

The literature on innovation diffusion suggests that neither a solely top-down nor bottom-up diffusion approach is effective (Dudink & Berge, 2006; Fullan, 1994, 2007; Panuwatwanich, Stewart, & Mohamed, 2009). In a top-down approach, people (such as teachers) are often mandated to adopt innovations being implemented by their management. Fullan (1994, 2007) observes that the purely top-down

J. S. Huang (✉)
National Institute of Education, Nanyang Technological University, Singapore, Singapore
e-mail: junsong.huang@nie.edu.sg

approach consistently fails. Such a top-down enforcement of mandated adoption was found to hinder people's adoption (Fullan, 1994; Sarason, 1990), because they are likely to be under forced compliance (Festinger, 1957) and are less willing to make adaptations of the innovations for their needs (Honey & McMillan-Culp, 2000; Luehmann, 2002; Rogers, 2003). The top-down forced compliance in adoption is also critiqued by Alexander (2008). In advocating for coherent pedagogy, Alexander makes reference to the UK government's prescription of pedagogy in 1997. He argues that pedagogy is more than the act of teaching. It involves the understanding, belief and justification of the act. Compliance often closes debates and undermines teachers' agency (Eisenhardt, 1989), as well as their learning about the innovation and their adaptation and customisation of the innovation for their own use. Without teachers' agentic learning and adaptation, the adoption of innovations can hardly be sustained when top-down pressure is removed.

In contrast, the bottom-up approach occurs when there is no centralised control and people have the agency to make their own adoption decisions (Rogers, 2003)—similar to a virus infection. The scaling leverages on bottom-up communication, such as word of mouth, through which a body of innovation adopters grows over time. Fullan (1994) and Mathews (2007) both demonstrated that in a bottom-up system, without enough central control, innovation either took an extremely long time to reach a high adoption rate, or not at all, before being replaced by new innovations (Rogers, 2003; Valente, 1996). Hence, a solely top-down or bottom-up diffusion approach has limitations.

In practice, there is a strong top-down tradition in innovation diffusion. In the Singapore context, school leaders (e.g. school Principals, Vice Principals, Heads of Department) often use an implementation model of mandating to scale up innovative pedagogies. Looi, Lim, Koh and Hung (2005) critique that school leaders generally hold a belief that if the top-down mandate is upheld for a long enough time, innovation will eventually be adopted by teachers sustainably. However, this approach has proven to be ineffective. Lam, Yim and Lam (2002) and Biott (1992) point out that, when teachers are coerced to conform to a top-down implementation plan, even when supports are provided, they will not appreciate it. Hence, it is necessary to develop an empirical understanding on how school leaders scale up innovations in Singapore and how they rationalise their scaling approaches. This is particularly timely because Singapore's culture of innovating and diffusing new pedagogies is progressively shifting towards decentralisation.

The purpose of this chapter is to present a study conducted to understand school leaders' diffusion approaches and their rationalisations. It complements existing literature which examines innovation diffusion and implementation mainly from the researcher's perspective, for example, the investigation of the characteristics of innovation and factors influencing teachers' decision-making for adoption (Surry & Ely, 2002).

The following sections outline the context of the study and, through thematic analysis, present the findings on why school leaders use top-down approaches to diffuse innovations. A discussion on the participants' rationalisations of their scaling approaches is presented at the end of the chapter. Implications are drawn on how to help school leaders learn to diffuse innovations effectively.

10.2   Research Design

To achieve the research objective, multiple case studies (Stake, 2013; Yin, 2013) were conducted involving eight school leaders as participants.

10.2.1   Case Contexts

The cases were selected through purposeful sampling strategy (Yin, 2013) by maximising case differences in terms of the types of the organisations. There were four cases: two cases from primary schools, one case from a secondary school and one case from the headquarters of Singapore's Ministry of Education (MOE). All three selected schools are mainstream schools which do not have access to additional financial resources for innovation or diffusion. Two cases from primary schools were chosen because there are more primary schools than secondary schools in Singapore. Compared to their counterparts in secondary schools, teachers in primary schools usually teach more subjects (Lim & Khine, 2006), which leads to distinctive contexts for innovation and diffusion. Between the two primary school cases, one school is an average-performing all-boys school that is affiliated to a religious body, while the other is a relatively high-performing mixed gender school. Therefore the two are varied in terms of their diffusion contexts.

The MOE case was selected because the participants from the MOE department (Educational Technology Officers, i.e. Ed-Tech Officers) dealt with the diffusion of pedagogical innovations across schools, making the case unique in terms of the diffusion goal and context.

Each case involved two school leaders from the same school or the same MOE department. Hence, in total, there were four dyad cases. The study was conducted in the meeting room of the respective dyad's organisation (i.e. schools or MOE).

The summary of the contexts of the cases is presented in Table 10.1, followed by a brief description of the participants in each case.

The participants in Case One were the Principal (C1P1) and the ICT Mentor (C1P2) from a mainstream secondary school, diffusing iPads for learning. C1P1

Table 10.1 The contexts of the four cases

Case	One	Two	Three	Four
Participant 1	Principal (C1P1)	Vice Principal (C2P1)	Head of ICT (C3P1)	Ed-Tech Officer (C4P1)
Participant 2	ICT Mentor (C1P2)	Head of Science (C2P2)	Assistant Head (C3P2)	Ed-Tech Officer (C4P2)
Organisation	Mixed secondary school	All-boys primary school	Mixed primary school	Ministry of Education
Curricular innovation	iPad for learning	Holistic assessment	Design pedagogy	Pedagogical innovation

was in his late 40s and was appointed as the Principal of the school 6 months before the study. Prior to this appointment, he was the Vice Principal of another mainstream secondary school for 2 years. He used to be a science teacher and the Head of the ICT Department (HoD-ICT) in a secondary school and an Educational Technology Officer (ETO) in the MOE promoting education innovations to a cluster of schools. C1P2 was in his late 30s. Before his appointment as the ICT Mentor for the school, he was the appointed ICT Champion for the English Language Department. As the ICT Mentor, every year he mentors two teachers in the school by leading them through the process of adopting ICT tools, planning and carrying out and reviewing a lesson that engages ICT tools.

In Case Two, the Vice Principal (C2P1) and the HoD-Science (C2P2) from an all-boys primary school took part in diffusing holistic assessment as an innovation. C2P1 was in her late 40s. She held a Master's Degree in Education and was appointed as the Vice Principal in 2009. Prior to this appointment, she worked in the MOE headquarters for 7 years. C2P2 was in her mid-30s with a Master's Degree in Education. She had 9 years' teaching experience and 1 year of working experience at the MOE headquarters. During the period of this study, she had been covering the previous HoD-Science's duty for 3 years and had been recently appointed as the new HoD-Science.

In Case Three, the HoD-ICT (C3P1) and a Subject Head (C3P2) from a mainstream primary school participated in diffusing a student-centred design-for-learning pedagogy (in short, "design pedagogy"). C3P1 was in her mid-30s and had previously worked in the commercial sector before she joined the school 7 years before. As a noneducation service staff member, she did not teach any subjects. She was the Subject Head for 3 years before she was appointed as the HoD-ICT in 2010. C3P2 was in her early 30s and had 9 years' teaching experience. She was transferred from an elite school 3 years before and was appointed as the Subject Head for the ICT Department 2 years before. C3P2 thought highly of the current school because she felt that the approaches to innovation diffusion in the current school were well-structured.

Two Ed-Tech Officers (C4P1 and C4P2) from the MOE headquarters were participants in Case Four to diffuse innovation across schools. C4P1 was in her late 30s. Prior to her appointment at the MOE headquarters, she worked as a science teacher and HoD-Science in a local mainstream secondary school. C4P2 was in her late 20s. Prior to her MOE appointment, she worked as a science teacher and Subject Head in a local mainstream primary school. No specific innovation was discussed in this case; rather, the reflection centred on the diffusion of pedagogical innovations in schools in general.

10.2.2   Data Collection and Analysis

The author facilitated the joint reflection of the two participants in each dyad on their views of the diffusion process in a conversational style, in particular by reflecting with metaphors.

The dyads were also guided to compare innovation diffusion with metaphors (e.g. a virus infection), to create more opportunities for reflection. Lakoff and Johnson (1980, 2003) demonstrated that people often understand one conceptual domain in terms of another (e.g. "time is money"). These perceptual-based metaphors not only shape communication but also transform how people think and act within the domain. Hence, a person's conceptual metaphor provides an avenue to investigate how the person conceives of the domain conceptually.

In order to develop more in-depth understanding on the dyads' knowledge on innovation diffusion, the study aimed to identify and understand the gaps between the participants' conceptual metaphors and their conceptual understanding. Falck and Gibbs (2012) recognise that people's use of metaphors is guided and constrained by their experiences with regard to the source (i.e. the metaphor) and the target (i.e. the phenomenon being described using a metaphor). Hence, there may be gaps between people's conceptual metaphors and conceptual understanding. Engaging the dyads to reflect on these gaps helps to better reveal the dyads' conceptual understanding on innovation diffusion.

Each dyad's spoken reflection was transcribed verbatim. The dyad was used as the unit of analysis in data analysis because the two participants in each dyad case reflected together and they rarely challenged each other's views.

Under an interpretivist paradigm (Cohen, Manion, & Morrison, 2000), thematic analysis (Boyatzis, 1998; Braun & Clarke, 2006) was adopted as the main data analysis method. It is an inductive approach to identify, analyse and report the dyads' patterned responses, without trying to fit the data into a pre-existing model or frame. Thematic analysis was applied in three dimensions, namely, the dyads' scaling approaches, their conceptual metaphors on scaling and the rationalisation of their scaling approaches. This paper focuses on reporting the common thematic patterns across the cases. The nuances within the context of each case are considered when making speculations on the variations across the cases in terms of their diffusion approaches and alignment with the conceptual metaphors.

10.3 Findings

Thematic analysis was first adopted to categorise the scaling approaches and conceptual metaphors shared by each dyad. For example, the Case One dyad is identified as using a more bottom-up approach to diffuse innovation and conceptualise innovation diffusion accordingly. The dyads from Cases Two to Four implemented innovations from the top-down. The dyads' justification on the alignment and misalignment between their scaling approaches and conceptual metaphors were then analysed to identify common emergent themes.

Table 10.2 summarises the dyads' scaling approaches and their conceptual metaphors.

Table 10.2 Summary of the findings

Case	One	Two	Three	Four
Scaling approach	Encourage voluntary adoption	Mandate teachers to adopt	Mandate teachers to adopt	Mandate teachers to adopt
Rationalisation for scaling approach	"(Many teachers) just stay in their comfort zones, just do things that they are sure (of)"	"If a teacher (has) not used an innovation before, he will perceive that using it is risky and scary"	"At least when (teachers) use the innovation in their classroom(s), their students can still benefit from the innovation being used. It is better than not using the innovation at all"	"In schools, time is a luxury""(To) quit smoking is a choice by people, but teachers have no choice. It is their job"
Conceptual metaphor	Virus infection and evangelising: one influences another	Bicycle: school leaders set direction and drive the diffusion	Waterfall: leaders are like waterfalls which flourish teachers	Big boat and mini-boats: big boat sets direction; mini-boats are hooked to the big boat and follow the direction

10.3.1 Scaling Approaches

The dyads in Cases Two to Four took a top-down approach to scaling. For example, with the support of the Principal, the Case Three dyad developed an innovation, validated it through an action research and implemented it school-wide. Then, in department meetings, the dyad communicated to teachers the benefits of the innovation and the management's decision for implementation. They also created and monitored a teaching roster which scheduled each teacher's roll-out timetable.

In contrast, the dyad in Case One took a bottom-up approach to diffusion. The dyad encouraged teachers who were interested in the innovation to join a "core group" (i.e. learning community). The school provided resources and training for members in the core group to learn, invent and implement the innovation in their respective classrooms. The school used different communication platforms (e.g. departmental sharing time and school ICT sharing time) to showcase the core group members' successes so that more teachers could see the value of the innovation and would want to join the core group. This approach is primarily bottom-up and does not sufficiently leverage on top-down structure and arrangement to enhance and optimise teachers' agentic learning and adaptation. In a solely bottom-up approach, without enough central control, innovation takes an extremely long time to reach a high adoption rate, or not at all, before being replaced by new innovations. Therefore, to facilitate a more speedy adoption, the dyad in Case One could have done more to leverage on the top-down structure and resources to create opportunities for the "core group" of teachers to share with other teachers and recruit members.

10.3.2 Conceptual Metaphors

Consistent with their top-down approaches to diffuse innovation, bicycle (Case 2), waterfall (Case 3) and boat (Case 4) were used by the dyads in Cases Two to Four as conceptual metaphors (Allbritton, McKoon, & Gerrig, 1995) to elaborate the scaling of innovation. For example, the dyad in Case Two shared that "[a] school is like a bicycle. The Principal holds the bar [to set the direction], the Vice Principal peddles, Heads of Departments are like the chains to pass the demand to the teachers, and finally, teachers move forward as the wheels". Thus, innovation is scaled up when the Principal selects an innovation and the Vice Principal and Heads of Department roll out the implementation plan.

The metaphors (i.e. waterfall and boat) offered by the dyads in Cases Three and Four carry some inconsistency between the metaphors and ways in which the scaling of innovation was elaborated with the metaphors. The Case Four dyad shared that:

> MOE is like a big boat, and schools are like mini-boats that are hooked onto this big boat. The boats sail toward one common goal, which is to improve students' learning.

In the context of diffusing innovation in schools, the dyad articulated the relationship between the MOE and schools as a big boat and mini-boats, respectively, whereby "mini-boats" suggest schools' agentic roles in the diffusion process, with MOE as the "big boat" which leads and encourages them. The dyad then elaborated that most teachers and schools are "followers" who just need to "follow the direction charted by the big boat", because "they were scared that if they did not (follow), they would be scolded (by their leaders)". The further elaboration by the participants reveals that agentic learning and adaptation were not considered: schools and teachers needed to follow the MOE's directives; otherwise they would be "scolded". Similarly, the Case Three dyad shared a "waterfall" metaphor, "I see (a) school as a waterfall. Leaders are the water that flow through this eco-system and flourish teachers who are trees and flowers", suggesting a preference for a bottom-up approach. However, when elaborating the metaphor in relation to the scaling of innovation, the dyad mentioned that school Principals are to "set the pace and expectations", department heads are "empowered to implement" and "supports are provided to teachers" to adopt innovation, indicating a top-down view.

The Case One dyad regarded innovation diffusion as "a virus infection" and "evangelising", which are consistent with its bottom-up approach to scaling. The dyad shared that innovation diffusion is like a "virus infection; one person passes it to another (and) then passes it to another". To facilitate such an "infection", the dyad planned to put iPads in the staff lounge to create a physical hub to attract teachers' interactions. "Whoever is there can just pick one up and see how it can be used", and "people can talk about it among themselves". The dyad also wanted to incentivise teachers in the core group to "evangelise and reach out to other teachers".

In summary, for Case One, the metaphor (virus infection) and the diffusion approach were relatively consistent and represented a bottom-up approach for innovation diffusion. Case Two's diffusion approach and metaphor (bicycle) were also

relatively consistent but represented a top-down approach. Cases Three (waterfall) and Four (big and mini-boats) show some inconsistency between their metaphors and their diffusion approaches. Both cases used top-down approaches for diffusion, but their metaphors carried some bottom-up significance.

The differences across the cases, especially the distinctive difference in the diffusion approach for Case One, might be attributable to the organisational contexts and the participants' past experiences. C1P1 from Case One had previously had 3 years of experience as an officer at the MOE, performing a role similar to the two participants in Case Four. It might be the case that his experience at MOE helped him to conceive of innovation diffusion differently, whereas the Case Four participants, having had only about 6 months' experience as officers at the MOE, were only at the starting stage of a learning journey towards different approaches for innovation diffusion. The distinction of Case One might also be due to the school context. Compared to their counterparts in primary schools, teachers at secondary schools teach fewer subjects and are more specialised in the subject areas they teach. Hence, teachers at secondary schools may require more autonomy in inventing new pedagogies, which leads to a different innovation and diffusion culture in secondary schools.

This study requires a focus on how school leaders rationalise their diffusion approaches. Hence, how Cases Three and Four dyads justified the connections between their diffusion approaches and their conceptions of diffusion (e.g. metaphors) is presented in the next section. To help readers better appreciate the constraints and perceptions that school leaders have, the data is supplemented by the rationalisations shared by the dyads from Cases One and Two.

10.3.3   Rationalisation

The thematic analysis of the data revealed that the dyads made use of four repertoires to justify their approaches: perceived external constraints, perceived internal constraints, perceived capacity to manage top-down implementation and a static view on innovation diffusion.

10.3.3.1   Perceived External Constraints

The pressure to demonstrate the scaling outcome to the MOE and other schools was a key external constraint that the dyads perceived. Although the dyads knew that they needed to convince their own teachers to adopt the innovation, they felt a pressure to deliver outcomes quickly (e.g. high adoption rate) and did not have time to persuade teachers' voluntary adoption. For example, the Case Three dyad justified that they were under pressure to show quick or prompt diffusion results to MOE and other schools; "We are known among schools for our (innovation). MOE and other schools are looking at what we are doing. We need to quickly show results". When

the Case Four dyad was facilitated by the author to compare between evangelising and scaling of innovations, the dyad shared that, when evangelising, "I try to share my testimonials with people and try to convince them". But "evangelising is difficult. You need to spend a lot of time to work on people". However, when scaling innovations "in schools, time is a luxury".

10.3.3.2   Perceived Internal Constraints

School leaders used three perceived internal constraints, especially with regard to teachers' attitudes and perceptions, to justify their scaling approaches. First, the notion that teachers are time-constrained suggests that adopting an innovation means performing an "additional task" (e.g. adapting and using the innovation in their classroom) that demands their limited time. For example, when comparing between innovation diffusion and a "virus infection", the Case Three dyad mentioned that in a virus infection, "the infection is beyond your control". But, in innovation diffusion, "if you choose to adopt, you will have to put in a lot of effort (i.e., time) to implement it in your classroom". However, "teachers' workloads are full", and they "do not have time". Hence, "if we do not mandate, they will never adopt it".

The second constraint is related to how school leaders perceive teachers' attitudes towards innovation. The Case One dyad shared that people who are resistant to adopt innovations are those who "just stay in their comfort zones, just do things that they are sure (of*)*", and are "very narrow-minded". "They sit on the fence" or are "lazy to do it (adopting the innovation)". Therefore, "if I force you (the teachers) to use (the innovation) and if I give you enough support, and if you use it, you will have a good experience (in generating a positive outcome from the innovation), (and) likely you will continue to use it". In summary, the dyad believed that teachers may not choose to adopt the innovation if it were not compulsory but would find it beneficial if they used it; therefore mandating was useful.

The third constraint is regarding the perception of the innovation. The Case Three dyad compared innovation diffusion to "spreading rumours" and mentioned "in spreading of rumours, people have that curiosity, which needs to be addressed (satisfied)". "We are able to create the curiosity if the innovation is novel. As (our innovation) has been in this school for some time, there is no longer novelty". Therefore, the dyad chose to mandate teachers to adopt, as the innovation was perceived not to be novel.

10.3.3.3   Perceived Capacity to Manage Top-Down Implementation

The dyads were confident of their capacities to manage top-down implementation. The data suggests that the dyads gained confidence from three sources: teachers' trust in school leaders, teachers' obligations (as employees) and teachers' passion for students' learning.

For example, the Case Three dyad shared that "our teachers trust our school leaders. They are very *guai* (Singapore Colloquial Chinese, meaning 'they are very obedient about school leaders' decisions')". When comparing innovation diffusion to "persuading smokers to quit smoking", the Case Four dyad stated that to "quit smoking is a choice by people, but teachers have no choice. It is their job". The Case Three dyad also highlighted that "if teachers see the big picture that (the innovation) is preparing students for higher standards (of learning), then they will follow and try their best to make (the innovation) work".

10.3.3.4   A Static View on Innovation Diffusion

The data also revealed that the dyads might be holding a static view of innovation diffusion, in particular for each innovation's benefit. For example, the Case Three dyad shared that when teachers were mandated to adopt an innovation:

> … at least when they use the innovation in their classroom, their students can still benefit from the innovation being used. It is better than not using the innovation at all.

This sharing implies the view that an innovation has a stable effect on learning, just like how medicine has a predictable effect in treating patients with different health backgrounds. The view does not recognise the role of teachers in recontextualising an innovation for different classroom needs. Literature suggests that when teachers are under forced compliance, they are less likely to reinvent, even when support is provided by the management (Biott, 1992). Without teachers' agentive learning and adapting innovation for different classroom contexts, pedagogical innovations are not likely to be effective for learning or sustainably adopted by teachers.

10.3.4   Speculations

The four cases are characterised based on each dyad's scaling approach and alignment with the dyad's conceptual metaphor of innovation diffusion, as summarised in Table 10.3.

The data collected in this study did not directly capture the dyads' justification of the alignment or misalignment. To overcome this limitation, contextual factors are taken into consideration as far as possible to make speculations on the dyads' selection of scaling approaches and alignments with their conceptual metaphors.

Two speculations are made based on the interpretation of the similarities and differences of the contexts across the four cases. The first speculation seeks to understand why Cases One and Two have more alignment than Cases Three and Four. The second speculation is about why Cases Two to Four adopted top-down implementation approaches, whereas Case One adopted a bottom-up diffusion approach.

Table 10.3 Dyads' diffusion approaches and alignment with their conceptual metaphors

		Alignment with conceptual metaphor	
		Less	More
Scaling approaches	Top-down	*Case Three: Waterfalls* (Head of ICT and Assistant Head)	*Case Two: Bicycle* (Vice Principal and Head of Science)
		Case Four: Big and mini-boats (Ed-Tech Officers)	
	Bottom-up	–	*Case One: Virus infection* (Principal and ICT Mentor)

10.3.4.1   Speculation on Alignment

It is noted that the cases that have more alignment between scaling approaches and conceptual metaphors involved senior leaders (i.e. Principal in Case One and Vice Principal in Case Two) as the participants. The cases that have less alignment involved middle-level leaders (i.e. Head/Assistant Head of Department in Case Three and Ed-Tech Officers in Case Four).

It is possible to speculate that the case differences may be attributable to two factors. The first factor is the alignment between the participants' everyday professional roles and their roles in diffusing innovation. For example, Principals and Vice Principals (as in Cases One and Two) operate at the overall school level when performing their everyday professional roles. There is high alignment between their embodied experience (in performing their professional role) and the role they play in innovation diffusion, which is also at the overall school level. For Heads of Departments and MOE officers (as in Cases Three and Four), there was low alignment between the participants' embodied everyday experience (which is at department and individual levels) and the role they play in diffusing innovation (which is at school level or across schools). When a dyad has everyday experiences at the departmental level and is tasked to scale up an innovation at the school level, there is a gap between the dyads' embodied experiences and the task to perform. This gap might lead to the misalignment between the dyad's scaling approach (e.g. performing tasks at the school level) and the conceptual metaphor (e.g. experience at the department level).

The second speculation is that teachers expect high consistency from senior leaders like school Principals and Vice Principals. As senior leaders, Principals and Vice Principals need to show consistency in their thinking (which is revealed in their conceptual metaphors) and their actions in diffusing innovations. Leaders who say one thing but act in another way could be perceived by teachers as inconsistent, and thus their leadership is less respected. Additionally, the culture in East Asia suggests that middle managers respect hierarchical seniority and cultural norms (Hofstede, 2007; Tamney, 1996). Hence, Department Heads and MOE officers may simply accept the scaling approaches endorsed by senior leaders (such as school Principals) or be influenced by existing practices in their schools or MOE departments. As such, acceptance may not be subject to critical reasoning and examination, and misalignments could arise between what middle managers accept (from senior leaders

or school norms) and what they embody in everyday experience (at departmental levels).

If this speculation is reasonable, it is crucial to intentionally help middle managers gain embodied experiences at the school level and facilitate them to critically reconcile their experiences at individual, departmental and school levels. Such experiences and reflections may help develop alignment between their conceptual understanding (e.g. conceptual metaphor) and their diffusion approaches.

10.3.4.2 Speculation on Adopting Bottom-Up Approaches for Diffusion

Across the cases, only the Case One dyad adopted a bottom-up approach to diffuse an innovation. It is possible to speculate that the difference across the cases may be due to a few reasons, including the training that school Principals in Singapore receive prior to their principal-ship appointment, the type of school and the school Principals' autonomy.

C1P1's bottom-up conceptualisation of innovation diffusion may arise from his training prior to his principal-ship appointment. In Singapore, before a candidate is promoted from Vice Principal to Principal, he/she needs to complete a 6-month Leadership Education Programme (LEP). The programme is designed to embody the participant with a different experience. For example, the Creative Action Project, which is part of the LEP, attaches the candidate to a real school as an officer. He/she needs to envisage the school's progress over 10–15 years and implement a project that fulfils one aspect of the vision. Because the school has its own Principal, the project requires the candidate to gain support from the Principal and staff of the attached school in order to implement his/her plan. Hence, the candidate needs to influence rather than mandate the implementation of the project. C1P1 was appointed as a Principal 6 months prior to his participation in this study. The recency effect (Murdock, 1962) from his participation in the LEP might have influenced how he conceptualised and diffused the innovation.

Other factors may have add-on effects. One possible factor is the type of school. Compared to primary schools (as in Cases Two and Three), secondary schools (as in Case One) deal with more mature students and may prioritise independence and critical thinking; therefore, they might prefer influencing students from the bottom-up, rather than mandating from the top-down. This dynamic with students may influence the school's overall culture and approach. Another possible factor is school Principals' autonomy. Compared to Vice Principals (as in Case Two), Department Heads (as in Case Three) and MOE officers (as in Case Four), school Principals (as in Case One) enjoy more autonomy in their schools in dealing with constraints, shifting priorities and setting the pace for innovation diffusion. Therefore, Principals may be at liberty to take a more autonomous approach to diffusion through bottom-up approaches.

The speculations raised above do not mean to be exhaustive. Other speculations were also explored but considered less convincing. For example, the characteristics of the innovation may also play a part. In Case Two, the "holistic assessment" inno-

vation may require school-wide adoption to yield sufficient benefit for student learning. It may partially explain why the Case Two dyad adopted a top-down diffusion approach. However, such characteristics alone could not explain the differences across the cases. For example, design pedagogy (Case Three) does not need school-wide adoption as a condition to generate sufficient learning outcomes, yet the Case Three dyad adopted a top-down diffusion approach.

10.4   Conclusion and Discussion

This study used thematic analysis to understand how school leaders diffuse innovations and how they rationalise their diffusion approaches. The findings in this study should be interpreted under the limitation of the case study methodology and the cases being selected.

The findings suggest that the participants tend to favour top-down approaches to diffuse innovations. As sustainable and scalable diffusion of innovations requires integration of both top-down and bottom-up approaches (Fullan, 2007), the findings imply the necessity to help school leaders to shift from purely top-down approaches towards an integrated approach of innovation diffusion.

To examine how to facilitate this shift, the study also explored why school leaders often take top-down approaches to scale up innovations. Besides contextual factors such as the characteristics of innovation, this study also identified conceptual metaphors and repertoires that school leaders used to justify their top-down diffusion approaches. Speculations are made to highlight some possible important factors that affected the dyads' diffusion approaches and alignment with conceptual metaphors.

To help school leaders shift from top-down approaches towards an integrated approach, it is necessary to shift school leaders' conceptual metaphors and repertories. For this purpose, the discussion focuses on two aspects. The first aspect is on the dyads' conceptual constraints, as revealed in the data. Overcoming such conceptual constraints requires intentionally designed learning interventions. In a separate paper, Huang and Kapur (2015) introduced a learning intervention and reported how the participants learned and overcame the conceptual constraints using analogical reasoning (Gentner, 2003). Furthermore, Vosniadou (1989) and Brown and Clement (1989) both suggest that analogical reasoning is a viable approach to overcome misconceptions. The second aspect deals with the perceived contextual constraints revealed in the data. It is argued in the discussion section that overcoming conceptual constraints may help the dyads alter their perceptions on contextual constraints.

10.4.1 Conceptual Constraint: A Lack of Process-Oriented Thinking

Rogers (2003) suggests that diffusion is a process in which an innovation is communicated and adopted over time among members of a social system, for example, in a school. In the diffusion process, teachers need to develop attitudes towards the innovation, acquire knowledge that is necessary to evaluate the innovation and adapt and reinvent the innovation for sustained use in their own contexts. Hence, it is unrealistic to assume that innovation does not involve the process of diffusion or to assume that, as long as the innovation is used in classrooms, students will benefit from the innovation. Teachers' agency in learning about an innovation and adapting it for their own use is particularly important for sustainability—the sustained use of the innovation to yield continued benefits (Scheirer, 2005).

The dyads' rationalisation, in particular their static view of an innovation's benefit, reveals a lack of process-oriented thinking on innovation diffusion. This view is to regard innovation diffusion as a process, and how the innovation can evolve through the diffusion process to better suit students' learning outcomes, rather than just focusing on a perceived outcome. This can serve as a learning opportunity for school leaders who tend to use top-down approaches for innovation diffusion.

When teachers are under forced compliance, they are not inclined to reinvent. Without teachers heightening their knowledge on an innovation and reinventing the innovation for their own classroom needs, the innovation is less likely to yield optimised learning outcomes for students. Without observing optimised effects on students' learning, teachers will then be less likely to use the innovation sustainably. If teachers are mandated to use the innovation continuously, their trust in school leaders and their professional identity may be undermined as well.

In the process-oriented view on innovation diffusion, teachers develop their interests on a certain innovation, learn from each other's experiences in using it, adapt and reinvent it for their own use and share their experiences with each other. This in turn shapes the interest level of non-adopters. In this process, the innovation and the context in which the innovation is diffused reciprocally change at the same time. Underpinning the process is teacher agency. When the top-down approach is used alone, it undermines teacher agency and hinders the diffusion process. When the bottom-up approach is used alone, the reciprocal change process takes a long time to lead to the desired diffusion outcome. Integrating the top-down and bottom-up approaches respects teacher agency and optimises the reciprocal change process.

Hence, developing a process-oriented view on innovation diffusion is critical for school leaders to overcome their conceptual constraints related to top-down diffusion approaches. In a separate paper, Huang (2011) further argued that, for school leaders to develop a process-oriented view on innovation diffusion, they need to learn about innovation diffusion as a complex system. Readers may refer to the paper for the argument that innovation diffusion is a complex adaptive process. Learning through programmes such as the Creative Action Project that C1P1

received may have the potential to overcome the conceptual constraints. The training could give the trainees an embodied experience to influence school or system levels over time. Such embodiment is important to help overcome conceptual constraints.

10.4.2   Perceived Contextual Constraints: Could They Be Re-rationalised?

Many repertoires identified in the study (such as teachers' lack of time) are legitimate contextual constraints that school leaders should deal with when diffusing innovations. This chapter argues that these contextual constraints can be re-rationalised or re-prioritised when school leaders decide on diffusion approaches, as did the Case One dyad.

Firstly, some contextual constraints may be attributable to perception gaps. For example, the dyads in the study might have overestimated their capacities in managing the top-down implementation of innovation. This overestimation may arise from factors distinctive to the East-Asian culture (Hofstede, 2007), such as the societal acceptance of greater power and respecting hierarchies. The emphasis on the collective good (Dimmock & Walker, 2002) and the orientation towards harmony may have also contributed to the dyads underestimating teachers' agentive learning and adaptation at the individual level (e.g. "if teachers see the big picture…, then they will follow and try their best …").

The East-Asian culture provides an indigenous context in which school leaders in Singapore diffuse innovation. In Singapore's context, the culture also influences school leaders' overestimation of success when mandating the implementation of innovations. Without undermining the importance of the indigenous context, this chapter feels that there is a need to highlight the perception gaps it induces. Reflecting on these gaps is particularly important in light of a process-oriented view on innovation diffusion, which emphasises teachers' agency and adaptation in innovation diffusion.

Secondly, there may be a need to examine the goal of diffusion in the larger context of student learning and teacher professional development. The dyads acknowledged that innovations promote students' learning (e.g. "at least when they use the innovation in their classroom, their students can still benefit from the innovation being used. It is better than not using the innovation at all"). Often, the dyads also highlighted other goals (e.g. showing quick results, "MOE and other schools are looking at what we are doing. We need to quickly show results"). These goals may not always be in line with the goal of students' learning. For example, the process-oriented view on diffusion suggests that it takes time for teachers to reinvent and to optimise the learning benefit of the innovation, but showing quick results does not permit teachers taking time to reinvent. The data in this study suggests that

the dyads put the goal of showing quick results on a higher priority than the goal of students' learning.

Hence, it is arguable that developing a process-oriented view on innovation diffusion may help school leaders re-rationalise or re-prioritise the contextual constraints they perceive and to shift from top-down approaches of diffusion to approaches that integrate top-down and bottom-up approaches.

In summary, this paper identifies metaphors and repertoires that school leaders use to elaborate and justify their top-down diffusion approaches. It builds an empirical understanding on why school leaders in Singapore often take top-down approaches to diffuse innovation. Findings suggest a need to help school leaders develop a process-oriented view on innovation diffusion. Addressing this conceptual constraint may help school leaders deal effectively with the contextual constraints they perceive. This study complements existing literature by providing empirical findings that justify the need and significance for engaging school leaders in developing process-oriented thinking for innovation diffusion.

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Jun Song Huang is a Senior Research Scientist at the Office of Education Research at the National Institute of Education, Singapore. He was formerly the Head of Education Research Administration and Communication, Office of Education Research. Prior to that, he was Research Manager of the Learning Sciences Laboratory. His research interests are in agent-based modelling (ABM), analogical reasoning, complex adaptive systems (CAS), innovation diffusion and learning complex systems.

Part IV
Innovation and Change from the Classroom and Learner's View

Chapter 11
Exploring the Change in Nature and Efficacy of Learners' Questions Through Progressive Interaction with the Stanford Mobile Inquiry-based Learning Environment (SMILE)

Kenneth Y. T. Lim, Bing Heng Song, and Matthew Xiang Kho

Abstract Through the use of the Stanford Mobile Inquiry-based Learning Environment (SMILE), students are provided with a digital platform to generate questions, with the purpose of clarifying conceptual doubts, as well as to challenge and learn from each other. This paper seeks to find out whether SMILE has any effect on the nature and efficacy of learners' questions in Singapore and assess whether SMILE is an effective and reliable tool in helping students achieve better conceptual understanding and accuracy. It also demonstrates how the use of SMILE can be translated as well as sustained in schools, in alignment with the ecological framework which is the thesis of the present book. SMILE lessons were conducted at a secondary school during Physics lessons, with students being encouraged to generate questions related to the subject. Survey data was collected from both teachers and students, and the questions generated by students from three classes were analysed according to content relevance, conceptual accuracy as well as question type, the latter of which is categorised by Bloom's Taxonomy. There do not seem to be significant changes with regard to the percentage of accurate questions generated, nor the proportion of higher-order thinking questions per student. Nevertheless, both teachers and students are fairly optimistic about the use of SMILE in engaging students in critical thinking. This finding correlates with data indicating an increase in variation of question type over time.

K. Y. T. Lim (✉) · B. H. Song · M. X. Kho
National Institute of Education, Nanyang Technological University, Singapore, Singapore
e-mail: kenneth.lim@nie.edu.sg

11.1 Introduction

11.1.1 Rationale

Acknowledging the paradigmatic effect of the then-nascent Internet and its transformative potential in teaching and learning, Information and Communication Technologies (ICT) were formally introduced in 1997 with the launch of the first masterplan for ICT in education (Koh & Lee, 2008). Since then, three follow-on masterplans have been implemented, with the latest being in early 2015. While each plan reinforced the previous ones and prioritised the factors that predominated its "success", they were also able to adapt strategies to the shifting contexts of the Singaporean education system. This seamless adaptability is a crucial factor of the strength of ICT in the implementation of education masterplans in local schools.

With the implementation of these masterplans, the overall ICT infrastructure in schools has improved to the current state which allows for high-speed broadband and 4G access island-wide (Koh & Lee, 2008). At the same time, by 2011, ownership of mobile devices has held steady at about 150% of the population (Infocomm Media Development Authority Singapore, 2017). With the current generation of technologically savvy students who are capable of handling mobile devices and associated applications with ease, it would be comparably more effective to make use of mobile technologies to support teaching and learning.

In addition, there has been continual professional development of teachers, including ICT skills trainings and the peer-supported, collaborative and self-directed nature of ICT pedagogical developments. Hence, having been equipped with the appropriate sets of skills, teachers are not only familiar and comfortable with utilising ICT for teaching and learning but have also developed the mindset of a reflective practitioner in exploring different avenues regarding ICT pedagogical approaches. On top of these, the strategies adopted for the professional development of school leaders have contributed significantly to a conducive environment for the use of ICT for teaching and learning. Thus, the education system has the cultural disposition, infrastructure and expertise to engage in mobile-based learning.

The core design principle for this project was to experiment and develop an ICT programme that increases learner participation, understanding, engagement and motivation through an inquiry-based, learner-centred pedagogical approach. An existing tool, the Stanford Mobile Inquiry-based Learning Environment (SMILE), was identified for this programme, as it was found to be suitable for translation to local classroom contexts. This ICT programme, in which SMILE is used as an ICT tool to enhance teaching and learning, was designed to be in alignment with the masterplan for ICT in education, as well as to serve the mandate of the school in which it was piloted, part of the FutureSchools programme, under which it receives additional funding in order to pilot and spread innovative technology-mediated practices.

11.1.2 Overview of SMILE

SMILE is a simple assessment/inquiry maker which allows students to generate questions related to what was taught to them in class. After connecting to the SMILE server, students are provided with a stimulus, in the form of a video, related to a Physics topic (refer to Fig. 11.1).

After which, students are to generate questions based on the stimulus. They can also choose to attach a photograph of a diagram or any other object from their textbooks or any phenomena discovered in the laboratory and create a homework item (refer to Fig. 11.2). The questions created by students are instantly collected and subsequently shared with the entire class.

Questions created by students will be rated by their classmates based on how relevant or useful the questions are to their own learning (refer to Fig. 11.3). The teachers provided a scaffold for the peer evaluation process, with the criteria being (1) whether there were any misconceptions; (2) whether the answer given was right or wrong; and (3) the level of the question according to Bloom's Taxonomy. Teachers or facilitators can also review the questions and remove those which are irrelevant or not as useful.

A summary of each student's results is also accessible by them individually, as well as by the teacher or facilitator. The summary contains details such as which questions the student answered correctly/incorrectly, how many questions they answered, their percentage of questions answered correctly, their average rating and

Fig. 11.1 Activity flowchart for a SMILE lesson
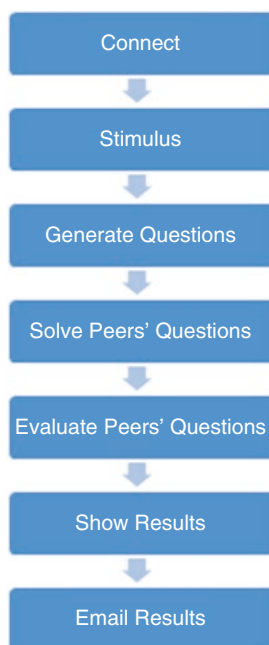
Fig. 11.2 Question-generating page on a SMILE device

their average time taken to answer. The session summary provides an overarching review of the session, including details such as who answered the most questions, who has the highest score, who answered the fastest and who posted the most questions.

The current prototype of this application supports the generation of students' questions for group sizes of around 40 learners. Larger learning communities such as at the village/school level or community/school district level will be supported soon. The former prototype, which comes in the form of a micro-cloud computer, takes place inside the classroom, while the latter application takes place outside the classroom. The current prototype can be accessed via a mobile device, which, in our study, was accessed via tablets using the SMILE website (https://smile2.stanford.edu/), thus enabling students or teachers to have access to the SMILE server regardless of time and place. In short, all homework items created by students are uploaded to and saved on the SMILE server, which is shared with the class. This in-out school network system offers continuous learning to students, enables them to pay attention to their own learning and assists them in acquiring a better understanding of what they have learned inside and outside the classroom.

Fig. 11.3 Question-evaluating page on a SMILE device

The SMILE environment leverages on existing mobile technology used by students to increase student engagement and inquiries. It offers a pedagogical shift in moving away from the traditional pedagogical approaches which rely on teachers to come up with questions while students simply memorise and recall the right answers. The activities are designed to develop inquiry making, critical thinking and analytical skills. They help to transform conventional teacher-led classrooms into active learning environments where students construct their own learning. The learning is self-directed and peer-to-peer, which relates relevant content to a learner's practical experiences. This helps teachers identify and address learning gaps in order to improve student learning.

The programme is not content-based and hence is not domain or subject specific. Thus, it offers the flexibility to be used in a variety of formal or nonformal education and training scenarios where promoting higher-order learning (i.e. versus rote memorisation) and generating instant learning analytics are of importance. The combination of mobile and micro-cloud technology has the potential to be used in unique education settings such as on field trips and in rural areas.

11.2   Aims and Objectives

The study sought to find out if progressive interaction with SMILE affects the nature and efficacy of learners' questions and, in so doing, find out the extent to which SMILE, as a platform, is efficient in helping students achieve better conceptual understanding and accuracy.

Considering that many systemic problems faced in a traditional classroom setting can be ameliorated with the use of technology, our project sought to find out the extent to which such technology is able to mediate these limitations.

The school in which the intervention described in this chapter was implemented is a state-funded school in Singapore. In the course of recent years, it has enjoyed access to additional funds under the FutureSchools@Singapore programme of the Ministry of Education. Under this programme, the National Institute of Education works in partnership with the Ministry to manage the National Research Foundation's R&D programme on Interactive and Digital Media (IDM) in Education.

The FutureSchools@Singapore programme operates under a unified structure (known as eduLab) that couples the endeavours of schools, an Institute of Higher Learning (IHL) and industry, to focus on IDM in Education projects. EduLab has been effective in developing Singapore as a "living" lab for IDM in Education products. It reinforces the capabilities developed in schools, industry and IHLs to drive the following objectives:

1. Prototype educational models and IDM tools with a view to effectively scaling up their adoption in the school system.
2. Strengthen the collaborative partnerships between schools, IHL researchers and industry.
3. Develop new knowledge and local manpower capability, including education models and IDM tools that have potential for commercialisation.

The leadership team in this school are strong supporters of innovative and effective use of ICT for teaching and learning. Over the past few years, such support has given rise to many ground-up initiatives from teachers. Besides providing support for bottom-up initiatives, the school leaders are also actively involved in leading curriculum innovations and research to promote higher-order thinking and collaborative learning amongst students.

In terms of teacher readiness, more than 85% of teachers in the school have been trained in Teaching for Understanding with Technology (Wiggins & McTighe, 2011), and of these, 30% of teachers attained the status of Microsoft Office Specialist. The teachers have common pedagogical language and expertise that allows for active engagement and participation in the development of innovative curriculum. The school nurtures professional learning communities amongst teachers to enable them to meet and collaborate on curriculum improvement and innovation.

The school campus is wireless and has subscribed to a dedicated data transfer capacity of 20 Mbps to back up teaching and learning. With respect to the student

profile, a research survey conducted by the school on 830 students in 2011 demonstrated that students are regular and proficient users of Web 2.0 technologies, and all students have access to an e-learning portal as well as Web 2.0 tools.

As seen in the following conversation which took place during a Physics lesson (without the use of SMILE technology) on 16 October 2013, a student was unable to clarify his thoughts with the teacher due to his inability to articulate his doubts:

> Teacher: Next question. If there is a change in the freezing process of a substance, what can we say about the substance? Hmmm.…you?
> Student: […]
> Teacher: What can we say?
> Student: {silence}

Through the use of SMILE, students were provided with a digital platform to raise questions, either to clarify certain doubts or to test and compete with each other. We hope to add to existing knowledge on the use of SMILE by studying whether it had any effect in helping students in Singapore learn how to generate better questions.

Some of the assumptions we made were that:

- Each class has been given the same verbal instructions by the teacher conducting the lesson..
- Each class has been given the same amount of time to interact with SMILE.

We acknowledge that these assumptions might not necessarily hold true. The investigation was conducted with 15- and 16-year-old students over the span of a few months (May to August for one class and June to September for two classes) in 2015. SMILE lessons were primarily carried out during Physics lessons, although towards the end of the study, teachers from other subjects had begun to use SMILE in their lessons as well. Such lessons included a Humanities field trip and an English language lesson on vocabulary.

The research question which drove our inquiry was: How does the nature and efficacy of learners' questions change over time through progressive interaction with SMILE?

11.3 Literature Review

The research described in this report is framed through Kaptelinin and Nardi's (2006) activity theory. For the purposes of the present analysis, Vygotsky's (1978) original focus on mediated action from the perspective of the individual would be most applicable.

Vygotsky argued that there is never a direct relationship between a human subject and an object; this relationship must be sought through other means in culture and society, as opposed to the individual mind unto itself (as cited in Engeström, 2001). In an attempt to explain the development of human consciousness, Vygotsky

(1978) proposed that consciousness emerges from human activity mediated by artefacts (tools) and sign, for example, physical artefacts such as hammers or machines, cultural artefacts such as language and theoretical artefacts such as algebra.

Wells (2007) represents this concept of semiotic mediation within Vygotsky's triangular model which features the triad of Subject, Object and Mediating Artefact. In mediated action, the Subject, Object and Artefact stand in a dialectical relationship, whereby each affects the other while also affecting the activity as a whole.

In the intervention described in this chapter, Subject would refer to the student, the Mediating Artefact would refer to the use of SMILE, Object would refer to the questions generated, and Outcome would refer to the greater conceptual understanding of the topic. Understood this way, some of the theories which form the context of this study are the pedagogical approaches of:

1. Inquiry-based learning, in which learners generate questions to develop their knowledge, is also defined as "an activity of a teacher and a pupil that is focused on the development of the knowledge, skills and attitudes based on the active and relatively individual cognition of the reality by the pupil who learns on his/her own how to explore and explores" (Dostál, 2015). This is a constructivist method of teaching, whereby learners actively construct knowledge from their experiences, which is crucial to the education of scientific subjects (Cole, 2009).
2. Socratic questioning, where learners are probed to think deeper through structured and systematic questioning. Socratic questions include:

   - Questions for clarification—Why do you say that?
   - Questions that probe assumptions—How can you verify or disprove that assumption?
   - Questions that probe reasons and evidence—What do you think causes…to happen? Why?
   - Questions about viewpoints and perspectives—What is another way to look at it?
   - Questions that probe implications and consequences—How does...affect...?
   - Questions about the question itself—What was the point of this question?

3. Bloom's Taxonomy, which provides a hierarchy and framework for categorising different types of questions.

A study done by Healey (2005) emphasises the benefits of inquiry-based learning, in terms of depth of students' learning and understanding. Kubieck (2005) found that when students generate questions, they are often required to revisit and expand upon prior curricular material. Chin and Brown (2002) also argue that questions can reveal students' thought processes as well as their gaps in knowledge or understanding, allowing teachers to surface misconceptions.

However, studies show that only a small percent of questions asked in class are student-generated. Dillon (1988) wrote that students generated very little questions, and of those, most were regarding instructional clarifications, rather than content-related inquiries. Kolb (2008) suggests that one of the many reasons why students were hesitant in asking questions was because they were afraid of negative reactions

from both classmates and teachers, which may have stemmed from structural concerns and the extent of the teacher's authority and control.

Technology, as a mediator, may be able to encourage students to generate more questions at their own pace and without facing negative reactions from their class. Indeed, mobile phones are being increasingly recognised as engaging tools that schools can take advantage of (Dillon, 1988). Kubieck (2005) similarly suggests the use of technology as a platform to employ inquiry-based learning in Science subjects but cautions that it must be used appropriately to be pedagogically effective.

Recent research on SMILE (Seol, Sharp, & Kim, 2011) has categorised the students' questions according to types drawn from Bloom's Taxonomy. Data gathered from 26 students revealed that the remembering-type were the most common, followed by understanding-type, with analysing-type questions being the least common (Seol et al., 2011). Another study by Buckner and Kim (2014) comments that students primarily generated remembering-type questions because they lacked the experience in asking questions and/or were used to memorising facts in their traditional classroom setting. It was also found that the facilitator played a key role in setting early guidelines for stimulation and learning evaluation, which helped improve the quality of questions asked over time (Buckner & Kim, 2014).

11.4 Methodology and Materials

The SMILE application enables homework generation, completion and competition during class. It encourages students to review what has been taught, tests their conceptual understanding and clarifies any misconceptions. Students can immediately review their results once they have submitted their answers and, in doing so, can quickly identify and clarify their mistakes or compensate their lack of learning with peers' questions. The instant activity prevents students' learning of the day from fading away easily and helps them to strengthen their conceptual knowledge as they can immediately apply what was taught. After the activity, a teacher can also choose to provide additional information and detailed explanations to the class.

Teachers can serve as facilitators by controlling and monitoring the activity flow so that students will not get distracted easily. They are also in charge of addressing and rectifying any mistakes made by the students during the question-generating stage. The teachers are also tasked with providing the stimulus and scaffolding the question-generating process by using the models of Bloom's Taxonomy and Socratic questioning. They can also choose to select and show good examples of higher-order thinking questions.

SMILE lessons have been carried out by the teachers at the school. Types of data include the questions generated by the students, survey responses gathered from students and teachers and audio recordings of the SMILE lessons.

These lessons are primarily conducted during Physics lessons in an integrated co-teaching classroom, where students are allowed to utilise tablets for the purpose of accessing SMILE (refer to Fig. 11.4). The teacher first explains the models of

Fig. 11.4 SMILE lesson in progress. (Copyright [2018] by K. Y. T. Lim. Reprinted with permission)

Table 11.1 Dates and topics of SMILE lessons per class

Class	Date	Topics covered
3R8 (Class C)	30 Jun 2015 (holiday assignment)	Kinematics, Forces
	28 May 2015	
	11 Aug 2015	Thermal Physics
4R6 (Class A)	1 Jul 2015	Kinematics, Forces, Dynamics, Sound
	30 Sep 2015 (e-learning)	
4R7 (Class B)	2 Jul 2015	Kinematics, Forces, Dynamics, Sound
	30 Sep 2015 (e-learning)	

Socratic questioning and Bloom's Taxonomy to the students. A Physics-related video is played, and students are to generate their own questions after that. The teacher then goes through the questions one by one and clarifies any conceptual inaccuracies with the students.

We report the data collected from three classes in Table 11.1. There were two 10th grade classes of 17 students each; these are referred to in this chapter as Classes A and B. Additionally, there was a 9th grade class of 29 students; this class is referred to in this chapter as Class C. Classes A and B were relatively smaller in size compared to Class C because of the subject combinations offered. Students from all three classes were of similar academic abilities as inferred from their performance in nationwide 6th grade examinations. SMILE lessons were conducted by the same teacher from May to July 2015, with an e-learning lesson conducted for two classes in September 2015.

11.5   Results and Discussion

11.5.1   Survey Data

The survey data conducted for teachers was analysed and categorised according to themes. Three questions were asked in the survey:

- Describe how you can make use of SMILE in your lesson.
- Does the use of SMILE make students more curious about the subject you teach?
- How do you think SMILE can benefit our students? Do you think it will make them change the way they ask questions?

As the third question is most pertinent to our research question, the analyses of the survey data are as follows: Teachers felt that the technology of SMILE "will provide students with the confidence to ask questions, without fearing judgement from their peers", and is also able to overcome practical barriers such as absence from class. Conversely, students may continue to be afraid of asking questions given that the questions are visible to the entire class. Teachers also believed that students "will be motivated to read up their content first in order to generate tougher questions and answer their peers' questions as well". Students may feel more inclined to read and understand the content before the lessons as the element of friendly competition encourages students to pose more challenging questions.

Teachers felt that students will "have a deeper understanding of the topic as they may want to ask higher order questions". In this way, SMILE can help students to think critically and try to find the answers themselves before asking questions, thus building on their conceptual understanding of the topic at hand. Students will also be able to understand the process behind crafting good questions, as stated by one of the teachers that they "will then realise that every part of the question is important and figure out what details they need to answer the question", thus learning to identify key points when answering questions.

Some teachers felt that "this activity is suited to students who are strong conceptually so the list of questions to correct would not have been extensive". However, some teachers believed that it can also benefit weaker students through process writing and encouraging them to be inquisitive and critical thinkers. Additionally, students will benefit from each other due to exposure to multiple perspectives and questions. Quite a number of teachers wanted to "use SMILE to conduct a post-lesson evaluation of the chapter with students" as it would be easier for students to test their own understanding of the concepts and clarify any misconceptions or doubts. Nevertheless, some teachers were sceptical towards SMILE's ability in benefiting how students learn and the efficiency in students' learning, as they felt that teachers "need to think how they can effectively employ it… so that it does not become a mere exercise".

The survey data conducted for students included the following open-ended questions:

- How does SMILE make you think more critically?
- Has using SMILE helped you in any way to have a better idea about how physicists look at the world?
- Does the use of SMILE make you more curious about Physics?
- Has SMILE changed the way you ask questions? How?
- What do you think are some questions that are important in physics?
- In general, how has SMILE benefited you?
- What are the challenges you face when doing a SMILE activity?

Some of our findings are as follows: SMILE makes students think about the subject they are learning as a few mentioned that "some questions posted by my friends require me to think harder". SMILE encourages students to ask questions and helps them to think deeper when trying to create a question. The majority of the students feel that SMILE has helped them to "relate physics concepts to real world problems" and have a better understanding of how physicists look at the world, as students have to think like physicists when creating Physics questions. There is, however, a minority of students who do not feel that SMILE has helped them in understanding how physicists look at the world. Nevertheless, students generally feel that the use of SMILE will make them more curious about Physics. A student commented that "when my classmates submit their questions, there are a few that I have not seen before and sometimes it is interesting".

Our observations suggest that quiet students tend to voice out their questions more often when using SMILE as compared to lessons conducted normally in class. Students will think critically and try to find the answers themselves before asking questions, building on their conceptual understanding of the topic. Most students "can't ask too easy questions because it will be too simple, so they have to think of questions that can activate their ability to think".

Students feel that the important questions are those that concern their "daily lives and practical use" so that they can relate to them and apply better conceptual understanding. Many students think that SMILE has benefited them by creating a more engaging learning environment because students are able to interact with one another. Most importantly, students feel that they "learn better" and "learn more stuff" from each other as they answer different types of questions created by their peers. Some students find that questions created by other students are difficult to understand as there were "some confusing questions and hard ones" and hence are unable to answer the questions. Students also find it hard to create what is deemed as a "good" or "suitable" question.

In addition to these questions, students were asked to rate several statements with regard to the usefulness of the SMILE activity as well as their interest towards it, from 1 being the least true to 7 being the most true. Figures 11.5 and 11.6 reveal that students are fairly optimistic towards SMILE's usefulness, although a considerable percentage of students are undecided. Nevertheless, the majority of students feel that the activity was enjoyable, and being actively engaged and interested is beneficial to the students' learning.

I think doing this activity could help me to ask better questions.

Not at all true: 1	2	3%
2	3	4.5%
3	5	7.6%
4	19	28.8%
5	17	25.8%
6	8	12.1%
Very true: 7	12	18.2%
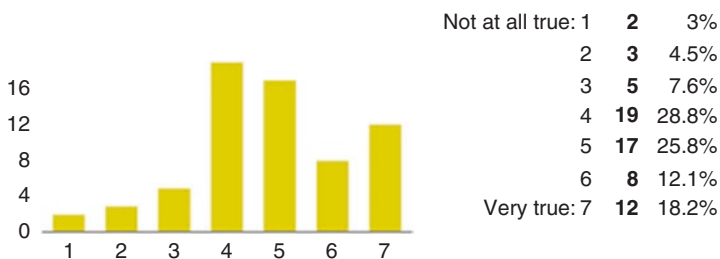
Fig. 11.5 Results of survey data concerning SMILE's perceived ability to improve learners' questions

I thought this activity was quite enjoyalbe.

Not at all true: 1	2	3%
2	0	0%
3	8	12.1%
4	18	27.3%
5	19	28.8%
6	8	12.1%
Very true: 7	11	16.7%
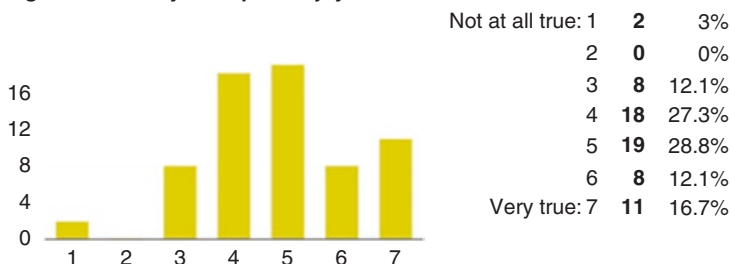
Fig. 11.6 Results of survey data concerning students' interest towards SMILE

11.5.2 Student-Generated Questions: Conceptual Accuracy

Apart from the survey data collected, questions generated by students from three classes were also collected and analysed. These questions were categorised according to various parameters, such as content relevance and conceptual accuracy. It was found that all but one question were relevant to the topic or subject, which in this case was Physics. This could imply either that the students are mature enough to use SMILE solely for educational purposes or that the presence of a teacher or facilitator is important in keeping the students focused.

Conceptual accuracy was dependent on both the question asked and the option students chose as correct. Examples of accurate questions generated by the students [(correct) indicates the option the student has chosen to be correct for the question] are:

1. According to kinetic molecular model, in gases

   a. The particles are closely packed together, and they occupy minimum space.
   b. The particles occur in clusters with molecules slightly further apart.
   c. The molecules are very far apart and occupy all the space made available to them. (correct)

   d. The particles vibrate about fixed positions and are held together by the strong intermolecular bonds.

2. Convection is transfer of thermal energy due to

   a. Vibration of the particles
   b. Expansion of fluid
   c. Movement of particles from one place to another (correct)
   d. Radiation of waves

3. Why do people standing on a bus tend to be at risk of falling when the bus suddenly comes to a stop?

   a. They did not grab hold of a pole.
   b. They were too heavy.
   c. They did not feel inclined to move.
   d. Due to inertia, the reluctance for a body to change its state of motion. (correct)

Examples of inaccurate questions generated by the students [(correct) indicates the option the student has chosen to be correct for the question] are:

1. A good thermometer generally

   a. Is able to measure a huge range of temperatures
   b. Responsive to some temperature changes only
   c. Is safe to use (correct)
   d. All of the above

The answer depends on what the thermometer is going to measure. The student did not state what the thermometer is measuring; hence, there could be more than one correct answer.

2. Which of the following increases when the volume of a fluid is reduced?

   a. Frequency of collision (correct)
   b. Speed
   c. Kinetic energy
   d. Pressure

There is more than one correct answer; both frequency of collision and pressure increases.

3. What happens to the mass and weight of a satellite as it is launched from earth into space?

   a. Mass decreases, weight increases
   b. Mass increases, weight decreases
   c. Mass stays the same, weight stays the same
   d. Mass increases, weight stays the same
   e. Mass stays the same, weight increases (correct)

The correct answer is none of the above; when a satellite is launched from earth into space, its mass stays the same and weight decreases.

Amongst the three classes combined, it was found that there was an increase in the percentage of inaccurate questions over time (from 2.41% to 8.90%). A two-sample t-test between proportions was performed to determine whether there was a significant difference between the first and second lessons with respect to the percentage of inaccurate questions. The t-statistic was not significant at the 0.05 critical alpha level, $t(228) = 1.919$, $p = 0.0562$ (1st lesson N = 83, 2nd lesson N = 146). Therefore, we fail to reject the null hypothesis and conclude that the increase in inaccurate questions between the first and second lessons was not significant.

11.5.3 Student-Generated Questions: Thinking Skills

Using the questions generated by the students, we analysed and categorised each question by using Bloom's Taxonomy to identify whether a student's question was indicative of higher-order thinking.

These are examples of the student-generated questions and how we have classified them according to Bloom's Taxonomy:

1. Remembering:

    a. What is the best way for a thermocouple to work?
    b. According to kinetic theory, what does temperature measure?
    c. What makes gases compressible?
    d. Convection is transfer of thermal energy due to _____?
    e. What is a property of both liquids and gases?

2. Understanding:

    a. The diagram shows a container with three spouts. The container is filled with water. Jets of water pour out of the spouts. Why does the jet of water from the bottom spout travel the furthest out from the container?
    b. When a barometer is taken up a balloon, the mercury level _____?
    c. Why is the base area of a lamp heavy?
    d. Is there a resultant force acting on an object moving with constant speed? If yes/no, why?
    e. When does an object float in water?

3. Applying:

    a. The surface of water in a domestic tank is 6 m above a cold water tap. The density of water is 1000 kg m³. What is the pressure of water as it leaves the tap?
    b. Person has 40 kg mass on earth. When Person is on the moon, what is the mass?
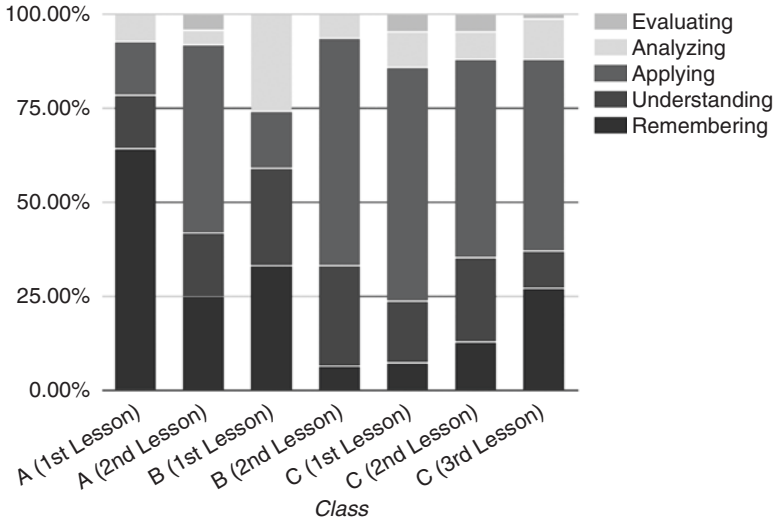
Fig. 11.7 Percentage of types of questions generated by students per lesson

c. A ball has a mass of 500 g. It travels towards a boy at 20 m/s. The boy kicks the ball with a velocity of 150,000 cm/min. What is the force exerted on the ball during contact?

d. If an object of mass 9 kg starts from rest and attains a velocity of 24 m/s after 6 s, then the force acting on it is?

e. What is the net force on a 200 g ball when it hits a wall with acceleration of 10m/s²?

4. Analysing:

a. Which of the following has the highest pressure?
b. Which of it explains what happens after the air is heated?
c. Which shows the greatest external pressure?
d. There are three states of water. Which of the following is the densest?
e. Which is the centre of gravity (CG) that will make the man be stable?

5. Evaluating:

a. What happens to the coloured water level in a round bottom flask with a coloured water droplet in a tube is held by warm hands?
b. A truck is travelling at constant speed along a road and discovers that a thin sheet of ice has formed on the road. Fearing for his safety, the driver applies the brakes to stop the truck. Compared to braking on a dry road, what may happen?
c. What does one person do when being chased by an elephant? And why?
d. The diagram below shows an oval disc free pivoted at point A. The bottom of the disc is pulled to the left by a thread at point D as shown. Which of the point is the centre of mass of the disc?
e. What would be the reasonable estimate for the volume of a metre rule?

Table 11.2 Change in proportion of remembering-type questions per student in Classes A and B

Remembering-type questions		N	Mean	Std dev.		
	1st lesson	17	0.515	0.419		
	2nd lesson	17	0.147	0.343		
		Sum of squares	df	Mean square	F	Sig.
	Treatment (between groups)	1.149	1	1.149	12.2	0.003
	Error	1.507	16	0.094		
	Ss/Bl	3.184	16			
	Total	5.840	33			
	η^2	0.197				

From Fig. 11.7, we can see that the percentage of remembering-type questions decreases over time with the use of SMILE, with the exception of Class C. There is also an increase in the percentage of applying-type questions in the second lesson for Classes A and B. However, majority of the questions fall under the applying-type as these are commonplace in Physics questions, and students may have been familiar with such questions before. Another probability is that students may not be generating the questions themselves and may have copied questions off other sources.

Tables 11.2, 11.3, 11.4 and 11.5 present a one-way analysis of variance (ANOVA) analysing the changes in proportion of question types against the first and second lessons for Classes A and B, as they were given the same instructions and topics. To paraphrase Field (2005) and Lund, Liu, and Shao (2016) (amongst others), ANOVA was used to determine whether there were any statistically significant differences between the means of three or more [question types]. The decrease in proportion of remembering-type questions and the increase in proportion of applying-type questions were both found to be significant ($p = 0.003$, $p = 0.011$, respectively), with the effect size being considered small according to Cohen's effect size criteria ($\eta^2 = 0.197$, $\eta^2 = 0.212$, respectively). This shows a small but significant improvement as students generate lesser remembering-type questions which belong to the lowest level of Bloom's Taxonomy and instead generate more applying-type questions.

However, as seen in Table 11.5, the change in analysing-type questions, which is considered a higher-order thinking question, is insignificant ($p = 0.332$). This may be due to the limited number of lessons the classes were exposed to.

Tables 11.6, 11.7, 11.8, 11.9 and 11.10 present a one-way analysis of variance analysing the changes in proportion of question types against the first, second and third lesson for Class C. Contrary to what was found earlier for Class A and B, the proportion of remembering-type questions for Class C increased steadily from the

Table 11.3 Change in proportion of understanding-type questions per student in Classes A and B

Understanding-type questions		N	Mean	Std dev.		
	1st lesson	17	0.191	0.300		
	2nd lesson	17	0.265	0.400		
		Sum of squares	df	Mean square	F	Sig.
	Treatment (between groups)	0.046	1	0.046	0.4	0.536
	Error	1.860	16	0.116		
	Ss/Bl	2.140	16			
	Total	4.046	33			
	η^2	0.011				

Table 11.4 Change in proportion of applying-type questions per student in Classes A and B

Applying-type questions		N	Mean	Std dev.		
	1st lesson	17	0.147	0.294		
	2nd lesson	17	0.529	0.450		
		Sum of squares	df	Mean square	F	Sig.
	Treatment (between groups)	1.243	1	1.247	8.35	0.011
	Error	2.382	16	0.149		
	Ss/Bl	2.235	16			
	Total	5.860	33			
	η^2	0.212				

Table 11.5 Change in proportion of analysing-type questions per student in Classes A and B

Analysing-type questions		N	Mean	Std dev.		
	1st lesson	17	0.147	0.294		
	2nd lesson	17	0.059	0.166		
		Sum of squares	df	Mean square	F	Sig.
	Treatment (between groups)	0.066	1	0.066	1	0.332
	Error	1.059	16	0.066		
	Ss/Bl	0.765	16			
	Total	1.890	33			
	η^2	0.035				

Table 11.6 Change in proportion of remembering-type questions per student in Class C

Remembering-type questions		N	Mean	Std dev.		
	1st lesson	29	0.059	0.206		
	2nd lesson	29	0.126	0.187		
	3rd lesson	29	0.241	0.280		
		Sum of squares	df	Mean square	F	Sig.
	Treatment (between groups)	0.495	2	0.248	4.53	0.015
	Error	3.065	56	0.055		
	Ss/Bl	1.306	28			
	Total	4.865	86			
	η^2	0.102				

Table 11.7 Change in proportion of understanding-type questions per student in Class C

Understanding-type questions		N	Mean	Std dev.		
	1st lesson	29	0.111	0.278		
	2nd lesson	29	0.218	0.271		
	3rd lesson	29	0.098	0.170		
		Sum of squares	df	Mean square	F	Sig.
	Treatment (between groups)	0.253	2	0.127	2.01	0.143
	Error	3.535	56	0.063		
	Ss/Bl	1.493	28			
	Total	5.282	86			
	η^2	0.048				

Table 11.8 Change in proportion of applying-type questions per student in Class C

Applying-type questions		N	Mean	Std dev.		
	1st lesson	29	0.698	0.419		
	2nd lesson	29	0.517	0.229		
	3rd lesson	29	0.546	0.364		
		Sum of squares	df	Mean square	F	Sig.
	Treatment (between groups)	0.545	2	0.273	2.52	0.090
	Error	6.061	56	0.108		
	Ss/Bl	4.023	28			
	Total	10.630	86			
	η^2	0.051				

Table 11.9 Change in proportion of analysing-type questions per student in Class C

Analysing-type questions		N	Mean	Std dev.		
	1st lesson	29	0.086	0.270		
	2nd lesson	29	0.092	0.152		
	3rd lesson	29	0.103	0.242		
		Sum of squares	df	Mean square	F	Sig.
	Treatment (between groups)	0.004	2	0.002	0.04	0.961
	Error	2.940	56	0.053		
	Ss/Bl	1.372	28			
	Total	4.317	86			
	η^2	0.001				

Table 11.10 Change in proportion of evaluating-type questions per student in Class C

Evaluating-type questions		N	Mean	Std dev.		
	1st lesson	29	0.046	0.194		
	2nd lesson	29	0.057	0.128		
	3rd lesson	29	0.011	0.062		
		Sum of squares	df	Mean square	F	Sig.
	Treatment (between groups)	0.033	2	0.017	0.81	0.450
	Error	1.152	56	0.021		
	Ss/Bl	0.465	28			
	Total	1.650	86			
	η^2	0.001				

first lesson to the third lesson, and this was found to be significant ($p = 0.015$). The effect size is likewise considered to be small ($\eta^2 = 0.102$). One of the reasons why the results for Class C may differ from the above results may be attributed to the different types of lessons that took place. Classes A and B had an e-learning lesson as their second lesson, whereas class C had their first lesson as a holiday assignment. Perhaps when students are given more time outside of class to generate their own questions, they will be more likely to generate questions that are of a higher level, resulting in a lower proportion of remembering-type questions.

Similar to Classes A and B, there was minimal change found in Class C in the mean proportion of understanding-type questions. This change was not found to be significant.

In line with results from Table 11.6, it was found that the mean proportion of applying-type questions decreased from the first lesson to the second lesson, but increased again from the second lesson to the third lesson, albeit still being lower than the first lesson. This change, however, was not significant.

Table 11.11 Change in question type per student amongst three classes

Class	Total no. of students who attended the first two lessons	No. of students who adopted a different question type	No. of students who adopted a different question type (which was of a higher order)
A	8	6	5
B	9	7	3
C	29	26	10

With regard to higher-order thinking questions (analysing-type questions and evaluating-type questions), it was found that the change in proportion did not differ significantly, which was similar to what was found for Classes A and B, despite the additional lesson held for Class C.

In order to track an individual student's progress over time, we took the most frequently used question type from all the questions generated by the student to be indicative of the student's level of thinking at that point in time. A considerable minority of students (38.3%) showed improvement in the second lesson with regard to the type of questions they generated (refer to Table 11.11), and a large majority of students (85.1%) adopted a different question type in the second lesson, which might be indicative of the students' ability to generate different types of questions after exposure to SMILE, despite not generating more higher-order questions.

Figure 11.8 shows that out of the students who did not adopt a different question type in the second/third lesson, most of them adhered to the applying-type questions. Despite the fact that the complexity of their questions may have increased, such as questions which indicated an appreciation of the multi-factorial nature of many problems in the sciences, the form of the questions were similar to each other. This could imply that these students may have been over-familiarised with such questions and thus became unable to think outside of the box. This rigidity in thinking, however, is a challenge that cannot be solved with SMILE alone and may require other forms of intervention or instruction.

Using these results to revisit our theoretical framework, it would seem that the use of SMILE (as a Mediating Artefact) may help the students (the Subjects in the diagrammatic representation) generate more questions of different types, but not necessarily more accurate questions or questions of a higher order (the Object), and thus may not build towards higher conceptual accuracy (the Outcome).

11.6   Considerations for Implementation, Diffusion and Sustainability

Through in-depth interviews with teachers and school leaders (of the schools involved in this study), several areas that can support the diffusion and sustainability of the SMILE platform were identified. In terms of Bronfenbrenner's (1995) ecological paradigm which this book has appropriated as a meta-structure, the
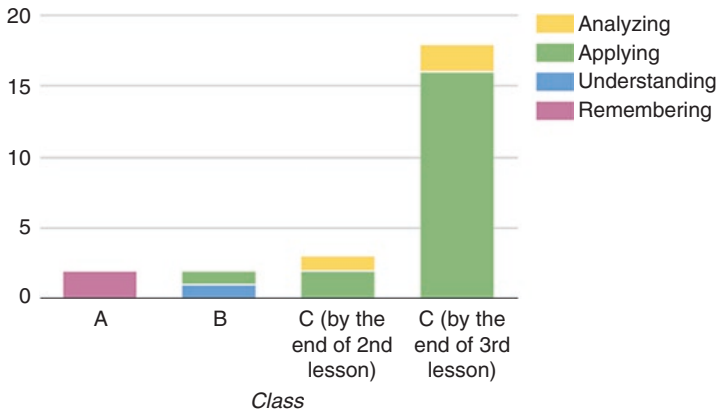
Fig. 11.8 Distribution of question type amongst students who did not adopt a different question type

dimensions pertinent to the present study can be analysed at the micro (classroom)-, meso (school)-, macro (policy)- and exo (partners)-levels.

At the level of micro-level analysis, the school leadership and teachers should have a positive attitude about the implementation. While top-down innovations are sometimes required, such adoptions can often be mechanical, superficial and fleeting. To create systems that support and educate students, the attitudes, assumptions and expectations from teachers and school leadership are important. This was stressed by teachers: "I think the first and foremost criteria [for a teacher to want to adopt SMILE, or try it out in their own context] is the teacher himself must have an open mind, and be willing to try, you know? Must see the potential". At the school involved in this study, SMILE benefited greatly from the hard work of the Science teachers who planned and implemented the platform. According to the school leadership:

> (Teacher A)...because of his ICT expertise, he is our in-house edu-tech consultant. So he goes around and helps different departments when edu-tech is concerned. He has been working with different groups of teachers: for example apps, and teachers who are interested in using SMILE… Even going to the classroom. He is not just giving technological support, but he works with the teacher before class to craft how the tool can best support the lesson objective. I think this really helps the adoption. That's our advantage. We have somebody who can go into the different classrooms (with the teacher). Looking at the wider picture, in terms of scaling to different schools, this can be a little challenging. You can take the tool, but do you have the person who can work with the teacher before the lesson, and maybe even going in during class to give you the support…

At a meso-level analysis, school-site leadership is responsible for planning and implementation. They must ensure that the implementation satisfies local needs, aligns with the school's academic mission and generates practice knowledge and data to inform improvements in the school community through sharing and practical advice.

In terms of a macro-level analysis, supportive policy and practices which encourage the diffusion of innovation across departments and schools is important. SMILE as a platform "is not subject-specific. It is a tool that you can use in (different) classrooms. And I think it is versatile enough that it can be used in most subjects". The school was very open to introducing new platforms to the teachers from various departments and allowing them to experiment:

> One issue is that whether the teacher is comfortable enough to use it. And (this) we can overcome. (Teacher A) and (Teacher B) are very happy to go into the classroom with the teacher and look at how that can be done, if there are any technical difficulties and so on. So, scaling within (School) is definitely possible. So as (Teacher A) and (Teacher B) suggested, one way is that, minimally, every department can try it out at least once. And then if they find it useful, they can obviously use it.

It was also observed that the school held regular sharing sessions amongst teachers within the school to facilitate the spread of innovations.

Finally, in terms of exo-level analysis, the importance of stable infrastructure support was commented on by the teachers who did the ground work for implementing SMILE: "Really, that we need a very stable infrastructure, especially the bandwidth. And also we need students to have ready devices to be able to, you know, better engage with this intervention".

11.7 Conclusion

This study set out to find out the extent to which SMILE might be an effective and reliable tool in enabling learners to achieve better conceptual understanding and accuracy, through the enabler of a tool which facilitates the student generation of questions. The research question that has driven our inquiry is how the nature and efficacy of learners' questions change over time, through progressive interaction with SMILE. Our analysis suggests that it is largely evident that SMILE, as an inquiry-based platform, is able to encourage and compel students to ask different types of questions over time. However, the accuracy of questions and the proportion of higher-order thinking questions do not seem to show any significant change.

We acknowledge the following limitations inherent in the study:

1. The sample size may be insufficient as we were limited to conducting the SMILE lessons in only one school, which may affect the validity of the results obtained.
2. The amount of time learners spend interacting with SMILE may be varied, due to technical errors that may disrupt lesson time.
3. The change in the nature and efficacy of learners' questions cannot be completely attributed to their progressive interaction with SMILE, as the timespan is over a few months, and other factors may come into play, such as exposure to inquiry-based methods in other subjects.

4. SMILE lessons cannot be carried out on a regular basis as it would disrupt the curriculum schedule.
5. Questions may not be entirely generated by students, as they could easily copy questions from other sources.

Nevertheless, there still remains a place for SMILE in the formal curriculum. For example, in a Physics lesson conducted without the use of SMILE which was carried out on 16 October 2013, conversation was mostly unidirectional, with the teacher driving the conversation and students being passive receivers. A probable reason as to why there was a lack of student response could be because there was insufficient time for students to generate questions on the spot, as seen in the following quote:

> *Teacher:* Are we clear? Any questions? We have already learned this theory, kinetic theory from chapter seven. And you'll be tested on Monday. Don't forget.

In comparison, the use of SMILE made it easier for the teacher to surface students' doubts, as seen in the following quotes, which were taken on 30 August 2014 during a Physics lesson with the use of SMILE:

> *Teacher:* Who wrote this question? Because I want to… I wanna [sic] know what it means. … Does it answer your question? Is what I interpreted the same as what you were going to ask?
>   *Teacher:* There's a lot of questions on Newton's 3rd Law… maybe the concept wasn't drilled in last year.

Beyond the immediate context of use reported in this chapter, SMILE has been used at the same school by a Physics teacher who used it during a feedback session on her lesson and a Chemistry/Biology teacher who used it during a Science practical lesson. SMILE was also used during the semester break for grade 9 Physics students—each student was tasked to craft three questions of low-, intermediate- and high-order thinking questions in the topics of Kinematics and Forces, and they would subsequently have to answer each other's questions as a form of revision and also provide feedback to their peers. For a grade 7 Science class from a relatively academically weaker cohort, SMILE was used as a summative assessment tool—each student was tasked to answer and rate the difficulty of the questions. During Science Week in the school, SMILE was used as a platform to gather students' impressions about the different stations and sites they had visited as part of the activities.

The use of SMILE has been applied in both the Sciences as well as in the Humanities and language learning. However, the latter has been less researched in our local context. For example, SMILE was used during a Humanities Learning Journey field trip, and it was also introduced to a grade seven class for the learning of vocabulary. In this lesson, each student was given a list of vocabulary words and tasked to craft questions to demonstrate their understanding of the word in use.

There has also been external research demonstrating the implementation of SMILE in Mathematics classroom and in the healthcare sector (Seol et al., 2011; Kim & An, 2016). The benefits of SMILE flexibility regarding different content are

clear. Students who are already using SMILE in one subject can continue to use it for other subjects, both in and out of school. Very often, students feel less pressure to answer perfectly the first time they try the questions in the SMILE environment. The platform can be extended for students' use at home, where they can revise in informal study groups as often as they want.

Schools and school networks are invaluable structures in sharing and scaling up any ICT innovation. Often, teachers and educators need to invest time in familiarising themselves with the technology, and it is important that there are supporting qualitative or quantitative evidence that the new practice is beneficial and of relevance to their work. In the case of SMILE, the skill level needed is low, and the programme can be fitted into a vitality of different subjects. For the initiative to not be short-lived or isolated, sustainability consideration should be built into the programme, either through sharing, publication or documentation. Various factor such as school and organisational culture, size of organisational networks, personal experience, level of executive support, etc. will affect how the project becomes more widely adopted and sustainable over time. There are some factors that can encourage the spread of any innovation: giving staff time away from normal duties to consider new changes and innovations, facilitating and supporting sharing amongst teachers and personal and professional development, providing evidence that new innovations help attainment certain learning targets and more.

Future research on SMILE could also consider its effect on the learning of other languages; however, this is contingent on whether SMILE allows for various language inputs. These, and other supporting structures such as a stable wireless network of sufficient bandwidth, and support for/assistance with the creation of student accounts, were raised by teachers on the programme.

SMILE lessons should also be conducted on a wider scale, in other schools and other levels, in order to broaden the sample size of the data, as well as to research its effect in differing contexts.

In a broader sense, the use of SMILE can potentially contribute significantly to the aims of the 3rd ICT masterplan, in particular the development of self-directed (SDL) and collaborative learning (CoL) skills in students. Key attributes of SDL, for instance, require that the student extend his/her learning. With a relatively simple tuning of pedagogical practices, the development and subsequent discussions of the questions generated by the students can be meaningfully employed to bring out an extension of student learning. More importantly, the students would have a good platform to "practise" such skills. At the same time, the collaborative aspects of SMILE can be made explicit for the students so as to enhance their understanding and "practice" of group processes. Given such possibilities, future iterations of SMILE can incorporate these aspects to not only bring about deeper learning of the subject matter but also important twenty-first-century skills. This implies that teacher professional development will need further tweaking to accommodate such pedagogical practices.

It is useful to note that inquiry-based learning is a key pedagogical approach advocated within the Singapore Science curriculum. To this end, SMILE is well-positioned to provide a strong illustration of what can be achieved when inquiry-based

pedagogies are effectively practised. This is useful for the purposes of spreading such practices within the system, as teachers are likely to be more receptive to SMILE given the emphasis of the curriculum.

From a teaching and learning perspective, perhaps the most important impact of SMILE is the nudge it provides towards shifting the role of the teachers towards being facilitators of learning rather than primary sources of knowledge. By getting the students to develop questions, teachers can facilitate the development of deeper understanding of the content through leading the students in the construction of the questions. This translates into professional development content for teachers with a focus on pedagogies of question constructions.

On the whole, the extension possibilities offered by SMILE can be potentially impactful in pushing students' learning towards greater depths, as well as providing a simple platform to rebalance the role of teachers with a stronger emphasis on the facilitation of learning.

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Kenneth Y. T. Lim is Research Scientist at the Office of Education Research, National Institute of Education. He operates at the intersection of Cultural Anthropology, the Learning Sciences and Cognitive Psychology. Kenneth is one of about a dozen people worldwide to have been invited by UNESCO as a member of the organisation's Symposia on the Future of Education for Sustainable Development, 2016–2017. He conceptualised the Six Learnings framework of curriculum design for fictive worlds and virtual environments. Kenneth edited a book titled *Landscapes of Participatory Making, Modding and Hacking: Maker Culture and Makerspaces* which was published in 2017. Kenneth's work on the Six Learnings framework and Maker Motes helped him posit a theory of learning around the notion of Disciplinary Intuitions; the latter is elaborated upon in a book published by Springer in 2015.

Bing Heng Song is an aspiring young man who enjoys learning and acquiring new knowledge. Throughout his Nanyang Research Programme journey, Bing Heng has developed inquiry skills that led him to perceive the world in different perspectives. He has also sharpened his time management skills and gained much insight to research paper writing. Bing Heng enjoys reading and volunteering during his free time. Bing Heng is currently serving his national service after completing his tertiary education in Innova Junior College.

Matthew Xiang Kho graduated from Raffles Junior College in 2016, having taken subjects such as Physics and Literature. He is interested in both the Sciences and Humanities and aspires to continue studying both in future. He is also piqued by the idea of using technology and video games for educational purposes, having played and learnt a lot from various video games. His other hobbies consist of finding good food and playing the guitar.

Chapter 12
Exploring the Dimensions of Interest Sustainability (5Cs Framework): Case Study of Nathan

Aik Lim Tan, David Hung, and Azilawati Jamaludin

Abstract This chapter explores the dimensions of how interest can be sustained in learners. Using the case study of Nathan, we trace his interest development journey in art and music within a Singapore school context. We suggest a framework that combines both individual psychological aspects of interest development and the impact of the sociocultural environment which includes five dimensions: community, culture, confidence, conflict resolution, and recreating process that are encompassed by the chronosystem. Based on a biblio-narrativical approach, we obtained data via interviews and a retrospective written narrative of Nathan's interest development journey. The data obtained was able to substantiate our hypothesis of the impact the dimensions have on interest sustainability, emphasising the importance of a positive sociocultural environment in interest development and sustainability. This has implications on the role stakeholders such as school management, teachers, peers and parents and also on an individual's interest development. Furthermore, we also established opportunities for innovations afforded by informal learning which adds value to what formal education can provide, creating a more holistic education for learners. Theoretically, the proposed framework extends extant literature on the four-phase model of interest development—which has a more psychological focus—by introducing specific dimensions contributing to interest sustainability through a sociocultural lens. The unification of psychological and sociocultural aspects of interest development would provide a more comprehensive perspective on interest sustainability which would benefit both practitioners and researchers.

12.1 Introduction

Over the years, there has been an increasing interest in the interplay between formal and informal learning. Formal learning is defined as learning that takes place in education and training institutions, leading to the attainment of recognised

A. L. Tan (✉) · D. Hung· A. Jamaludin
National Institute of Education, Nanyang Technological University, Singapore, Singapore
e-mail: aiklim.tan@nie.edu.sg

qualifications (United Nations Educational, Scientific and Cultural Organization [UNESCO], 2012). Formal learning situations occur when an agent, such as a teacher, is directing a students' learning through a formalised set of objectives such as curriculum standards (Greenhow & Lewin, 2016).

Non-formal learning occurs in addition to formal learning where one has specific objectives in mind and is actively seeking information from various sources such as peers, mentors or the media (Greenhow & Lewin, 2016). This form of learning usually takes place in community-based settings such as clubs or societies (UNESCO, 2012).

Informal learning is defined as learning that occurs in everyday life (UNESCO, 2012) and is described as spontaneous, experiential and mainly learner controlled, where the learners themselves control their own learning process and goals based on interest (Ferguson, Faulkner, Whitelock, & Sheehy, 2015; Greenhow & Robelia, 2009; Tan, 2013). Authors have also suggested formal learning to indicate learning within classroom settings and informal learning to include everything else outside classroom settings (Reynolds & Chiu, 2013).

This chapter aims to explore the relationships between the formal disciplinary and academic nature of student learning typical of local classrooms and that of informal settings in schools such as cocurricular activities. From the extant literature, these school-based organised activities are "semi-formal" in nature, whereas learning in out-of-school contexts and settings is known as "informal", both of which are important in the holistic development of a child. For the purposes of this chapter, we have appropriated definitions of informal learning in a different way as typically defined in literature. Our definition of informal learning is a combination of the aforementioned definitions of non-formal and informal learning, and we will thus define informal learning as any learning that takes place outside the typical classroom, including contexts such as cocurricular activities, interests and hobbies and involves immersion into the experience, making learning natural and experiential.

Singapore schools are well-organised and robustly structured with a wide variety of programmes and initiatives both in and out of school. However, there is a need for a synergy between the formal academic nature of the school curriculum and that of the informal learning that takes place outside the classroom in order to maximise the effectiveness of these programmes and to prevent the overloading of student schedules.

Hence, it is the intent of this chapter to make explicit how youths engage in interest-based activities with the view of helping teachers and parents to appreciate the multiple identity trajectories of their children and to see intrinsic value in these pursuits. This is also with a view of getting parents to be less anxious about academic studies per se, especially when their children do not always score "top" marks for tests and exams. We argue for a greater awareness of such pursuits as youth's development of these dispositions would potentially benefit them for future readiness within times of rapid uncertainty. We intend to explicate this issue by proposing a framework on interest sustaining—recognising interest as the critical driving force behind learning.

12.1.1   Types of Informal Learning

Over the years, schools and education systems have developed various programmes and activities for students to learn outside the classroom. As such, there is a myriad of opportunities where students can engage in informal learning. One such avenue is through Science, Technology, Engineering, and Mathematics (STEM) programmes. Activities that are detached from real-world issues and life experiences have been found to decrease interest in STEM subjects (Cleaves, 2005). In an effort to narrow this disconnect, after-school STEM programmes have been developed to engage youths through design-based learning, providing students with the time and space required to engage in collaborative and open-ended projects without the stress and constraints of a formal school curriculum (Sahin, Ayar, & Adiguzel, 2014). For example, Studio STEM is an after-school and summer programme in the United States designed to engage middle school youth in STEM (Evans, Lopez, Maddox, Drape, & Duke, 2014). In this programme, the participants were presented with current global issues, of which they were tasked to design and build a product to solve the issue in a free-choice environment made up of various workstations.

An example in Singapore is the implementation of a makerspace in Bright Hill Secondary School (pseudonym). In response to the increasing need for digital skills in the workplace and to improve equity in opportunity for their students, the school made the decision to embark on their pursuit of maker education (Ajam & Lee, 2016). They developed staff development programmes, student activities and the appropriate infrastructure to pilot their maker programme in 2013, achieving a fully functional makerspace in 2015. The makerspace housed tools for fabrication learning such as 3D printers, laser cutters and power tools, which showed the school's commitment to this project. This makerspace ties into their formal curriculum within the craft and technology subjects; however, teachers from other departments such as science and literature have increasingly been using the makerspace for their teaching. In addition, the school organises Maker Thursdays, which is a weekly after-school programme conducted by staff and is free for all students to participate and immerse themselves in a wide variety of activities and interests.

Informal learning can also take place in day-to-day activities. Informal learning occurs in everyday living (UNESCO, 2012), at work, leisure or community. A study done by Pilz and Wilmshofer (2015) in a fishing village concluded that informal learning is central for the youths to pick up skills and knowledge. The girls were involved in household duties and supporting family businesses, while the boys were assimilated into fishing activities at a young age to pick up the skills and experience needed for work. Other examples include the use of social media to discover and share resources for learning and using digital media such as YouTube to support individual learning (Tan, 2013). Although these examples are not exhaustive, a common theme that can be observed is that there is no formal teaching taking place in all the different types of informal learning. Learning is achieved during the process of participation in the activities and immersion into the experience, supporting the definition that informal learning is natural and experiential (Greenhow & Lewin, 2016). One important aspect of informal learning is the concept of play as learning.

12.1.2   Pedagogies of Play and Recreation

Play is the ability to experiment with one's surroundings as a form of problem-solving (Jenkins, Clinton, Purushotma, Robison, & Weigel, 2006), and it creates a means for a child to make sense of his/her world (Samuelsson & Carlsson, 2008). Play can be described via three perspectives (Anderson, 1998): its exploratory nature, evolutionary and intrinsic nature and developmental aspects. The exploratory nature of play is a way for children to discover new experiences and make sense of the world around them. The evolutionary and intrinsic nature of play is seen in its creative aspect, which is unpredictable and open-ended in nature. From a child's perspective, this open-ended nature of play can become inherently rewarding and, eventually, something intrinsically motivated (Anderson, 1998). The developmental aspect of play is the child's social, cognitive language and physical and creative development, which are facilitated during play. It affords a degree of predictability and stability while at the same time allowing spontaneous and fluid behaviours to take place (Stegelin, 2005), allowing the child's time and space to develop and express their creativity and ideas.

The process of play, or "recreating", brings about many benefits. A study by Howe (2016) concluded that children who were engaged in play were observed to have increased motivation, perseverance, enjoyment and a higher level thinking than those who were not. Honeyford and Boyd (2015) did a study on an after-school programme for middle school students which included components of literacy, nutrition and sports. Students were given weekly "quests" leading up to the final product of creating a poster for public exhibition. At the end of the study, the authors found that by allowing students to experiment and play, they cultivated a strong sense of agency and increased their confidence in meaning-making. It also helped to level the playing field between all students, especially those who initially struggled with literacy tasks in school. The students were also focused on the process of learning rather than results due to the low-stake nature of the programme.

As can be seen from the literature and examples above, recreation has a vital role to play in enabling children to make sense of the world around them, develop ownership of their learning and engage in higher level cognitive functioning. These skills are critical in this current age and would benefit youths greatly as they transit from adolescence into adulthood.

12.1.3   Defining "Interest"

Until recently, academics have struggled with coming to an agreement on how best to describe interest, with some describing it as a preference or attitude, passion for learning, an emotion or a motivational belief (Hidi & Ainley, 2008).

There are many definitions of interest and its development that have been suggested by various authors. Schank (1979) defined situational interest as an emo-

Fig. 12.1 The development of interest. (Adapted from Renninger & Hidi, 2016)
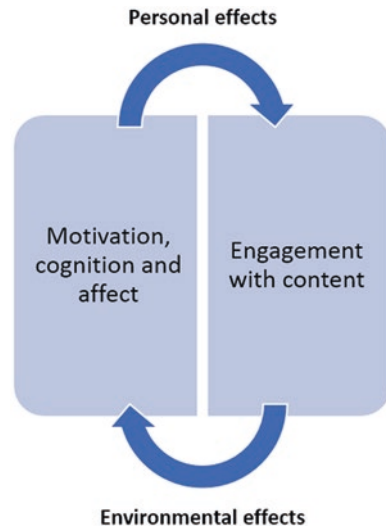
tional state caused by situational stimuli. Schiefele (1991) defines individual interest as having two forms. The first views individual interest as having a relatively long-term trajectory towards an object, activity or knowledge, while the second form describes interest as content specific and intrinsically motivated. Mitchell's (1993) definition refers to interest as tied directly to content and is a phase that is triggered and subsequently sustained. Lent, Brown and Hackett (1994) then suggested that initial emergent interest would lead to goals for increased exposure, increasing the likelihood of subsequent task participation which leads to particular performance attainments. Krapp (2003) conceptualised interest on two levels of analysis. The first level focuses on the interactions between a person and object of interest and posits that the awareness of an interest requires a situation-specific interaction between person and object. On the second level, interest is interpreted as a relatively stable tendency for an individual to sustain interest with an object of interest.

In this chapter, we will define interest according to Renninger and Hidi (2016) as their definition encompasses the constructs of interest from the various authors and converges them into a coherent definition. They frame interest to have a dual meaning, referring to the psychological state of a person engaging in some content, as well as the cognitive and affective motivational predisposition to engage with that content over a period of time. It exists in or is the product of the interaction of the characteristics of the person and the environment (see Fig. 12.1).

Interest as a psychological state relates to a person's physiological or neurological reaction to a myriad of objects such as other people, specific objects and tasks. It is characterised by increases in attention, effort and concentration and affects during engagement with objects of interest. Interest as a motivational variable is content specific and is responsible for the processes of how people feel, engage and act and makes the distinction between shorter-term (situational) interest and longer-term (individual) interest (Renninger & Hidi, 2016). The dual meanings of interest

are interrelated in that a psychological state of interest that is generated may support the development of interest as a motivational variable or how the level of interest as a motivational variable may determine the level of environmental support needed to maintain the psychological state of interest.

The two primary types of interest in education research are situational interest and individual interest (Hidi & Renninger, 2006). Situational interest is described as giving focused attention to and having an affective response, both positive and negative, to a particular activity or content. It is also referred to as the early phase of interest development (Renninger & Hidi, 2016). Individual interest, or a later phase of interest development, refers to a person's relatively enduring predisposition to reengage with a particular activity or content over time. It is usually associated with positive feelings and a recurrent relationship between knowledge and value of the content, whereby the development of knowledge leads to a deepening of value, which would lead to continued engagement and a further deepening of the value (Renninger & Hidi, 2016). Based on the existing literature on interest, Hidi and Renninger (2006) identified four phases of interest and proposed the four-phase model of interest development which have been validated empirically by various studies (Lipstein & Renninger, 2007; Nolen, 2007).

12.1.4 The Four-Phase Model of Interest Development

The four-phase model of interest development positions interest as a psychological state (Hidi & Renninger, 2006) and describes phases of situational and individual interests in terms of affective and cognitive processes, making up the motivational variable of interest (Renninger & Hidi, 2016). The four phases are triggered situational interest, maintained situational interest, emerging individual interest and well-developed individual interest. Their definitions and characteristics are summarised in Table 12.1.

Interest in the earlier phases would require more support from the external environment to develop and maintain interest as compared to the later phases. In addition, without self-generated or environmental support to facilitate continued engagement, it is possible for a person's interest in something to decrease or disappear completely (Renninger & Hidi, 2016). In this chapter, we delve deeper into how interest can be sustained in youths as they participate in various interest-based activities as a result of influences from the sociocultural ecology.

12.1.5 Current Gaps in Literature

The extant literature has been studying interest mainly from a psychological perspective (Barron, 2006; Krapp, 2003; Nolen, 2007; Schiefele, 1991), making it mostly individual focused. It has been observed that the sociocultural environment

Table 12.1 The four phases of interest development

	Phases of interest development			
	Less developed (earlier) ⟶			More developed (later)
	Phase 1 (Triggered situational)	Phase 2 (Maintained situational)	Phase 3 (Emerging individual)	Phase 4 (Well-developed individual)
Definition	Psychological state resulting from short-term changes in cognitive and affective processing associated with specific content	Psychological state that involves focused attention to a specific content that reoccurs and persists over time	Psychological state and the beginning of a relatively enduring predisposition to seek reengagement with specific content over time	Psychological state and a relatively enduring predisposition to reengage specific content over time
Learner characteristics	• Attends to content, if only momentarily • May need support to engage, from others and instruction • May be reflexively aware of experience • May experience positive or negative feelings • May not persevere in face of challenges • May want to be told what to do	• Reengages content that previously triggered attention • Developing content knowledge • Developing sense of content's value • Likely able to be supported by others to find connections to content based on prior skills and knowledge • Likely to have positive feelings • May want to be told what to do	• Likely to independently reengage content • Has stored knowledge and value • Reflective about content • Focused on own questions • Has positive feelings • May not persevere in face of challenges • May not want feedback from others	• Independently reengages content • Has stored knowledge and value • Reflective about content • Likely to recognise others' contributions to discipline • Self-regulates easily to reframe questions and seek answers • Can persevere through challenges to meet goals • Appreciates and may actively seek feedback

Source: Adapted from Renninger and Hidi (2016)

plays a significant role in interest development (Azevedo, 2011); however, there has been limited in-depth work done that studies the impact of the wider environment. Renninger and Hidi (2016) acknowledge that interest is the product of characteristics of the person and the environment, though the focus of their research is still primarily focused on the psychological states of an individual with limited emphasis on the environment.

There have been some studies done on the impact of learning environments on interest development (Baumert & Koller, 1998; Del Favero, Boscolo, Vidotto, & Vicentini, 2007; Stegelin, 2005) which trace the influence of components of the learning environment such as learning activities and specific topics taught and how it affects interest development. However, these studies are specific to learning environments such as classrooms. As such, there is still a lack of research in the area of how the wider sociocultural environment influences interest development.

12.1.6 Benefits of Interest-Driven Learning: Why Is It Important?

Research has shown that there are many benefits of interest to learning not only affecting learning outcomes positively but learning processes as well (Lipstein & Renninger, 2007). Studies have found that as individuals develop an interest in a specific discipline or content, there is an observable improvement in their performance (Hulleman, Godes, Hendricks, & Harackiewicz, 2010). Depending on their level of development of interest, individuals have been observed to persevere more in seeking to deepen their understanding of their area of interest, leading them to be more proactive in seeking feedback from others and sourcing for additional resources to learn and to create opportunities for themselves that enable them to better engage in their interests (Lipstein & Renninger, 2007). This would eventually lead to the development of a deeper conceptual understanding of the interest area and content (Schiefele, 1999). In addition, when individuals have an interest in a specific task or content to be learnt, they have more focused attention (Ainley, Hidi, & Berndorff, 2002) on the task, as well as better learning strategies being employed to enhance their learning (Schiefele, 1999). As a result, the individual would develop a higher degree of self-efficacy (Kim, Jiang, & Song, 2015) and be able to self-regulate their interest and motivation in pursuing the topic of interest (Sansone, Fraughton, Zachary, Butner, & Heiner, 2011).

Therefore, as youths participate in activities that engage them and develop their interests, they will be intrinsically motivated to further their learning. Through this process, they will be able to cultivate various skills and competencies that are of intrinsic value to the individuals and which help them mature in their identity formations.

12.1.7   *The Singapore School Context*

In the Singapore context, pursuing academics for students is deemed important, as reflected by the Singapore education system's reputation for being highly competitive and highly focused on examination grades (Teng & Yang, 2016). While this pursuit of good grades is the focus of majority of schools and students, it might not suffice for them to mature in their identity formation (Hung, Lim, & Jamaludin, 2011). There is a need to have variations in identities afforded by differing places and processes. As such, encouraging youths to participate in multiple and varying contexts both in and out of school should facilitate rather than detract them from a holistic learning experience and development.

Students in Singapore spend a significant proportion of their time outside the formal curriculum, taking part in activities characterised by uniform groups, sports and clubs, such as robotics (Lee, 2014). Singapore schools are also encouraged to develop unique niche areas to develop twenty-first-century learning opportunities. For instance, there are an increasing number of secondary schools incorporating "maker education" into their curriculum which have set up makerspaces for students to tinker with various equipment and materials (Ng, 2016). Singapore's Ministry of Education (MOE) is also offering an annual fund of S$50,000 to secondary schools to develop STEM Applied Learning Programmes (ALP), aimed at bridging the gap between science knowledge and real-world application (Ng, 2016). Fullan (2001) states that the fundamental purpose of education is to make a positive difference in the lives of students and to cultivate citizens who are able to live and work productively in a progressively dynamic and complex society. By being involved in these programmes, Singapore students will be able to better apply their knowledge into real-world contexts, becoming productive citizens of the country.

12.1.8   *5Cs Framework of Interest Sustaining*

As previous studies have been studying interest from a psychological perspective, we would like to examine it from a sociocultural perspective and attempt to integrate both the sociocultural aspect and psychological aspect of interest development in youths. Our framework will thus attempt to fill the gaps in literature by expounding the impact of the sociocultural environment on interest development and sustainability.

In our suggestive framework, the "5Cs framework for interest sustaining", we postulate that in order for youths to sustain their interest in a specific content or activity, they require five characteristics as shown in Fig. 12.2., community, culture, the (re)creating process, confidence and conflict resolution/management, which are bound by time or the chronosystem. This framework ties together different strands of interest research and various studies which have identified the above characteristics, the details of which will be elaborated below. This framework thus offers us a

Fig. 12.2 Framework for
interest sustaining
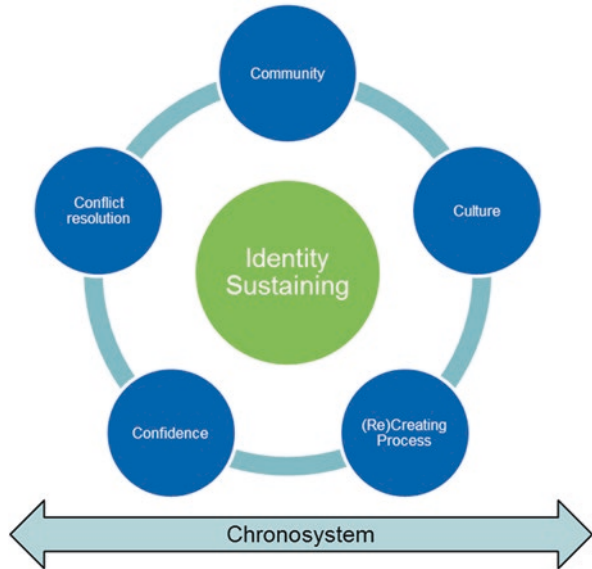
sociocultural lens to determine what environmental factors influence (or hinder) interest. It describes five essential characteristics that contribute to the sustainability of interest in youths, and we hypothesise that all five of these dimensions are necessary for youths to sustain interest in a specific activity or content over time.

12.1.8.1   C1: Community

We refer to community as the social environment or group(s) of people that have a direct influence and impact on an individual's participation in an activity of interest. This encompasses characteristics such as whether the environment is supportive or not, other's recognition and acceptance and the general characteristics of the people within the group itself, such as the teachers, mentors, peers or competitors. As stated by Greeno, Collins and Resnick (1996), "Effective learning involves being strongly engaged in activities that capture the learner's interests because of their intrinsic qualities as well as participation in communities" (p. 26). However, if the community is not a supportive one, there may be an adverse impact on the individual's interest development.

Bandura (2001) states that when there is a strong perceived collective efficacy or collective performance, the group would have higher aspirations, motivation, perseverance in face of obstacles, morale, resilience and overall greater performance accomplishments. Therefore, having a community of people with the same interest would be of great value in traversing the journey of interest development to mutually motivate one another and persevere through obstacles and setbacks.

12.1.8.2   C2: Culture

Culture is the proliferation of the interest activity outside of the four walls of the school or classroom, forming threads between school, home and the wider community. This involves fostering a culture of interest development and making this interest relevant in the daily lives of the individual. A question that Azevedo (2011) asks concerning sustaining interest is how much an interest activity is continuously made relevant to an individual's life. This is aligned with what was suggested by Brophy (1999) that if specific topics can be easily linked with everyday experiences, they may represent a source of situational interest. We suggest that culture is context specific, and every context has their own culture of whether interest is encouraged or not. For instance, in a classroom setting, the teacher would most likely be the one who sets the culture of whether the students are encouraged or given the space and opportunity to develop their interests. At home, it could be the parents who set the culture, which can be influenced by financial ability or their own interest in the subject matter.

Interest-driven learning activities are boundary-crossing and self-sustaining, comprising of multidirectional relationships between learning activities across contexts (Barron, 2006). An interest sparked at school may be followed up by new knowledge-producing activities at home or at a workshop, leading to the development of that interest. Activities that are able to stretch across sites and communities of practice, such as between the classroom and home environment, are more likely to lead to the development of interest and are critical for the sustainability of this interest (Pressick-Kilborn & Walker, 2002).

In order for youths to sustain an interest over time, there needs to be a culture that enables and encourages them to engage in their interest activity. This culture cannot be determined solely by the teacher or parent alone, but it has to be nurtured across all aspects of their lives in order for the interest to become self-sustaining.

12.1.8.3   C3: Confidence

Confidence refers to how self-assured the youth is in their ability to achieve or contribute to an activity or content of interest. This can be in the form of self-efficacy and self-esteem. Zimmerman (2000) defines self-efficacy as a person's judgement of one's own capabilities to organise and execute courses of action in order to attain designated goals. The fact that interest is always directed towards a specific object (Krapp, 2003) such as a particular hobby or topic and that literature has recognised that self-efficacy is domain specific (Bandura, 2001) ties both self-efficacy and interest together in a robust relationship. Furthermore, self-efficacy has been identified as an important characteristic of the various phases of interest within the four-phase model of interest development (Hidi & Renninger, 2006).

Other than simply focusing on the individual, this component also considers external influences such as any factors which may demean or lower the confidence of the youth such as overstressing standards that may be unmeasurable or having

unsupportive teachers or peers. External support that is content specific has been found to be crucial in the early phases of interest development, and it is during these early phases that teachers play a significant role in supporting students and developing their sense of self-efficacy (Eccles et al., 1993). Hidi and Renninger (2006) state that a teacher's continued support of students' feelings of self-efficacy is important in the development and sustaining of interest in students, emphasising the important role a teacher or mentor plays in the sustainability of interest.

12.1.8.4   C4: Conflict Resolution

Conflict resolution is the ability of the individual to overcome challenges and constraints in the course of pursuing their interest. This component is in a similar vein to conditions of practice, which is described as any constraints or affordances of practice within different sites of practice such as circumstances of the individual's life, social, cultural and institutional spaces (Azevedo, 2011). This component is linked to the previous component of confidence and self-efficacy, as self-efficacy beliefs determine the challenges undertaken, how long individuals are able to persevere in face of challenges and whether failures motivate or demoralise them (Bandura, 2001).

We suggest that there are mechanisms of conflict resolution that determine how well youths respond to conflict and constraints. These mechanisms can be categorised into individual and collective factors. The individual aspect relates to individual traits of perseverance and tenacity, which is the ability to accommodate to challenges (O'Dougherty, Masten, & Narayan, 2013). The collective aspect refers to the communal and intentional effort from schools, teachers and parents to help the individual overcome these challenges, and they can be in the form of school policies or structures. For instance, when a youth faces challenges without support from the school or teachers, he/she may not know how to properly manage and rise above the obstacle, leading to discouragement and eventually loss of interest. On the other hand, if proper guidance and support is given, that same youth will be able to manage the challenge well, gaining confidence as well as an increase in interest.

Different youths have different confidence and conflict management limits, and we hypothesise that the aforementioned mechanisms for conflict resolution have to be present in order for interest to be sustained.

12.1.8.5   C5: (Re)Creating Process

Without opportunities to deepen and develop interest, even well-developed interest may become dormant or die off (Renninger & Hidi, 2016). The recreating and re-creating process are opportunities for interest to be developed. These come in the form of recreation and competition. As mentioned earlier, recreation involves play, which would afford youths with the opportunity for them to pursue their interests without the high stakes of academic exams and in a relaxed environment. This is

important in allowing them to develop intrinsic motivation, skills and creative thinking. However, if there is no competition at all, we hypothesise that the individual may be too relaxed and as such has no motivation to engage and develop in the activity of interest leading to stagnation. On the other hand, if competition is too intense, interest may be diminished due to the overly stressful nature of the activity. This dimension will provide a novel perspective to interest development theory as there have not been studies which examine the impact competition has on interest development and sustainability over time.

12.1.9 Chronosystem: The Effect of Time

The 5Cs are encompassed by an additional dimension of time, the chronosystem, which weaves through all five elements of interest sustainability. The chrono-dimension includes external elements such as the timing of a family member's death and internal elements such as physiological changes within the child (Bronfenbrenner, 1989). As the framework highlights how interest is sustained over time, the chrono-dimension is apt in accounting for the effects of time on the situational circumstances of the learner.

12.2 Methodology

The case study adopts a narrative inquiry approach where the participants at hand engage in a biblio-narratival approach in reflecting their learning experiences both in the formal and semi-formal learning school contexts. Narrative inquiry uses stories, autobiographies, journals and other documentation of life experiences as the unit of analysis to understand the ways people create meaning in their lives as a research process (Clandinin & Connelly, 2000).

The researchers interviewed the participant and gained further details of his interest development process through narratives such as a written narrative of his journey over time. We posit that from the youths' lived experiences point of view, there should be many such manifestations of factors of interest sustaining which come into play, which may not be well-documented. Neither is it easy for researchers to have access to such manifestations. Hence, a biblio-narratival method is recommended for this study.

This case study on Nathan was based on interviews with him, as well as a retrospective written narrative of his experiences and interest development journey across the schools and years of his secondary school life. The interview data was collected based on face-to-face interviews conducted with the researcher, which were recorded with a voice recorder and subsequently transcribed. The transcripts were then analysed via thematic analysis of data codes to identify emergent themes. Some of the questions asked include "You mentioned that you lost interest in art

because of the competitive nature of the school. Why?", "How did your peers, teachers and parents influence your interests?" and "Did you face any challenges while pursuing your interests? How did you overcome them?" Nathan also provided a written piece of his reflections tracing his experiences in art and music from when he was a young boy to the present day. The main question given to him was to write about his education journey and trajectory of his art and music interest, and he was given the freedom to express this writing. The written piece was then analysed to draw out his thoughts and reflections on topics which were discussed during the interviews which he may not have mentioned at that time.

12.3   Case Study of Nathan

Eighteen-year-old Nathan (pseudonym) grew up in the Singapore education system. He has completed his secondary school education and has obtained admission into a local university. He is interested in art and music. His interest in art and drawing began at the early age of 3 years old where he would take an interest in and attempt to illustrate things which caught his attention, ranging from people to animals. This interest in drawing not only endured over the years as he grew up but flourished at every stage of his growth. Even though he never went for any art classes, he made use of every opportunity to do drawings and sketches.

At the end of his primary school education, he enrolled into a specialised arts school, which combined academics with a focus on arts education. The school consisted of a 4-year foundation programme, leading up to a 2-year International Baccalaureate (IB) programme. In the first 2 years in the school, he learnt the foundations of making art and enjoyed himself while at the same time achieving good grades. However, this changed as he entered the next 2 years of his education. The demands from the coursework increased substantially, and the requirements of their work are becoming more stringent and challenging, causing Nathan to struggle with meeting these requirements. Due to the lack of guidance and support from the teachers and peers, art suddenly became pressurising for him which affected his confidence in making art.

At that same time, Nathan began developing a fondness for music, with a particular interest in guitar. He started to be exposed to different artistes and genres in music, and his parents bought him a beginner's guitar and signed him up for music lessons. His guitar teacher taught him the basics and exposed him to a wide range of genres of music, encouraging him to keep making music. The music lessons ended about a year and a half later, but he continued learning the guitar, slowly developing an interest in singing and songwriting, as well as knowing and gaining inspiration from all the great guitar players.

At the end of his fifth year in the arts school, Nathan was informed that he would not be able to progress to the final year because his academic results did not suffi-

ciently meet the prescribed standards. The institutional demands of the school created a conflict within Nathan's microworld of learning which he was unable to overcome. Even though he persevered to work hard to resolve this conflict by putting in hours of work into his study and projects, he was still unable to meet the institutional demands. Furthermore, there was a lack of collective conflict resolution mechanisms such as a lack in teacher or school leader support, which discouraged him and subsequently attributed to his loss of situational interest in making art.

As a result, his parents approached another school which was open to allow him to complete his final year of IB there. The vice-principal was impressed with Nathan's grades from the previous school, which helped him gain an interview and eventually acceptance into their school to complete his final year there. This final year in the new school greatly impacted his life, especially in the areas of his interest in art and music. The new school had a positive and supportive community, nurturing teachers and many opportunities for him to further engage his passions in both art and music.

Based on our earlier definitions, in this case study of Nathan's interest trajectory, his art education within the classroom would be defined as formal learning, and learning music as his hobby/interest is classified as informal learning.

12.3.1 C1: Community

The role of community greatly affected Nathan's passion for art and music. The community in the first school was not a positive one for Nathan, and this led him to lose his passion and interest in art. He felt that the mentors and peers were overly critical and one instance greatly affected his interest for art. Nathan mentioned an instance when a mentor said to him that his "artwork is like primary school work", which led him to feeling "absolutely crushed that day, and I told myself to never do art again". Furthermore, he mentioned that "a lot of people were like cynical and critical and people judged very easily".

On the other hand, in the new school, he found the community to be much more accepting and supportive, as he recounted that "The community (friends, teachers) managed to assimilate myself with the school quickly". He also found a group of peers who had similar interests in making music in the contemporary band cocurricular activity (CCA), which motivated him to pursue his interest in music further because they "had that common interest". He was also given the recognition from his peers that he had talent in playing the guitar, which encouraged him to continue pursuing his passion in music.

"I had people around me like schoolmates; they see me perform around the canteen and say 'hey you're good'. These sorts of comments encourage me to continue my passion. So I've been blessed with a community around me that has been supportive in what I do."

12.3.2   C2: Culture

In the first school, Nathan expressed that there was a negative and overly critical culture, which may have contributed to his loss of interest in art. There was a great focus on completing assignments and projects, without much time to truly allow art to permeate their lives.

> I think for an art school, it didn't have the culture. I'm not sure whether the issue was how it ran, I think it was just the culture that didn't allow time to develop… Live art. I mean, we were all very busy.

The new school had a culture which encouraged the students to pursue their interests and nurture well-rounded students. Nathan mentioned that "every platform I did perform ever before… are somewhat affiliated to the school", which exemplifies how the school has a culture that provides a platform for Nathan to pursue his interest in music. His art teacher also shaped his interest in art by inspiring him and making art relevant with the world today.

> Having a lot of these outside class discussions about art, what art should be and maybe like world issues sort of lead me to inspire to become like him one day... And it's just these inspirations, the people around you, that shape your interest… It's like a whole culture.

12.3.3   C3: Confidence

Over the course of his pursuit of art, Nathan met with various instances which affected his self-confidence in his artistic ability. In his third and fourth year in the art school, there was a significant increase in the standards required of the students, which added to the pressure of creating good art. He struggled to catch up with the increased workload and demands to the point where his confidence was shaken, making remarks such as "my artwork was not very impressive" and "my (creative) process was terrible". Furthermore, he did not receive much support and encouragement during that time, and he even came to the point of despising his art. As art was subjective, there were no clear standards that Nathan could work towards, further decreasing his confidence in being able to produce good art.

> A lot of people were pretentious, they criticise my art, and I just didn't know what was good art and bad art…

This downward trend was reversed when he entered the new school. He had a new art teacher who was "helpful and nurturing" and who explained to him the "depths and context of different artworks and artists". As a result of this, Nathan began to like art again, and through this teacher's mentorship, he was able to "truly think like an artist", which was when his "confidence in making and creating started to flourish" again.

His confidence in music also grew when his band from the contemporary band CCA won the first place in a talent show at his school, which further boosted his confidence as it was "one of the proudest moments of (his) life". Following that, he also began receiving more affirmation on his music skills from his peers with comments such as "Nathan's good at playing guitar" and "Nathan can sing".

12.3.4   C4: Conflict Resolution

An initial constraint that Nathan faced in his pursuit of music was that even though he was able to attend beginner guitar lessons initially, he had to stop them as it was financially taxing on his parents. However, he was able to overcome this constraint by taking the initiative to continue learning guitar on his own, improving his skills and increasing his exposure to music in the process.

With regard to Nathan's interest in art, the first school had a structure where the students were made to constantly work on projects. Together with the lack of guidance, it caused him to lose interest in making art.

> I didn't really enjoy what I was doing. Especially in school when project after project you have to come up with an artwork. Maybe it was lack of guidance, I don't know. That sort of bummed me out. I didn't really want to produce any more. I just didn't have any motivation to produce any more art.

In the second school, Nathan's teacher mentor provided support and the right "push" to encourage him towards creating good art whenever he meets with difficulty in creating art and is stuck along the way.

> It's only when my mentor sort of pushes me to a certain direction, and then I am more confident on like what to do and then I think the artwork turns out great in a sense.

12.3.5   C5: (Re)Creating Process

The impact of the recreating and re-creating process can be seen in Nathan's experiences in both art and music. In music, Nathan was "addicted to it" from the very first instance when he picked up the guitar and began playing. He would be "literally lying on (his) parents' bed watching TV, just strumming…" which forms part of his recreation. Other than that, he also took part in talent competitions and performances, which afforded him the platform to improve his skills while gaining exposure to wider audiences. It was also through this platform that the rest of the school acknowledged his talent in music, encouraging him to further pursue this interest.

With regard to his interest in art, Nathan had an interest in art since young, and his passion for it continued to grow throughout the years as it was mainly a recreational hobby. He would feel a sense of fulfilment when he completed a drawing,

which kept his passion growing. Generally, he felt that art should not be made into a competition as there are no fixed criteria that it can be objectively based on, as art itself is subjective.

> Competition in sports make[s] sense…It follows a set of rules and how you are at it defines how accomplished you are. Art is different… I think from a young age, I got a wrong idea of what art was, and that everything was a competition. To create is not a competition. It's the expression of your ideas.

12.4 Discussion

In this chapter, we introduced a framework that offers a perspective on how interest can be sustained in individuals. Through a case study of Nathan's journey in discovering and developing his interests, we used the lens of the "5Cs framework of interest sustaining" to draw out how these five dimensions amalgamate to contribute to Nathan's sustained interest and development in the arts and music.

From our study, we found that all five dimensions play an important role in determining the development and sustainability of interest in an individual. Overall, the findings from this case study illuminate the importance of a positive environment, which has an impact on all five dimensions of the framework. Even dimension C3, confidence, which is usually assumed to be an innate or self-generated attribute, is found to be greatly affected by external factors such as the standards of a school, support and encouragement given through the learning process and a nurturing teacher or mentor to walk through the learning process together.

In this case study, we were able to accompany Nathan in his journey of exploring and innovating in his ways of learning in an informal context, which goes beyond the psychological views of the typical interest-driven studies to focus on the sociocultural views of interest-driven learning and how the ecology shapes his innovations in learning. Upon examination of Nathan's journey over the years in secondary school, we observed two contrasting environments from the two schools, which illustrated how environments affected the five dimensions and ultimately interest sustainability.

In the first school, Nathan felt that the community within the school was overly critical and judged quickly, which made him feel demoralised and inhibited his development of interest in art. The culture was also still overly focused on completing assignments instead of making art relevant to their lives. Over time, his confidence was also affected in such a way where he began to doubt his own artistic capabilities, especially since art is subjective and there are no clear standards that he could refer to. In addition, there was a mismatch in collective conflict resolution mechanisms whereby the school's structure expected students to constantly work on projects with limited guidance, which adversely affected Nathan's interest in art as well. Therefore, even though Nathan had an interest in art since young and he engaged with it as a recreational hobby, this recreating process was affected by all the other factors which eventually took a toll on his interest in art.

In contrast, the second school had a much more conducive environment that sustained interest. The community was more accepting and supportive in helping Nathan assimilate into the new environment, which would have provided a tighter community of support. The culture created by his art teacher also invigorated his interest in art, while the school's culture encouraged holistic growth in students and cultivated his interest in music as well. Through the teacher's mentorship, Nathan regained his confidence in creating art again while at the same time receiving affirmation for his musical ability. Nathan's art mentor in school helped him overcome challenges, facilitating conflict resolution by providing appropriate guidance. This school also facilitated the recreating process as it was not so heavy on assignments and completing projects, which rekindled his passion and interest.

These findings clearly illustrated the important role of stakeholders in schools and the sociocultural environment in influencing students' interest in a particular content, activity and even learning itself. Beginning from school management, we observed the importance of having supportive school leaders who are able to see the potential in students and give them the opportunity to cultivate their potential, such as in the case of the principal of the new school Nathan enrolled in. The school management was also able to create a desirable culture that encouraged and provided a channel for students to discover, pursue and cultivate their interests. Teachers/mentors also played a role in inspiring and encouraging Nathan to pursue his interest in the case of both art and music. His music teacher also encouraged him not to stop making music, which he held closely to and continues to do so until today. Peers played a significant role in determining Nathan's participation in his music. His peers in the contemporary band CCA motivate him to improve his music. Together with positive affirmation and recognition of his musical aptitude, his peers spur him on in pursuing this interest. Lastly, Nathan's parents were pivotal in grooming his interest in music by providing the financial support for his guitar lessons which gave him the foundation to self-learn music and develop his skills as a musician. Therefore, as outlined above, we can see how the ecology provides sociocultural affordances which contribute to the shaping of Nathan's involvement and deepening of interest in his music.

From the case study, we can establish some opportunities for innovations afforded by informal learning because it is interest-driven and less high stakes in nature. Firstly, as it is interest-driven, there is a higher motivation to overcome challenges to keep learning and improving. In Nathan's case, even though he had to stop attending guitar lessons, he continued to seek out various ways to learn and improve his skills. This initiative and resourcefulness to seek new learning opportunities diffused to his formal learning in how he found solutions to any problem he faced. Informal learning also provided the opportunity for play and experimentation typically missing in formal, high-stakes learning. Nathan was able to further deepen his learning by participating in the contemporary band CCA which provided him more avenues to play his music but also the opportunity to play with other members in a band, broadening his scope of learning from playing as an individual to collaborating and playing in a band. This form of low-stake, low-stress play affords Nathan with the opportunity to explore different avenues of engaging in his music individu-

ally as well as with his peers, providing him insights on the best ways he can develop his musical talent. Over the course of playing his music, Nathan discovered his own unique style of learning, which he was able to integrate into his own formal learning of academic subjects, such as how he can deconstruct different maths and science algorithms to understand them better. Furthermore, this process had an especially direct and significant impact on his art as they are both creative outlets, which is the sequential process of constructing and developing ideas leading up to the creation of an end product.

Therefore, by leveraging these opportunities afforded by informal learning, there will be great value-addedness to what formal education can provide. This interplay between the formal and informal learning will thus be able to provide a more holistic and well-rounded education for individuals, as highlighted in Nathan's case study.

12.4.1 Recommendations to Classroom Learning

Based on these findings on informal learning, we would like to propose some recommendations on improving classroom learning. Taking a top-down approach, we recommend the school leadership to be intentional in creating informal learning environments within the school and classrooms. This could be physical spaces within the school or perhaps time set aside during lessons where students are afforded the freedom to play and experiment topics of interest to them. Together with the teachers, this can create a culture of learning through play in the school and within the classrooms. Teachers would play a significant role in modelling to students that experimentation and play are encouraged, instead of simply focusing on grades and preparing for high-stake examinations.

Subject teachers can also communicate and collaborate with one another to facilitate interdisciplinary learning as well. For instance, a physics teacher can collaborate with a physical education teacher to design an activity or lesson that combines soccer with physics theory on speed, angles and velocity of shooting a ball. Episodes like these would be able to integrate learning a theoretical concept together with play and may cultivate a deeper interest to both soccer and physics.

12.4.2 Contributions to Existing Literature

The 5Cs framework's contribution to interest-based learning research is its support and extension of the four-phase model of interest development (Hidi & Renninger, 2006) by exploring the specific dimensions which facilitate the sustaining of interest in individuals. This framework applies to all four phases of interest development, because regardless of the stage of interest development, it is critical for

individuals to have self-generated interest or environmental support to facilitate continued engagement in the activity, lest their interests diminish or fade away completely (Renninger & Hidi, 2016). The dimensions presented in the proposed framework are therefore relevant as it provides a basis on what particular aspects of a child's environment parents or teachers can focus on in order to sustain and develop their interest in specific content or activities.

Based on the existing literature, the potential for interest is within an individual, but the specific content and environment delineate its direction and contribute to its development (Hidi & Renninger, 2006). The 5Cs framework thus provides a sociocultural lens where we can view interest development, attempting to narrow this gap in the literature while, at the same time, complementing the psychological aspect of interest sufficiently expounded presently.

This is still a preliminary study, and further research and data are needed to substantiate the 5Cs framework of interest sustaining.

12.5   Conclusion

This chapter attempts to illuminate the importance of studying interest from both a psychological perspective and a sociocultural perspective. Using the case study of Nathan, we describe the importance of sociocultural factors in the sustaining of interest using the 5Cs framework consisting of community, culture, confidence, conflict resolution and the recreating process.

Findings from the case study highlight the importance of external environmental support in interest development, and the vital role educators play in helping students develop their interests (Hidi & Renninger, 2006). The sociocultural lens of the 5Cs framework afford us a schema of the specific support required to cultivate interest development and sustainability as seen from the case study above. This case study illustrates the importance of teacher support for engagement in an object of interest, echoing the findings from Eccles et al. (1993), but goes one step further to highlight the importance of a positive culture that supports the interest across the boundaries of school, community and home.

Interest development cannot be devoid of its interaction with the sociocultural environment and the support structures it provides, beginning from the early phases of its development to the later stages of maintaining continued engagement. The psychological lens afforded by the four-phase model of interest will thus enable us to study interest from the individual level and to trace how an interest will develop over time. The 5Cs framework provides a more macroview of interest development by showing how much the sociocultural environment is able to affect interest sustainability. Our framework would therefore provide a preliminary attempt at unifying the psychological and sociocultural aspects of interest development in hope of providing a more comprehensive perspective of how interest can be sustained, benefiting both practitioners and researchers in the process.

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Aik Lim Tan is a research assistant at the National Institute of Education, Singapore. Prior to this, he was a public school teacher in Australia. His research interests include interest-driven learning, student engagement and motivation and educational neuroscience. He presented a paper at the Redesigning Pedagogy Conference 2017 in Singapore on resilience development through school innovations.

David Hung is a Dean of Education Research at the National Institute of Education, Singapore. He has served as Contributing Editor and Associate Editor for several well-read international academic publications in the learning sciences field and appointed as journal reviewer for various well-established international academic journals. His research interests are in learning and instructional technologies; constructivism, in particular, social constructivism; social cultural orientations to cognition; and communities of practice.

Azilawati Jamaludin is an Assistant Profession at the Curriculum, Teaching and Learning Academic Group, National Institute of Education, Singapore. Her research interests include progressive pedagogies, reform pedagogies, institutional innovations, gamification, game-based interactivity, immersive environments, argumentative knowledge construction, trans-contextual learning, embodiment, embodied knowing, embodied subjectivities, trajectories of *becoming,* and construction of self.

Chapter 13
Conclusion: Tenets for Cultivating Ecologies: Towards Sustaining Innovations and Self-Improving Schools

David Hung, Shu-Shing Lee, Azilawati Jamaludin, Yancy Toh, and Longkai Wu

Abstract In this concluding chapter, we take an ecological perspective and synthesise all preceding book chapters to derive three key tenets for building new contexts that emphasise synergies to diffuse and sustain educational innovations. The first tenet is concerned with calibrating top-down and bottom-up approaches and structures across the respective layers of the education ecology to create optimal conditions for diffusing innovations. The second tenet is concerned with collaborations and networks as means to build lateral connections and partnerships. Instead of competition and accountability, there is collective moral purpose to develop capacity, mentor, and collaboration between schools to co-construct innovations that benefit local contexts. The ultimate goal of networks and spreading innovative practices is to focus on sustainability and enable self-improving school systems. This leads to the third tenet, which is concerned with ecological leadership as a role that stakeholders across all levels of the education ecology could embrace to mitigate tensions and contradictions, align local needs with overall system mandates, and harness collective wisdom.

13.1 Introduction

The evolving twenty-first-century landscape entails that today's learners need knowledge, skills, and dispositions that are different from yesteryears (Brown, 2012; Jamaludin & Hung, 2016). New socio-economic demands and political shifts mean that different schooling outcomes, skills, and competencies are expected (Soffell, 2016; Teo, Deng, Lee, & Lim-Ratnam, 2013). Educational innovations, coupled with developments in technology, drive change by creating new modes of learning. These modes emphasise inquiry and student-centred practices that develop

D. Hung · S.-S. Lee (✉) · A. Jamaludin · Y. Toh · L. Wu
National Institute of Education, Nanyang Technological University, Singapore, Singapore
e-mail: shushing.lee@nie.edu.sg

social-constructivist competencies such as student questioning, problem-solving, critical thinking, and other process dispositions (Brown, 2014; Hung, Jamaludin, & Toh, 2015a).

New forms of learning help education systems stay relevant. Yet, rigid demands associated with the "grammar of schooling" (Tyack & Cuban, 1995), such as subject compartmentalising, institutional routines, timetabling and exams, and risks involved, may limit educational innovations' agility in spreading to other adopting schools. Societal expectations of schooling to achieve productive outcomes also mean that spreading educational innovations requires stakeholders to work synergistically.

Education is inherently varied and socially messy (Beach, 1999). Issues related to the scalability, transferability, and sustainability of innovations surface when integrating new practices in schools. Diffusing innovations for educational change is, therefore, a complex, non-linear process that goes beyond replication and efficiency. There is a need to focus on spreading understandings of innovations where adaptations are made for local needs and partnerships and collaborations are sought to enable diffusion (Elmore, 2016; Shirley, 2017).

Chapters in this book go beyond conceptual understandings to provide concrete examples in the form of case studies to show the dynamic interactions between stakeholders and contexts for different innovations and needs. These interactions and considerations suggest that a top-down replication approach for spreading innovations may not be as efficacious as combining top-down and bottom-up approaches (Hung, Lee, & Wu, 2015b; Lee, Hung, & Teh, 2016). The chapters illustrate the complementary and varied ways of combining top-down and bottom-up approaches depending on the innovation and level of the education ecology the innovation foregrounds. The chapters are organised based on different levels of the education ecology (chronological, systems, school, or classroom and learner subsystems) to unpack the tenets, stakeholders, and interactions of innovation and change as well as show the varied ways top-down and bottom-up approaches may complement each other.

All chapters have adopted a critical lens of innovation diffusion by using an ecological perspective (Bronfenbrenner, 1979, 1993). The ecological perspective embraces the rhizomatic nature of innovation diffusion (Jamaludin & Hung, 2016) where chapters discuss the multiple possibilities and intricacies for spreading and sustaining educational innovations from microsystem to chronological layers (see Fig. 13.1) and where new connections and nodal points for innovation diffusion may further develop and thrive. Collaborations and synergies across subsystems (e.g. system, schools, and classrooms) in the education system feature strongly for cultivating ecologies and enabling improvements. Diverse stakeholders play key roles in synergising and brokering differences within and between boundaries in the educational ecology to facilitate collective improvement and change. In this concluding chapter, we draw lessons from preceding chapters to synthesise the rationale and key tenets for building synergies and diffusing educational innovations for sustainability and self-improving schools.
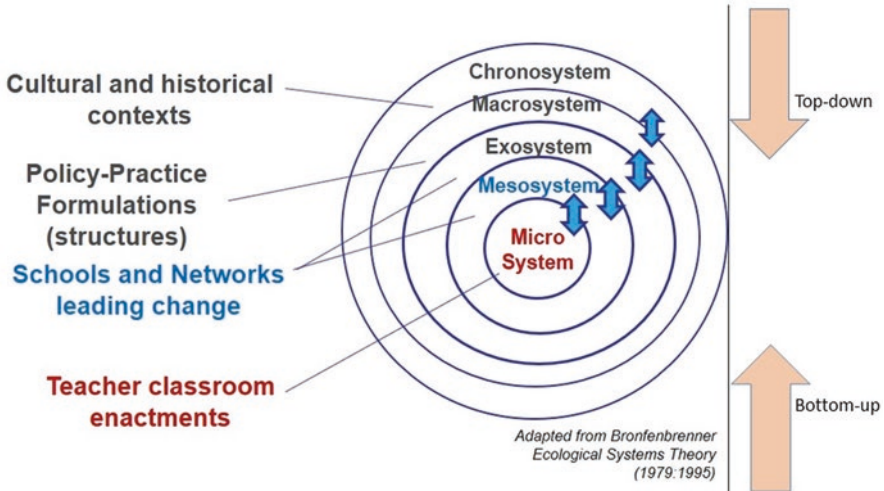
Fig. 13.1 An ecological perspective for spreading and sustaining educational innovations

13.2 Top-Down and Bottom-Up Approaches for Diffusing Innovations in an Education Ecology

Teaching and learning is a context-sensitive, sociocultural process (Bodilly, Glennan, Kerr, & Galegher, 2004; Clarke & Dede, 2009). Proponents of education reform foreground the preference for using "diffusion" rather than "scaling" to describe the complexity and dynamic nature of spreadingeducational innovations for change (Fullan, 2014; Garcia-Huidobro, Nannemann, Bacon, & Thompson, 2017; Hargreaves, 2012). Scholars such as Fullan (2014) and Hargreaves (2012) highlight that traditional notions of scaling connote a linear process whereby an idea is first tested in a laboratory and goes through clinical trials under different conditions before it is pushed to the mass market. This linear process raises issues for educational innovations because proponents of scaling and school reform studies recognise the importance of contextual affordances. Diffusion is preferred to emphasise recontextualisations and readaptations that integrate and spread innovative practices in education contexts. Key elements of the diffusion process include the innovation's core principles, communication channels for transferring understandings to multiple stakeholders of the social system, and temporal dimensions (Rogers, 1995). Diffusing innovations in educational contexts values the interconnectedness between curriculum, learning resources, activities, assessment, professional development, and leadership (Looi, So, Toh, & Chen, 2011; Pea & Collins, 2008) as well as the organisational learning that results from adapting, embedding, and spreading new practices (Spillane, Gomez, & Mesler, 2009).

By adopting an ecological perspective, chapters have gleaned diverse understandings of how the influential and interacting nature of nested subsystems in the

educational ecology at the system, school, and classroom/individual layers across chronological levels has bearings on innovation diffusion. The chronological level involves temporal aspects relating to the historical developments and evolution of an education system. The system level refers to national and global trends, policies, and initiatives that impact an education system. The school level relates to school's organisational attributes such as culture, structure, and leadership practices. The classroom/individual level refers to classroom influences on the innovation, such as classroom culture, students' readiness, and teachers' pedagogies.

From an ecological perspective, diffusing educational innovations involves schools leveraging affordances and resources from the broader education system. This book has appropriated the ecological perspective to argue that both top-down (centralised) and bottom-up (decentralised) efforts work in evolving and synergistic ways to create new contexts, synergies, and impetus for diffusing educational innovations and developing the socio-technological infrastructures that sustain change. Various coupling of top-down (centralised) and bottom-up (decentralised) efforts for diffusing new practices has been articulated in the respective chapters situated at various levels of the education ecology.

Chapter 1 by Chua, Toh, He, Jamaludin, and Hung and Chap. 2 by Brown, Husbands, and Woods explicated ideas of harnessing existing approaches of education system, whether it is centralised or decentralised, to reach synergies of top-down and bottom-up approaches, against a chronological layer backdrop. These efforts enabled optimisations to be attained to create productive macro contexts for diffusing innovations within respective education ecologies.

At the system level, policies, frameworks, and communities have provided schools with directives to establish synergies that enable innovations to take root and change practices. Zohar in Chap. 3 provided insights on how top-down, system-wide professional development initiatives developed teachers' capacities for enacting policies and implementing higher-order thinking. Yet, there is a need to communicate to schools that there are spaces for bottom-up autonomy so that teachers can bridge gaps between policy and practice and ensure innovations fit local contexts. Chapter 4 by Lim, Kwan, and Poh and Chap. 5 by Shaari, Hung, and Osman acknowledged the value of communities of practice and teacher champions as drivers of innovations and change in schools. While communities and teacher champions are bottom-up drivers, their efforts could be complemented by system-level, top-down efforts to hasten and create more concerted leverages for innovation diffusion. Teo in Chap. 6 further illustrated how researchers with rich understandings of system-level policies complement bottom-up, school-based efforts to initiate and align innovations that meet policy directives as well as schools' needs. Such synergies create meaningful contexts for innovations to flourish.

At the school level, school leaders play key roles in interpreting policies, negotiating understandings with teachers, as well as creating structures and processes for a productive ecology and culture towards innovations. While school leaders have the authority to adopt a top-down approach, the chapters in this book illuminated how school leaders become critical agents of change when they recognised that teacher collaborations within and across schools are necessary to create new

ecologies for innovations and change. Spillane and Anderson in Chap. 7 illustrated the social strategies that school leaders implemented to bridge policy directives and garner teachers' cooperation for innovations. Besides socially oriented means, Huang in Chap. 10 further described metaphors as another strategy that school leaders used to help teachers understand and rationalise the innovation diffusion approaches that schools have adopted. These metaphors embraced top-down and bottom-up approaches to spread innovations and change. Pedder and Opfer in Chap. 8 as well as Lee, Seow, and Hung in Chap. 9 highlighted the importance of foregrounding teacher capacity building in schools to sustain innovations. While the former emphasised that supportive ecologies for teacher capacity occurred when schools' orientations to teacher learning are aligned, the latter illustrated how a school leader created structures and processes for capacity building so teachers can continue to sustain the innovation ecology and culture of spreading innovations within and across schools.

At the microsystem level, teachers and learners could create synergies across levels of the education ecology to enable innovations in classrooms and spread it to other contexts. Chapter 11 by Lim, Song, and Kho provided insights into how teachers worked with researchers to implement classroom innovations through a bottom-up approach and, subsequently, established possible synergies with top-down structures at the school district and policy levels for diffusion. Chapter 12 by Tan illuminated possibilities of how cross-contextual learning can become contexts for innovation diffusion as learners leverage learning in informal contexts to value-add learning in formal, classroom contexts.

The chapters highlight that a synergistic education ecology that couples top-down and bottom-up approaches in evolving ways is thus a viable, vibrant context for the diffusion of not just innovations but so too for innovative practices that impact desired outcomes of education. Figure 13.2 provides a summary of the key
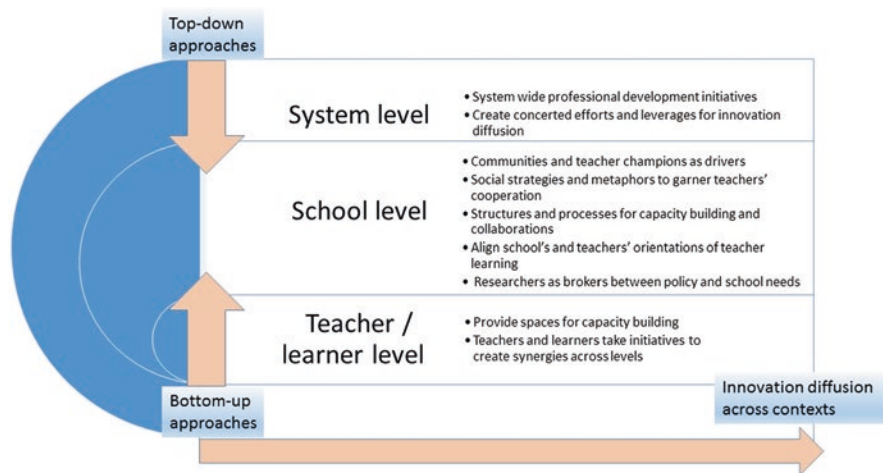
Fig. 13.2 Key aspects for coupling top-down and bottom-up approaches for diffusion

aspects and roles of stakeholders at the respective ecological layers in coupling top-down and bottom-up approaches for innovation diffusion.

13.3 Collaboration and Networks for Sustainability and Self-Improving Schools

While we have articulated the critical tenet of harnessing top-down and bottom-up approaches for *vertical* synergies across subsystems of the education ecology that can catalyse new contexts for innovation diffusion, we now highlight a second important tenet of *horizontal* synergies across the ecology which involves collaborations with stakeholders from different subsystems to cocreate value propositions and lateral connections. Literature has shown that deep change requires time, planning, and participatory efforts from entire schools and the educational ecology (Bain, 2007; Coppola, 2004; Dimmock, Kwek, & Toh, 2013). These efforts have enabled innovations to diffuse and progress from school level to system-wide changes (Harris & Chrispeels, 2006). For example, innovations at the micro-school level may not sustain if synergies are not established for continuous diffusion and transformations.

David Hargreaves (2010) elaborates that sustainable and widespread change is built on the notion of "self-improving school systems". In such systems, schools and stakeholders take ownership and accountability of self-improvement by learning new practices through collaborating and networking with others. Schools and stakeholders with more mature understandings of innovations take up leadership roles as nodal schools. Nodal schools collaborate and network with other schools, in a horizontal synergistic fashion, to expand the reach of new practices and help other schools attain similar achievements and understandings of innovations. Thus, such collaborations and lateral connections support the diffusion of innovations as well as expand schools' and stakeholders' "repertoire of choices, [by] moving ideas and good practices around the system" (Stoll, 2009, p. 12) and "transcending their individual capacities" (Bain, 2007, p. 6).

Collaboration and lateral connections can be social capital drivers for diffusion built on trust, reciprocity, identity, and collective moral purpose (Hargreaves, 2012). While school networks might facilitate diffusion, the continuity of innovations requires adapting and transforming innovations to local contexts such that the initial innovation could look visibly discontinued or different (Sannino, 2010). This aligns with the ecological framing of innovations adopted in this book where diffusion and sustainability might not construe the complete adoption of initial innovations but adapt innovations to enrich local practices and needs.

Hargreaves (2010) stresses that a system of self-improving schools and partnerships is developed through three key thrusts: "professional development", "partnership competence", and "collaborative capital" (p. 5). Professional development refers to building teachers' capacities to implement innovative practices across

schools. Partnership competence relates to how teachers champion and mentor other teachers within network of schools. Collaborative capital focuses on how "horizontal" collaboration across schools enables knowledge transfers and new knowledge or innovations to surface. Authors in this book have aligned with these thrusts to illustrate how top-down system supports might work in complementary ways to enable bottom-up school collaborations and networks.

For instance, Zohar in Chap. 3 described a system-wide model that emphasised professional development and the formation of communities to bridge gaps between policy and practice. Within this model, top-down structures stressed alignment to the innovation's overall goals. However, spaces for bottom-up adaptations are also afforded where teachers, in mentorship roles, developed partnerships with colleagues to tailor professional development and change processes for local needs.

In other examples, Chap. 4 by Lim, Kwan, and Poh and Chap. 5 by Shaari, Hung, and Osman discussed how networks and collaborations as "horizontal" bottom-up constructs could be driven by "vertical" top-down supports to develop dynamism for innovation diffusion and change. Chapter 4 acknowledged the role of across school communities as vehicles to develop champion teachers who have created partnerships and collaborations that helped innovations become more widespread. The chapter elaborated on the construct of "structured informality", to describe the role of system structures in leveraging the informality and networking capacities of communities to dialogue, build understandings, and adapt innovations' principles to more contexts for sustained spread and change. Chapter 5 elaborated on a classification framework that characterised different educational innovations and the role of across school communities in driving diffusion at particular levels of the education ecology. The classification framework discussed the complexity of diffusing educational innovations to include dimensions such as adaptability, accessibility, and relevance of innovations. The chapter highlighted that although system-level supports are useful to drive innovations through across school communities, the dimensions that characterised innovations also shaped the extent of diffusion, whether it is at the teacher, school, or system levels.

Lateral professional development initiatives can also be initiated from a bottom-up approach. Chapter 6 by Teo has described how a researcher harnessed different schools to come together to develop capacities by codesigning and cocreating practices, structures, and processes that shaped and sustained the innovation. Interactions between the researcher and teachers ensured alignment of the innovation and professional development with the school's and system's directives. These interactions also enabled contextualised insights to be developed, so champion teachers could be "seeded" and "grown" within schools to mentor other teachers and generate new insights for other innovative practices.

Schools can also take initiatives to build capacities and network with other schools for spreading innovations. In Chap. 9, Lee, Seow, and Hung discussed how a school-based change journey leveraged professional development as a driver to develop teachers' capacities to innovatively balance teacher-directed and student-centred approaches. The chapter documented how one school embarked on their own bottom-up efforts in complementary ways with its system-level mandate as a
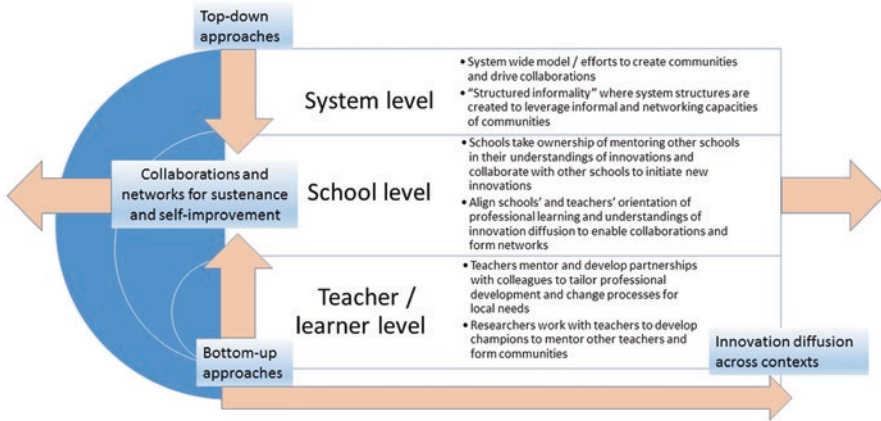
Fig. 13.3 Key aspects of collaboration and networks for self-improving schools

centre of excellence. In this manner, the school became a nodal school that took ownership of mentoring other schools within its district, guiding teachers in their understandings of innovations, as well as collaborating with these schools in initiating new innovations when opportunities arose. Pedder and Opfer in Chap. 8 further emphasised that effective professional development efforts require alignment between schools' (top-down) and teachers' (bottom-up) orientations of professional learning. School leaders could also help teachers understand the school's directions for innovationdiffusion through social tactics and metaphors, which are elaborated in Chaps. 7 and 9, respectively.

These important tenets of literalities and horizontal synergies enable collaborations and networks for self-improving schools that are intersecting at the various levels of the educational ecology as highlighted in Fig. 13.3.

13.4   Leadership for Synergies Across the Ecology

We have foregrounded two important tenets of top-down and bottom-up synergies and lateral collaborations and networks as catalytic contexts for diffusion and change. A third tenet is the importance of a driving force for change both "horizontally" and "vertically" within a vibrant ecology. Fullan (2004) argues that sustaining and enabling system-wide changes involves system thinkers who work beyond own spheres of influence, such as schools or national agencies, to connect to other parts of the education system. System thinkers see the education system in entirety where individual parts or subsystems cannot function in isolation without interacting with the rest (Kofman & Senge, 1995). System leaders embrace wider leadership roles to

include the success of their own schools as well as other schools (Hopkins & Higham, 2007). The role of system leadership includes leading school practices, forging partnerships with other schools, and becoming a mentor to help other schools progress. Leadership is thus a critical tenet as the driving force for change within any ecological system.

The combination of systems thinking and system leadership when situated in an ecological framing goes beyond an expansive outlook to balancing local and systemic tensions, as well as creating enabling conditions for across school improvement and innovation diffusion. An ecological-oriented leadership entails the following critical dimensions for innovation diffusion and change (Toh, Jamaludin, Hung, & Chua, 2014):

- Systems thinking to enable more schools develop collaborations and communities.
- Converge and contextualise innovations between local needs, vision, and overarching system mandates.
- Align efforts to address tensions and contradictions within and across multiple levels of the education ecology.
- Leverage collective wisdom, resources, and enablers across different levels of the educational ecology for diffusing innovations.
- Emergence of new capacities for adapting, spreading, and sustaining innovations.

The premise of ecological leadership aligns with the ecological view foregrounded in this book where synergies between top-down (centralised, formal) and bottom-up (decentralised, informal) approaches as well as structures that are carefully calibrated across subsystems to enable optimal results for innovationdiffusion (Chua, Hatch, & Faughey, 2014). Ecological leadership is different from distributed leadership and system leadership. Distributed leadership includes the collaboration of multiple leaders working together, but it usually focuses within particular level of the ecology, a school, rather than across levels (Hallinger & Heck, 2009; Harris & Spillane, 2008). System leadership focuses on leaders within their own schools or sphere of influence while remaining mindful of the bigger picture (Fullan, 2004). Ecological leaders goes beyond distributed and system leadership to create synergies by rebalancing the dialectics of across school competition to focus on collaboration and networking for developing self-improving school systems. Collaborations and networks are built on dynamic and reciprocal relationships where schools work together in calibrated ways to achieve collective moral good (Hargreaves, 2012) and optimise the education ecology's performance as a whole for innovation and change.

Chapters in this book have elaborated efforts by education systems that considered the system's historical developments from a chronological perspective where attempts are made to create a "balanced" context for ecological leadership. For instance, Chap. 1 by Chua, Toh, He, Jamaludin, and Hung foregrounded the concept of centralised-decentralisation which created a backdrop for developing ecological leadership as a way of thinking for all stakeholders situated across subsystems of the Singapore education ecology. Similarly, Chap. 2 by Brown, Husbands, and

Woods elaborated on how a decentralised education context, such as the United Kingdom, created synergies with top-down efforts and funding to nurture teachers' leadership capacities to align innovations between schools' and systems' needs for sustained district transformations.

Palpably, the concept of ecological leadership shifts away from positional leaders to leadership that can be distributed to collective voices stemming from stakeholders at various layers of the education ecology. By listening to and consolidating the voices of diverse stakeholders, the ecological leader works in aligning and converging different subsystems of the education ecology as well as mitigating tensions and paradoxes when diffusing innovations within and across schools (Toh et al., 2014). Thus, ecological leadership is not just a construct that resides in key leaders or individuals in the education ecology. Rather, dimensions of ecological leadership can be embraced by the collective capacities of multiple stakeholders across different subsystems of the ecology.

These ideas of ecological leadership when appropriated to chapters in this book suggest that ecological leadership could be embraced by stakeholders in all levels of the ecology as long as they are cognisant of the dimensions of ecological leadership and seek synergies within and across schools for innovation diffusion and progressive improvements. At the systems level of the ecology, stakeholders from the ministry or national agencies may develop top-down structures to facilitate and enable bottom-up initiatives to surface in complementary ways. Chapters 3, 4, 5 and 6 have elaborated on how stakeholders at the system level developed integrated professional development and communities of teacher champions which enabled the spreading of innovations across schools. These collaborations and networks created collective understandings of innovations that fit school and policy mandates to spread existing and new innovations. At the school level of the ecology, Chaps. 7, 8, 9 and 10 have demonstrated how school leaders engaged in ecological leadership by using different social tactics, metaphors, structures, and processes to converge schools' and teachers' understandings of innovations and capacity building efforts. These efforts addressed tensions and contradictions so innovations could diffuse beyond schools. At the classroom and individual level of the ecology, teachers and learners in Chaps. 12 and 13 have shown examples of how they made innovations meaningful for their own contexts, as well as adapted it to ensure coherences across other levels of the education ecology so that innovations can be transferred to benefit other contexts. In essence, ecological leadership may be enacted at different levels of the education ecology where the interactions and outcomes at different levels of the education ecology contribute towards collaborations and networks in calibrated and synergistic ways for innovation diffusion and sustainability. Fig. 13.4 provides an illustrative summary of the key dimensions of ecological leadership as articulated and exemplified in the respective chapters of this book.
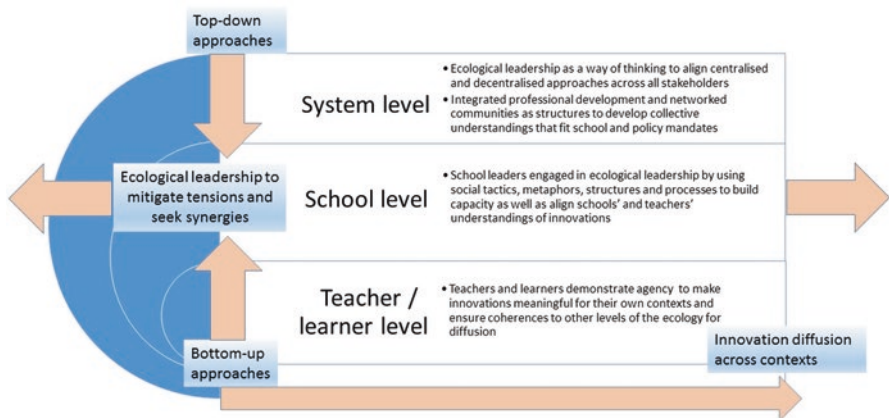
Fig. 13.4 Key dimensions of ecological leadership for synergies across the ecology

13.5 Conclusion

In this concluding chapter, we have taken an ecological perspective and synthesised all preceding book chapters to derive three key tenets for building new contexts that emphasise synergies to diffuse and sustain educational innovations. The first tenet is concerned with calibrating top-down and bottom-up approaches and structures across the respective layers of the education ecology to create optimal conditions for diffusing innovations. The second tenet is concerned with collaborations and networks as means to build lateral connections and partnerships. Instead of competition and accountability, there is collective moral purpose to develop capacity, mentor, and collaboration between schools to co-construct innovations that benefit local contexts. The ultimate goal of networks and spreading innovative practices is to focus on sustainability and enable self-improving school systems. This leads to the third tenet, which is concerned with ecological leadership as a role that stakeholders across all levels of the education ecology could embrace to mitigate tensions and contradictions, align local needs with overall system mandates, and harness collective wisdom. Ecological leaders, therefore, need to create enablers that thrust innovation diffusion and grow capacities to initiate and adopt new innovations so that the ecology continuously evolves.

It is hoped that through the collection of chapters presented in this book, the authors have provided insights into the synergies and calibrations that could be sought where layers of the education ecology come together to create productive contexts for innovations diffusion. We also hope that the detailed case studies exemplify nuances and pathways for the operationalisation and implementation of innovations for change that could be experimented in readers' respective educational contexts. We recognise that every system is complex and that the starting points for educational change and the diffusion process for innovations may be contextually different. We posit that critical tenets of horizontal and vertical synergies enabled by

driving forces of change instantiated through ecological leadership remain resonant as the crux for change to occur. Admittedly, these changes will not be smooth, setbacks may occur, and hurdles may be presented, for example, through rigid adherence to traditional tried and tested pedagogies or fervent teaching to the high-stakes tests. Yet, if we want to focus on energising and empowering stakeholders at the respective layers of the ecology, we need to remain cognisant of the need for horizontal and vertical synergies as well as ecological orientations to leading change. It is hoped that these synergies and orientations enable the incremental pathways that lead us to the desired peaks of excellence inherent in every system.

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David Hung is a Dean of Education Research at the National Institute of Education, Singapore. He has served as Contributing Editor and Associate Editor for several well-read international academic publications in the learning sciences field and appointed as journal reviewer for various well-established international academic journals. His research interests are in learning and instructional technologies; constructivism, in particular, social constructivism; social cultural orientations to cognition; and communities of practice.

Shu-Shing Lee is a Research Scientist at the Centre for Research in Pedagogy and Practice, National Institute of Education, Singapore. Her research interests include teacher learning as well as understanding contextual factors and leverages for spreading and sustaining ICT-mediated educational innovations. Shu-Shing has published book chapters and journal papers and served as a reviewer for Social Sciences Citation Indexed journals. She is coeditor of the book *Adaptivity as a Transformative Disposition for Learning in the twenty-first century*.

Azilawati Jamaludin is an Assistant Profession at the Curriculum, Teaching and Learning Academic Group, National Institute of Education, Singapore. Her research interests include progressive pedagogies, reform pedagogies, institutional innovations, gamification, game-based interactivity, immersive environments, argumentative knowledge construction, trans-contextual learning, embodiment, embodied knowing, embodied subjectivities, trajectories of *becoming,* and construction of self.

Yancy Toh was a Research Scientist at the Centre for Research in Pedagogy and Practice, National Institute of Education, Singapore. Her research interests include leadership studies, school reforms, innovation diffusion, complex systems, and seamless learning. She is particularly interested in examining the systemic influences that impinge on a school's capacity to sustain technology-enabled pedagogical innovations for student-centred learning.

Longkai Wu is a Research Scientist at the Centre for Research in Pedagogy and Practice, National Institute of Education, Singapore. His current research focuses on the design and implementation of technology-enhanced learning activities in classrooms that help students develop deeper understandings. Dr. Wu has published his research work on classroom inquiry and computational thinking at several international conferences and in established international journals.

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