The Diffusion of Inquiry Based Practices in the Singapore Education System: Navigating *eddies* of the 21st century

David Hung, Azilawati Jamaludin, Yancy Toh, Yu Ling Lee
“You must be ... like a white water kayaker who skillfully reads the currents and disruptions of the context around you” (Brown, 2015)

<table>
<thead>
<tr>
<th>Level</th>
<th>Role</th>
<th>Tasks</th>
</tr>
</thead>
<tbody>
<tr>
<td>Macro</td>
<td>School Leaders</td>
<td>• Avoiding episodic experimentation</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Enabling sustainable and scalable epistemic change</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Building capacity for adaptive (and not routine) expertise</td>
</tr>
<tr>
<td>Meso</td>
<td>Teachers</td>
<td>• Traversing performative and inquiry based learning pedagogies</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Moving away from entrenched efficiency mindset to enact</td>
</tr>
<tr>
<td></td>
<td></td>
<td>democratic and process-oriented dialogues</td>
</tr>
<tr>
<td>Micro</td>
<td>Students</td>
<td>• Traversing disciplinary ways of constructing meanings and coping</td>
</tr>
<tr>
<td></td>
<td></td>
<td>with the examinations</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Coping with high performance demands and opportunities for</td>
</tr>
<tr>
<td></td>
<td></td>
<td>tinkering and experimentations</td>
</tr>
</tbody>
</table>
## 2012 PISA Overall Scores for Math, Reading & Science

<table>
<thead>
<tr>
<th>Country</th>
<th>Overall Math</th>
<th>Overall Reading</th>
<th>Overall Science</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>1. Shanghai-China</strong></td>
<td>613</td>
<td>570</td>
<td>580</td>
</tr>
<tr>
<td><strong>2. Singapore</strong></td>
<td>573</td>
<td>542</td>
<td>551</td>
</tr>
<tr>
<td>3. Hong Kong</td>
<td>561</td>
<td>545</td>
<td>555</td>
</tr>
<tr>
<td>4. Chinese Taipei</td>
<td>560</td>
<td>523</td>
<td>523</td>
</tr>
<tr>
<td>5. Korea</td>
<td>554</td>
<td>536</td>
<td>538</td>
</tr>
<tr>
<td>6. Macao-China</td>
<td>538</td>
<td>509</td>
<td>521</td>
</tr>
<tr>
<td>7. Japan</td>
<td>536</td>
<td>538</td>
<td>547</td>
</tr>
<tr>
<td>8. Liechtenstein</td>
<td>535</td>
<td>516</td>
<td>525</td>
</tr>
<tr>
<td>9. Switzerland</td>
<td>531</td>
<td>509</td>
<td>515</td>
</tr>
<tr>
<td>10. Netherlands</td>
<td>523</td>
<td>511</td>
<td>522</td>
</tr>
<tr>
<td>12. Finland</td>
<td>519</td>
<td>524</td>
<td>545</td>
</tr>
<tr>
<td><strong>13. Canada</strong></td>
<td>518</td>
<td>523</td>
<td>525</td>
</tr>
<tr>
<td>19. Australia</td>
<td>504</td>
<td>512</td>
<td>521</td>
</tr>
<tr>
<td>22. New Zealand</td>
<td>500</td>
<td>512</td>
<td>516</td>
</tr>
<tr>
<td><strong>OECD Average</strong></td>
<td><strong>494</strong></td>
<td><strong>496</strong></td>
<td><strong>501</strong></td>
</tr>
<tr>
<td>25. United Kingdom</td>
<td>494</td>
<td>499</td>
<td>514</td>
</tr>
<tr>
<td>35. United States</td>
<td>481</td>
<td>498</td>
<td>497</td>
</tr>
</tbody>
</table>

Singapore wants creativity not cramming

By Rebecca Lim
BBC News, Singapore

Singapore's schools have become global role models, with consistently high results in international tests.

But now they want to move beyond this - towards something that cultivates creativity and what they term as "holistic education".

Minister for Education, Heng Swee Keat, said this is "less about content knowledge" but "more about how to process information".

He describes this challenge to innovate as "not just trying to improve current education systems, but thinking about how the education system can be fundamentally different".

Kicking on: Singapore's education system, praised for high test results, is now targeting innovation.
# World Economic Forum (WEF) Index

<table>
<thead>
<tr>
<th>Country</th>
<th>Global rank</th>
</tr>
</thead>
<tbody>
<tr>
<td>Switzerland</td>
<td>1</td>
</tr>
<tr>
<td>Singapore</td>
<td>2</td>
</tr>
<tr>
<td>United States</td>
<td>3</td>
</tr>
<tr>
<td>Finland</td>
<td>4</td>
</tr>
<tr>
<td>Germany</td>
<td>5</td>
</tr>
<tr>
<td>Japan</td>
<td>6</td>
</tr>
<tr>
<td>Hong Kong SAR</td>
<td>7</td>
</tr>
<tr>
<td>Netherlands</td>
<td>8</td>
</tr>
<tr>
<td>United Kingdom</td>
<td>9</td>
</tr>
<tr>
<td>Sweden</td>
<td>10</td>
</tr>
</tbody>
</table>

Note: * 2014-2015 rank out of 144 economies
# World Economic Forum (WEF) Index

## Infrastructure Top 10

<table>
<thead>
<tr>
<th>Rank</th>
<th>Country</th>
<th>Global rank*</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Hong Kong SAR</td>
<td>1</td>
</tr>
<tr>
<td>2</td>
<td>Singapore</td>
<td>2</td>
</tr>
<tr>
<td>3</td>
<td>United Arab Emirates</td>
<td>3</td>
</tr>
<tr>
<td>4</td>
<td>Netherlands</td>
<td>4</td>
</tr>
<tr>
<td>5</td>
<td>Switzerland</td>
<td>5</td>
</tr>
<tr>
<td>6</td>
<td>Japan</td>
<td>6</td>
</tr>
<tr>
<td>7</td>
<td>Germany</td>
<td>7</td>
</tr>
<tr>
<td>8</td>
<td>France</td>
<td>8</td>
</tr>
<tr>
<td>9</td>
<td>Spain</td>
<td>9</td>
</tr>
<tr>
<td>10</td>
<td>United Kingdom</td>
<td>10</td>
</tr>
</tbody>
</table>


Note: * 2014-2015 rank out of 144 economies
# World Economic Forum (WEF) Index

## Higher Education & Training Top 10

<table>
<thead>
<tr>
<th>Country</th>
<th>Global rank*</th>
</tr>
</thead>
<tbody>
<tr>
<td>Finland</td>
<td>1</td>
</tr>
<tr>
<td><strong>Singapore</strong></td>
<td>2</td>
</tr>
<tr>
<td>Netherlands</td>
<td>3</td>
</tr>
<tr>
<td>Switzerland</td>
<td>4</td>
</tr>
<tr>
<td>Belgium</td>
<td>5</td>
</tr>
<tr>
<td>United Arab Emirates</td>
<td>6</td>
</tr>
<tr>
<td>United States</td>
<td>7</td>
</tr>
<tr>
<td>Norway</td>
<td>8</td>
</tr>
<tr>
<td>New Zealand</td>
<td>9</td>
</tr>
<tr>
<td>Denmark</td>
<td>10</td>
</tr>
</tbody>
</table>

Note: * 2014-2015 rank out of 144 economies
## World Economic Forum (WEF) Index

<table>
<thead>
<tr>
<th>Innovation Top 10</th>
<th>The Global Competitiveness Index 2014-2015</th>
<th>Global rank*</th>
</tr>
</thead>
<tbody>
<tr>
<td>Finland</td>
<td></td>
<td>1</td>
</tr>
<tr>
<td>Switzerland</td>
<td></td>
<td>2</td>
</tr>
<tr>
<td>Israel</td>
<td></td>
<td>3</td>
</tr>
<tr>
<td>Japan</td>
<td></td>
<td>4</td>
</tr>
<tr>
<td>United States</td>
<td></td>
<td>5</td>
</tr>
<tr>
<td>Germany</td>
<td></td>
<td>6</td>
</tr>
<tr>
<td>Sweden</td>
<td></td>
<td>7</td>
</tr>
<tr>
<td>Netherlands</td>
<td></td>
<td>8</td>
</tr>
<tr>
<td><strong>Singapore</strong></td>
<td></td>
<td>9</td>
</tr>
<tr>
<td>Taiwan, China</td>
<td></td>
<td>10</td>
</tr>
</tbody>
</table>

Note: * 2014-2015 rank out of 144 economies
“Can changes in Singapore education rapidly raise the capacity for invention and innovation, and foster/create conditions for an entrepreneurial workforce?”

(Gopinathan, 2006, p. 224)
School Leader (Cluster)

Singapore students may top PISA but we may not be preparing them for the real world … While MOE may have put in place reduced curriculum content but if the teachers are not equipped with the appropriate dispositions and skills, they will revert to old practices …
Inquiry-Based Learning (IBL) as a change agenda

• **Process-learning** embedded within Inquiry-based *practices*

  – Questioning
  – Problem solving
  – Critical thinking
  – Argumentation
  – Metacognitive thinking
  – Knowledge construction
  – Creativity & imagination
  – Aesthetics & design thinking

Adapted from David Hogan

What is next after researcher-led school-based interventions?

<table>
<thead>
<tr>
<th>Working memory</th>
<th>Bilingual work</th>
<th>Science Inquiry</th>
<th>Seamless Learning</th>
<th>Group Scribbles</th>
<th>Ideas First</th>
<th>Productive failure</th>
</tr>
</thead>
<tbody>
<tr>
<td>108 schools</td>
<td>8 schools</td>
<td>5 schools</td>
<td>6+ schools</td>
<td>10+ schools</td>
<td>1 school</td>
<td>14 schools</td>
</tr>
<tr>
<td>108 teachers</td>
<td>18 teachers</td>
<td>50 Teachers</td>
<td>20+ Teachers</td>
<td>50+ teachers</td>
<td>13 teachers</td>
<td>81 teachers</td>
</tr>
<tr>
<td>108 classrooms</td>
<td>23 classrooms</td>
<td>10 classrooms</td>
<td>24+ classrooms</td>
<td>30+ classrooms</td>
<td>24 classrooms</td>
<td>158 classrooms</td>
</tr>
<tr>
<td>10 grades (K2 to S3)</td>
<td>4 grades (P1-P4)</td>
<td>1 grade (P4)</td>
<td>2 grade (P3 &amp; P4)</td>
<td>10 grades</td>
<td>2 grades (P3, S1 to S4, J1&amp;2)</td>
<td>7 grades (P3, S1 to S4, J1&amp;2)</td>
</tr>
</tbody>
</table>

• Apprenticeship Model
  - Cluster
    - school
    - classroom
e.g., Seamless learning, KB

• Distributed Model
  - A
  - B1 … Bn
  - Designed Deep
  - Designed Wide
  - Critical Web Reader
    - 6 schools
    - 12 Teachers
    - 7 classrooms
    - 1 grade (S3)
e.g., Digital Learning Trails

• Move Idioms
  - 1 school
  - 10 teachers
  - 8 classrooms
  - 1 grades (P3)

• Knowledge building
  - 2 + 5 schools
  - 5 + 7 + 30 teachers
  - 5 + 10 + 14 classrooms

• Six Learnings
  - 9 schools
  - 28 teachers
  - 50 classrooms
  - 5 grades (P5, S1 to S4)
Translation and Diffusion studies to inform change at different levels of the education system

CORE Research Programme to engage in baseline studies of where we are as a system in regular cycles

Interventions Research in all disciplinary areas to inform change at the micro level e.g., student cognition/gains to teacher learning

Leadership & School Improvement Studies to inform at the meso level: change in teacher leadership, school leadership, network learning leadership, issues of sustainability & impact, and teacher learning models that work
From Basic to Applied Research

Pure Basic Research

Use-Inspired Basic Research (Strategic RD&I)

Applied Research (Priority Innovation and Invention)

Applied Research (Scaling Translation and Knowledge Management)

Bilingual Development/ Applied Cognitive Development (Working Memory) / Early Childhood Cognition / Assessment for Learning (Theory) / Visualisation (Corpus)

Learning within & out of School / Cyberwellness

CCE / SOTA

Game-based Learning / New Media / Special Needs / Bilingual Studies / Productive Failure / Group Scribbles / Mobile Learning


Early Childhood / Teacher Education Evaluation Studies / ICT Integration @ NIE/E-port folio / Science Inquiry

Edulab Projects/ Mother Tongue Evaluation Study

Design for Scalability

SMAPP / Six Learning Framework / AfL / SEL / Science Inquiry / EPMT / Math Problem Solving

Student Classroom Teacher School National Regional & International Chrono-system

Focus of Investigation

From Individual to System studies

TIMSS / East Asia / International Benchmarking

CORE 1 / PERI / MP3 / CORE 2 / Leadership/ IELTS/ Assessment Baseline
Research Funding

- CRPP established
- OER established (NIE wide)
- OER established (NIE wide with Academies)
- LSL established

38% of funding on interventions
From knowledge **transmission and acquisition** to knowledge **co-creation**
From predominantly *monologic* to *dialogic* pedagogies
From textbook abstractions to experiential understandings
From linear modes of learning to iterative cycles of thinking-conceptualizing-designing-fabricating-testing-failing → thinking-conceptualizing-designing-fabricating-testing-success-joy
From classroom to authentic learning spaces

From learning to be to learning as becoming
Sustainable change in Inquiry Based Learning

Equity of innovative learning opportunities towards deep learning

Whole system improvement – advancing the top, progressing the middle and levelling up the bottom

From ‘letting go’ to reigning in (Fullan, 2014)
Moral Purpose ... Motivation - education is about success for all students

Benefits to all schools arising from research and development

What are the mechanisms for sustainability?

“Bringing more students than ever before to higher levels of achievement than ever before, on a broader range of skills and attributes than ever before, with less inequity in outcomes than ever before” (UNESCO, 2012, p. 11)
Collective navigation of eddies through inquiry-based innovations

Cluster superintendent, teachers, school leaders, students, researchers

Singapore’s educational system

Top-down Policies and Initiatives
- Governance
- Resource Allocation
- Curriculum & Assessment
- Capacity Building

School Zonal Layer (4 NSEW zones)

Cluster of schools (30 clusters)

Maneuverability at ground level
- School Autonomy
- Ownership & Agency

Guided decentralization (Fullan, 2015)
Ecological Perspective for understanding sustainability

3M Layers

- **Chronosystem**
- **Macrosystem**
- **Exosystem**
- **Mesosystem**
- **Micro System**

- Historical trajectory (Culture)
- Educational System Policies
- Stakeholder Partnerships
- Operational Structures & Professional Collaboration
- School/Classroom Practices

Adapted from Bronfenbrenner
Tension 1 – *high performance outcomes versus process (inquiry based) learning*
Tension 2 – *episodic* versus *sustainable* interventions
Learning in context changes the context itself (Spillane, 2006)

- Both improvement processes and outcomes dialectically co-inform and co-evolve
- Inter-twining relations between leadership, curriculum and pedagogy, and teacher professionalism
Macro Layer (System) – System Improvement
Large-scale, **sustained** improvement in student outcomes requires a **sustained** effort to change school and classroom practices, not just structures such as governance and accountability. The heart of improvement lies in changing teaching and learning practices in thousands and thousands of classrooms, and this requires focused and **sustained** effort by **all parts of the education system** and its **partners** (Levin & Fullan, 2009, pp. 189-190)

What we wanted is really a **systemic change in the classroom** for the school itself. Teachers can have very good ideas and translate them into the classrooms. **But the question is if it is really a good practice, we definitely want to sustain** in the school and how we are going about to do that …

*Interview excerpt from former **deputy school leader** of the nodal school*
System improvement

- Levin (2012, p. 11) suggests that an effective, system-wide change strategy requires the following elements:
  - a small number of ambitious yet achievable and well-grounded goals, publicly stated
  - a positive stance on improving all schools and success for all students
  - an emphasis on capacity building and a focus on results
  - multi-level engagement with strong leadership and a ‘guiding coalition’
  - continuous learning through innovation and effective use of research and data
  - a focus on key strategies while also managing other interests and issues
  - effective use of resources
  - a strong implementation effort to support the change process

School/System Improvement Tenets

• Schools are capable of improving themselves *when there is a coherent relationship with the broader educational context with a system-wide change strategy* (Levin, 2012)

• ‘Guiding coalition’ (Levin, 2012) is the idea that *key leaders at different levels, politicians, administrators, teacher educators, teachers, all understand and articulate the change strategy in very similar ways, so that leadership at all levels is mutually reinforcing*

• *Success depends on changes in the actions and beliefs of teachers* (OECD, 2009)
  – Promoting and participating in teacher learning and development has significant effect size of 0.84 (Robinson, 2009)

• *Factors and conditions of the (indigenous) context* are important in system improvement and related theories of action/implementation (Fullan, 2009; 2015; Hung et al, 2015)

• *System infrastructure to support system-wide improvements*, and the ability of an education ministry to lead and support the work (Levin, 2012)
Tenets of sustainable change

- Focus on improving learning and pedagogy
- Evidence based data driven approach in guiding change
- Teachers are in the center of the change process
- School leaders are centrally involved in supporting teachers’ work
- Trust culture and collaboration among stakeholders through communities
- Contextual relevance (*indigenous conditions*)
  (Fullan, 2011; 2015; Hargreaves, 2010)

“The problem [is that] there is almost no opportunity for teachers to engage in continuous and sustained learning about their practice in the settings in which they actually work, observing and being observed by their colleagues in their own classrooms and classrooms of other teachers in other schools confronting similar problems” (Elmore, 2004, p.11).
Meso Layer (Cluster) – Leadership from the Middle
Leadership from the Middle

“Leadership from the Middle can be briefly defined as: a deliberate strategy that increases the capacity and internal coherence of the middle as it becomes a more effective partner upward to the state and downward to its schools and communities, in pursuit of greater system performance. …” (Fullan, 2015, p. 24)
Literature on Leadership models

• Varied researched approaches, each preceded by different ‘adjectives’:
  – Change leadership (e.g. Wagner et al, 2006),
  – Connective leadership (e.g. Lipman-Blumen, 1984; Walker, 2011)
  – Constructivist leadership (e.g. Lamber et al, 1995)
  – Curriculum leadership (e.g. Glatthorn & Whitehead, 1987)
  – Distributed leadership (e.g. Harris & Spillane, 2008)
  – Ecological leadership (e.g. Brymer et al, 2010; Law et al, 2011; Toh et al, 2014)
  – Educational leadership (e.g. Leithwood & Jantzi, 1999b; Dimmock & Walker, 2005)
  – Instructional leadership (e.g. Heck & Hallinger, 1999; Hallinger, 2000)
  – Sustainable leadership (e.g. Hargreaves & Fink, 2003)
  – System leadership (e.g. Caldwell, 2011)
  – Teacher leadership (e.g. York-Barr & Duke, 2004)
  – Transformational leadership (e.g. Bass, 1997; Howell & Avolio, 1993; Day & Sammons, 2013)

Our research indicates: no single model of leadership satisfactorily captures cluster, school and teacher leader enactments, rather leadership trajectories are evolutionary in nature within the context-of-change.
Micro Layer (School) – Micro-genetic changes at teachers’ level
Shifting teachers’ ‘indigenous’ beliefs

- From fear of failure to willingness to try
- From inertia to embodied action and participation

S: the teachers are very worried, ‘confirm cannot come up one’, ‘what if they don’t come up with what I want to hear?’ … That’s always their worry. So that’s why, just let go. They just don’t want to let go. So we show that, see, you can let go. … And then show them how we make the links. And they’re like, okay it’s possible. Okay let’s try.

Our research indicates teachers’ epistemic shifts as the highest point of leverage for sustainability
Examples of **epistemic shift** in teachers

- **My eyes were opened** [to this pedagogy] when I saw my students ask questions ... when they saw connections to the concepts we were exploring and going beyond the covered syllabus. ...

- **When the teachers I work with** see their students’ change ... it is the most powerful (Teacher mentor)

- **previously I just teach** based on the syllabus ... now I will ask students to make authentic real world connections ...

- **it is OK if I cannot answer** the students’ questions ... students direct the learning

- **I started to appreciate** pedagogy better ... I now buy in to pedagogy

- **I used to like rote teaching**, but now I facilitate...
Visibility of student learning gains for teachers’ epistemic shifts

L: ...Z said her tail-end standard science students can’t do KB. Only the first top 3 classes like mine can do KB. So they’re quite jealous because when we do videos or sharing, they can see the excitement and how rich the ideas put forth. And the teachers have their own aha moment, ‘huh my students can do this!’ or ‘this boy ah..’ you know. That motivation was very strong.
Epistemic Learning is the process through which ‘how we come to know’ is changed

Balance between efficiency and innovation: developing teachers’ *Adaptive Expertise* for sustainability

Innovativeness  Frustrated novice

21\textsuperscript{st} Century skills

Inquiry & Innovation

Novice

Routine expert

Specific skills & knowledge  Efficiency

Failure to understand *how people [teachers] experience change* in contrast to how it was intended lies at the very heart of the spectacular lack of success of most social reforms (Fullan, 2016)
Case Studies

Case Study 1
Indigenous knowledge and leadership tenets for innovation diffusion and sustainability

Case Study 2
Micro-genetic teacher change for ownership and sustainability

Case Study 3
Ecosystem carryovers and mitigating ecological misalignments
Case Studies – Methodology

• *Delving deeper to study the contextually rich and socially-embedded innovation diffusion phenomena*
  - Iterative interviews with school leaders, teachers, researchers (semi-structured, in-depth, and at different time points)
  - Document analysis (e.g. school’s mission, vision statements; school website; school innovation project proposals)
  - School visits and observations
  - Thematic analysis which includes the process of i) analyzing and identifying aforementioned data that are linked to a common theme or idea and ii) categorization of themes

• Profile of schools (where innovations are diffused)

• Limitations of the respective cases
Case Study 1 – Key themes
(NIE Researcher initiated)
East Asian *Cultures: Indigenous tenets*

- Hierarchy and Collectivism seem paradoxical from a Western centric lens (e.g., Rowleya & Ulrich, 2012)
  - Respect for elders (hierarchical)
  - Collective good (Dimmock & Walker, 2002)
  - Acceptance and expectation of unequal power distribution (Hofstede, 1997)
  - Great(er) power distance

- East Asian leaders orientate towards harmony, *collectivism*, social hierarchy and relationship-based trust (Craven and Hallinger, 2012)
  - ... the social legacies of Confucianism can turn citizens toward *communitarian democracy* under which individual members collaborate instead of competing against each other (Sing, 2013, p. 563)

- Efficiency mindset
  - Teachers are *bottom line driven*
  - Fear of failure
Historical Perspective: Phases of the Singapore’s Education System

1959—1978: SURVIVAL
1979-1996: EFFICIENCY
1997-2011: ABILITY
2012 till Present: STUDENT CENTRIC, VALUES DRIVEN

1959:
Singapore gained self-governance

1965:
Singapore gained self independence

1979:
Streaming

1997:
Teachers & schools given more autonomy

2012:
Focus more on soft skills (21st CC)
Day (2013, p. 2) states that school leaders “play an important role in establishing the conditions, structures, cultures and climate for professional learning and development in their schools” (p. 2).
Case Study in the diffusion of Seamless Learning

…My involvement signals the importance I place in this effort … Together with the principals from all the 6 schools involved, we **steer and monitor** the curricular innovation efforts … we want to encourage all our **teachers** who are undergoing the change process to take the journey in good stead …

**Interview excerpt from former school leader (cluster) M**

…when we first started, it could have been easy for us to just deliver the 5 schools with our package. … **how to get their hands dirty and how to redesign the whole package** … **how has our teachers’ mind-sets and their skills and classroom changed.**

**Interview excerpt from former deputy school leader of the nodal school**
**Indigenous leadership knowledge – Upward first, then Downward Percolation**

We decided by moving the school leaders first … we did quite a fair bit with the school leaders [of the 5 schools] .. **We did not first move the teachers** … If we don’t get the buy in from school leaders, we will not be able to get sustainability … … we then engaged the next level of the 5 schools … There was a kind of **mapping of the people needed** – school leaders to school leaders; KPs to KPs; Teachers to teachers … There was a leadership handholding process …

Interview excerpt from **former deputy school leader** of the nodal school
Adaptive Expertise in Singapore’s indigenous context

It makes teachers understand that what (the new learning designs) they are doing is not just experimenting... Teachers need to understand that (it is) experimenting with boundaries ... Teachers need to change the ways they teach and yet meet curriculum objectives ...

Interview excerpt from former school leader of the nodal school

Evidence of student gains matters:

Before I got myself into this project, I was also very half-hearted ... I was not totally convinced but results showed that they [students] improved ... the pupils’ responded not only in terms of examination; also in terms of vocal. They were able to express themselves...

Interview excerpt from teacher J from one of the five schools
Spreading a mind-set … ownership

Mindset/epistemic change:

Every school has its own pedagogical niche. … there is a transference of expertise … less about resources but more about PD … less about skills of seamless learning but more about the mindset of our teachers. … It is not just application of old knowledge. It is a certain thinking approach here. If teachers have this … it will scale to other things. They will share it with other people [when they have the mindset]

Interview Excerpt from school leader of one of the 5 schools

Comparing to other schools, School X has a core team of teachers [at the department level]. … School X uses stories and teacher questions to engage students. We usually start with experiments to engage students. …We are not just expecting teachers to carry out the lessons, they also need to know how to prepare and review… enhance the lessons by better considering needs of their students, and engage the students. School X did very well in this area…

Interview excerpt from apprenticing leader of the nodal school
Apprenticeship Learning

Tolerance  ➔  Acceptance  ➔  Signs of Epistemic Change

.... I think for me, before I could move into being very open about listening to other people ... I find that it’s [I come to] an acceptance. Because it’s different from tolerance. You tolerate...every week, you come and you tolerate. You are not taking joy in it. You will not want to participate in it but once you accept it ... it’s part of learning as a teacher. And you have to look at it as my students benefit. It’s not just me. But, if I don’t translate all these information or share it with my students, my students do not have the chance. So, why should I be a blocked vessel? So, I would rather take in whatever is good. Of course, I could make my own judgement and then if it is applicable to my class and it benefits them, then why not. Taking joy in acceptance ...

Interview excerpt from teacher E from one of the six schools

Apprenticing Leadership

**Tolerance**
- Goal of the network was “to co-design lessons for enactment”
- Potential challenges brought by the participants, indicating dissatisfaction about the goal. Issues about parents, homework, etc.
- Unwilling but “tolerate” (teacher ownership not established yet)
- Teacher leaders orchestrating for common goals

**Acceptance**
- Seeing inquiry classrooms in action by teacher leaders
- Peer facilitation -- promote ownership, trust, and accountability
- Discourse to share experiences in refining actions towards the goal
- Gradual “acceptance” (submission) of others’ epistemology
- Imitate desired pedagogy

**Signs of Epistemic Change**
- Initial indications of epistemic learning – “willingly” offered constructive suggestions from personal experience to improve on the lesson plan”, display some confidence
- Reflective discourse with more focus on refining lessons
- Signs of enjoyment in reenacting the “refined” lesson plan
- Signs of sharing with others
- Gradual ‘construction’ and ‘ownership’ manifestations

**Timeline**
- June/July 2014
- Oct/Nov 2014
- July 2015

**Timeline**
- June/July 2014
- Oct/Nov 2014
- July 2015
Downward percolation (in a distributed leadership sense) is observed to be significantly higher compared to upward percolation.

Ecological leadership exhibits the characteristics of forging alignments and convergences in the different ecological layers, mitigating systemic paradoxes as well as local and cross-school tensions … (Toh et al, 2015)

Foregrounding indigenous school and teacher leadership practices

- **Apprenticing Leadership** (*horizontal percolations*)
  - Initial ‘involuntary’ assignment (high power distance) does seem have a place here, but good facilitation is needed to achieve collectivism towards teacher learning and change
    - Being privileged to be called as an alternative interpretation to power distance

- **Ecological Leadership** (*vertical percolations*)
  - School leaders’ intentional reaching-out to teachers to bridge ‘power distance’ between levels – 2 directional percolations
  - **Upward percolation by teacher leaders** is particularly necessary to situate ‘what works’ (with evidence to support) as a means of achieving alignments for the benefit of students overcoming multiple misalignments which may arise through the system
Importance of indigenous knowledge

Sustainability (school ownership)

Epistemic Change

Apprenticing Leadership
(Case study 2)

Ecological Leadership
(Case study 3)

Case Study 2 – Key themes
(MOE Specialist initiated)
Delving into the micro-genetics of Teacher M

- Tracing the evolutionary development of Teacher M
  - Teasing out the tenets of apprenticeship learning and the process of epistemic change
  - Teacher interview, lesson observations, and students’ artefacts and postings analysis
Teacher case study (6 year trajectory)

2010 - KB was started in School P by a Science teacher, Ms P

2012 - Through students’ sharing and school-based PLCs, Teacher M of School P acquires knowledge about KB and begins to implement KB in his History classroom

2014 - Through the iterative process of implementing KB, Teacher M gains participatory insights into the value of KB for his students and for learning history through a historian’s perspective

2015 - Teacher M is posted to another school in the north of Singapore. Teacher M continues to implement KB in his new school

2016 - Teacher M apprentices another history teacher in his department on using KB for history. Teacher M plays to a more central role in the KB networked community through facilitating KB network sessions and opening his classroom to teachers from other schools

Proximal handholding by AL: Moving from periphery to core
Teacher M’s epistemic shift

“…In the past when I just started teaching, I think that was 6 years ago… Mainly frontal teaching itself where.. I still see the value of frontal teaching, but right now my frontal teaching is switched towards as a summative…. As of now I still have all this in between my knowledge building lessons too. But the focus is quite different. In the past, activities … is just activities. […] I will just design any activities related to the content knowledge that we have…”
Apprenticing Leadership in Action

- In early PLC observations -- Apprenticing Leader (AL) assists Teacher M in his understanding of Knowledge Building principles (pedagogical aspects)

M: Democratizing knowledge..
AL: That means everybody contributes. [...] 
M: Then symmetric knowledge…
AL: That [principle] it just means that if I’m not as strong as you, I can also advance.
M: [students] will see, the ultimate goal, knowledge building is not just a subject bound pedagogy, it should exist even outside their subjects, even outside the school, their own life…

AL: This one is 3 months, 6 months later. The child is still gathering evidence and writing back. So the archive is very important. Sometimes that 3 months later the kids do experiments, then they post it back and we realized that kind of pervasiveness.
AL: …collaborative learning and having students understand ideas can be improved, what will other goals that you have process skill?
M: Oh process skills ah?
AL: Able to write a better theory? Or leading them to write a better theory?
M: Something like that. That means er…
AL: Scaffolding them to actually have concrete ideas of how to improve.
M: Yeah… That means ultimately I want them to have a theory that is more grounded in [disciplinary] content …
AL: That means more researched…?
M: More detailed. More detailed argument …
Student states his stand and gives a brief explanation

- Perspective taking
- Contextualized interpretation
- Evidence seeking
- Historical reasoning

Student responds to classmate’s query and builds on to Teacher M’s questions by providing evidence to support his stand. Student poses a corresponding inquiry to Teacher M.
Student goes on to further substantiate his argument by contextualizing the historical situation (Germany being aggressive vs defensive) in the socio-cultural conditions of life (fighting in school).
Teacher Epistemic apprenticeship

Sustainability

Apprenticing Leadership from the middle

Ownership (Teacher)  Apprenticeship

Teacher epistemic change

Student process learning outcomes
Case Study 3 – Key themes

Macro
- Cultural and Indigenous tenets
- System Improvement

Meso
- Leadership from the middle
- Eco-system Carry-overs
- Leadership within schools

Micro
- Apprenticeship Learning
- Student Outcomes
Tension (1) between Performative Pedagogies and IBL

P: There is this rush to get things done. […] When you bring down upper sec content or syllabus to sec one, what are we compromising in the process? Because there’s content reduction but you are putting in so many things at an earlier stage that you are taking up the white space that is being given for students to explore and learn.
T1 - Mitigating tension between Performative Pedagogies and IBL

Socio-cultural carryover
Managing crisis as part of school improvement journey

• School leader navigating eddies

Ecological leadership in action (downwards)

on hindsight I would say that that big drop [in results in 2011] was a very good thing that happened. Because it made us reexamine certain practices, and it started us on a journey of improvement, such that now we’re in a much better state than if it hadn’t happened. So that’s why I will say sometimes crisis failure is a spur to improvement.

I do not see any problem … if we do [IBL] well, students [should be] able to also perform for the test. …

Interview Excerpt from school leader P
T1 - Mitigating tension between Performative Pedagogies and IBL

- Actually MOE these days, our sups don’t come to us and talk about our PSLE results, it’s not like that anymore.

- The parents who choose our school know what they are in for. And we are very clear about this during open house and when they come to us. [...] So the character, leadership, and creativity – they want this, they will come here. They want a lot of tests and drills and super good results, they go somewhere else.

Interview Excerpt from school leader P
Tension (2) between episodic and sustainable interventions

- Epistemic change did not diffuse to more agents when faced with disconnection at the school socio-cultural and policy level.

Policy implementation gap

L: I told the management, I build a team of people, they’re ready to lead already, lead small groups at different levels. I mean how wonderful, they start to influence, they are the change agents these two (Z & J), and they can start leading. But no, just collapsed. I say what for I train people and then collapse?
T2 - Mitigating tension with teacher leader percolating upwards

Epistemic carryover

• Aligning teacher practices to school policy

Ecological leadership in action (upwards)

L: … I told my [new] principal I want to volunteer, because I see flip classroom complements [the inquiry innovation] … And she said, don’t worry..

L: The principal didn’t stop me from doing … so that’s very good …
Creating socio-technical **System** structures for sustainability *(percolating upwards)*

- **Master Teacher**
- **Lead Teacher**
- **Senior Teacher**
- **Beginning Teacher**

I mean I’ve got P [Lead teacher], one day she might become a master teacher [structure]... yeah so it’s like that. **We have to ensure [...] succession planning, sustainability of these projects going.**

Interview Excerpt from **school leader P**
Creating socio-technical **Cluster** structures for Apprenticeship Learning *(percolating downwards)*

- **Structural carryover**
- **Epistemic carryover**

**Capacity building structures**

- **Master Teacher**
- **Lead Teacher**
- **Senior Teacher**
- **Beginning Teacher**

Taking over the apprenticing leadership – succession planning

**P:** The fellow teachers’ progress is something that I speak to the teachers, AL doesn’t get much involved … And being a senior teacher [then], I’m asked to like handhold them… so I actually sit through with them for all these things. So the progress-wise I actually tell them, the classroom management, the questioning, and how are they doing, that kind of thing……
Creating socio-technical School structures for sustainability (percolating up, down, side-wards)

- Structural carryover
- Creating supporting structures
- Process integration
- Resource integration
- Expertise integration

very often for [innovations] to work, we have to integrate processes. Because it was not just about the curriculum design, very often you have to look into time, timetabling for them ..., funding, professional development, all these things. So it’s about integrating resources. That’s the implementation stage. But the earlier part would be, you know, we try to capitalize on strengths and strategic opportunities.

Interview Excerpt from school leader C

Support, space and time is important …what does it mean? For teachers its to explore the design of the lesson. TA will be around to handle the technical issues.

Interview Excerpt from school leader S
Mechanisms for Sustainability

Leveraging on ecosystem carryover effects

Ecosystem carryover effects
The process of leveraging successful elements in constructing one ecosystem to create advantage in constructing a new ecosystem (Adner, 2013)

Structural carryover
- Building architectures for reflexivity and capacity augmentation
- Building architectures for operationalization

Economic carryover
- Resource pooling
- Bulk purchase
- Bearing implicit cost of coordination

Socio-cultural carryover
- Localised accommodation
- Leadership practices
  - Cultural emphasis of risk taking
  - Succession planning
  - Building microcosm of social learning environment/partnership

Epistemic carryover
- Epistemic shift in classroom culture/discourse
- Tinkering process of innovation
- Common inquiry framework and cognitive artefacts

A successful innovation ecosystem engages in symbiosis. Externalization of embodied knowledge, co-production of new knowledge and presence of supporting socio-technological infrastructure can potentially lead to socio-ecological resilience and innovation sustainability.

Leadership enabling socio-technical infrastructure for Epistemic Change

**Macro Layer**
- Culture of innovation, risk taking and low recourse to failure
- Creating sociotechnological supports and structures for teachers to innovate and learn

**Meso Layer**
- peer apprenticeship learning facilitated through PLCs
- peer observation and modelling facilitated through open classrooms
- embodied participation in lesson re-design

**Micro Layer**
- designing for inquiry
- evidence of student gains and development
- Disciplinary ways of seeing meanings
Increase capacity and internal coherence of the Meso middle as it becomes a more effective partner upward to the Macro layer and downward Micro layers to schools and communities.
Tight interplay of the Three-m Layers: ‘Fractal’ alignments to cohere ‘upwards and downwards’

3m exists at the various levels of the system (3M)
Leadership from the Middle (for Ecological Alignments)

• “… it implicates the whole system starting from the middle out, up and down. In addition to our system-use of the concept, LftM can and should be used at other levels. Schools, for example are the middle if you use a within-district focus. Teachers, students and families are the middle when you think of intra-school and community work.” (Fullan, 2015, p. 26)
Teacher at the heart of change

- Teacher epistemic learning
- Teacher meaning making (skills and conceptual understanding)
- Teacher identity becoming
- Teacher transformative practices

Visible student learning gains (conceptual understanding and 21st CC process skills)
Visible students’ Thinking Progression (e.g. KB)
Visible students’ Epistemic Shift (e.g. thinking like a historian)
Observable deepening of students’ discourse
Student-directedness and ownership towards their own learning

Acquisition
Transformation
Participation

‘System’ (AST or ETD) led NLCs
Cluster/Affinity-led nLCs
School/ Teacher-led PLC

To collaborative

‘Catalytic Levelers’
Structure-agency

From ‘individual’

Professional need

- Continual Teacher Learning
- Develop Teacher Leadership
- Augment Teacher Ownership

Performative need

- Achieve students’ desired outcomes of education (DOE-academic, 21cc, values education)


Epistemic change –
Teachers navigating eddies

Tolerance

Acceptance

Epistemic Change

Acquisition

Participation

Transformation

[ownership/agency]

Situated Teachers’ Learning

• Level 1 – Acquisition
  – *create awareness* through mechanisms such as Workshops for School Leaders, Open Classrooms
  – interested schools to come and observe and see for themselves how the pedagogy can work

• Level 2 – Participation
  – *more intentional designs* to shift mindset e.g. participation in PLCs and NLCs with assigned responsibilities to engage in reflective practice

• Level 3 – Transformation
  – *close proximal apprenticing* leveraging on the cluster system with apprenticing programs for identified to-be-potential innovation champions (*with* time-off, assigned mentors, and other socio-technically afforded opportunities to engage in innovation) coordinated at the cluster
Scalable epistemic apprenticeships
(through leadership from the middle)

Ownership

Sustainability

Leadership from the middle

Apprenticeship

Alignments

Carryovers and Mechanisms

Teacher epistemic change

Student process learning outcomes
Implications for Teacher Education

• Leadership programs
  – Unpacking the tension points
  – Explicating the assumptions of our indigenous knowledge around scaling/diffusion

• Partnerships and impact trajectories
  – Academy of Singapore Teachers for the development of innovation champions
  – Joint construction of R&D goals
  – Reflections through dialogue

• Working with school clusters for teacher learning, capacity building, and teacher positioning
Next Steps – Value Proposition

• Leveraging on the cluster and zonal system to reach out to all schools – moving from ‘isolated’ interventions to systems designed interventions where students’ IBL is at the core.
• Fullan’s (2014) from *letting go and reigning in*
  – moving from disparate pockets of change to more systemic movements that can serve as catalytic force for educational change in Singapore, towards 21st CC process skills
• “… now I leverage on the cluster and zonal system to do that” (interview with potential Cluster partner)
Future work

<table>
<thead>
<tr>
<th>Macro (system)</th>
<th>Meso (cluster)</th>
<th>Micro (school)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Macro-macro</td>
<td>Meso-macro</td>
<td>Micro-macro</td>
</tr>
<tr>
<td>Macro-meso</td>
<td>Meso-meso</td>
<td>Micro-meso</td>
</tr>
<tr>
<td>Macro-micro</td>
<td>Meso-micro</td>
<td>Micro-micro</td>
</tr>
</tbody>
</table>

- Grounded upon *indigenous knowledge*
- *Reflective dialogues* (especially for school leaders) for prospective actions and decisions
- Intentional *teacher identity positionings*
“You [We] must be ... like a white water kayaker who skillfully reads the currents and disruptions of the context around you” (Brown, 2015)

Navigating eddies – collectively, we can do it!

<table>
<thead>
<tr>
<th>School Leaders</th>
<th>Teachers</th>
<th>Students</th>
</tr>
</thead>
<tbody>
<tr>
<td>• Avoiding episodic experimentation</td>
<td>• Traversing performative and inquiry based learning pedagogies</td>
<td>• Traversing disciplinary ways of constructing meanings and coping with the examinations</td>
</tr>
<tr>
<td>• Enabling sustainable and scalable epistemic change</td>
<td>• Moving away from entrenched efficiency mindset to enact democratic and process-oriented dialogues</td>
<td>• Coping with high performance demands and opportunities for tinkering and experimentations</td>
</tr>
<tr>
<td>• Building capacity for adaptive (and not routine) expertise</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

micro  

meso  

macro
Acknowledgements

Ministry of Education
Educational Technology Division (ETD)
Academy of Singapore Teachers (AST)

eduLab Projects
NRF2013-EDU002-STUDY01
NRF2011-EDU001-EL002
NRF2011-EDU002-EL004
NRF2011-EDU002-EL005
NRF2011-EDU002-EL008
NRF2013-EDU001-EL018
NRF2013-EDU001-IHL02
NRF2013-EDU001-IHL03