# International Comparative Design-based Innovation Networks: Tension Resolution as Design Challenge

## Abstract

Research on design-based innovation networks often focuses on the activities and interactions of the actors and on exploring their scalability mechanisms. There is agreement that such phenomena cannot be analyzed in isolation from the contexts of the participants to such networks. Less attention has been given to the difficult task of conceptualizing relations between the bigger educational context, individual schools and the network. The relationship between network design and the quality of school improvement has also not been adequately addressed. This paper presents the analysis of tensions, specially ones regarding roles, in SUNG (School-UNiversity-Government) partnership networks that point to contradictions in three innovation networks, located respectively in Singapore, Quebec and Hong Kong, and discusses the implications of the inherent and explicit tensions as design challenges.

## Introduction

This paper looks at three design-based innovation school networks (DBIN), organized as SUNG (School-UNiversity-Government) partnerships that are situated in three different education systems: Hong Kong, Quebec and Singapore. Schools joining a DBIN indicate their intention to share the vision and goals of the network. This paper investigates how the SUNG network designs influence school improvement outcomes.

In centralized systems, networks (of teachers-as-learners) function as vehicles for developing laterality within a hierarchical context (Shaari and Hung, 2018). For robust deepening of knowledge, scaling and sustaining, both centralized and decentralized governance within and beyond the network are needed for effective school improvement (Lisbeth, 2002, Ng, 2017, Toh, et. al, 2014).

Studies on scaling of learning innovations in diverse educational systems also point to the need for coordination and change across multiple levels (Blamire & Gerhard, 2009; Law, Kampylis & Punie, 2015). The lateral and cross-level interactions among actors in a network naturally becomes a major design challenge. And overcoming it becomes a key leverage for school improvement efforts in complex education systems.

In this paper, for each of the three networks we analyze (i) the key tensions that are most significant in moving the network forward in achieving its goals, and (ii) the tensions addressed by the activities

organized by the university-based (UN) partners. It is important to note that both are dynamic features of the network that change over time. The analyses provide an important perspective to inform continuing design efforts to improve school quality, including changes/refinement of the architectures for learning to enhance lateral and cross-level relationships within the networks to address the key tensions that arise. Challenges to network development are identified.

**Conceptual framework**

*Centralized and decentralized contexts in relation to a self-organizing network*

Research on innovation networks in educational contexts (e.g., Baker-Doyle & Yoon, 2018; Shaari & Hung et al., 2016; Hargreaves, 2003; Mintrom & Vergari, 1998) have often highlighted the issue of autonomy and the role of centralized structures in regulating practices and maintaining system consistency and quality. While centralized ministerial efforts help to maintain common core standards, they may impede efforts in self organization. The contradictions between centralization and decentralization, manifested as tensions surrounding goals and roles, impact the level of autonomy and adaptability in innovation networks. While centralized structures may accelerate the speed of adoption or adaptation of pedagogical innovations, the quality of the school improvement efforts resulting from the percolation of innovative practices across schools relies essentially on networks of teachers on the ground. We need a better understanding of how aspects of sustaining an innovation network driven by a centralized body interacts with the autonomous, self-organizing activities of teachers, university researchers and others in influencing the rate of network- and capacity-building processes.

*Tension resolution for design and scaling*

A self-organizing innovation network may be described as one that is in constant adjustment and negotiation to create new structures, drive new interaction mechanisms and foci for different actors in the network, resulting in new (learning) outcomes, and possibly shifting the tensions in the system. Innovation networks can be viewed as ecological systems where the movement of people, resources, and the subsystems influences the entire system on an ongoing basis. Tensions such as competition vs. collaboration, conformity vs. creativity, and individualism vs. collectivism that arise are challenges (and opportunities) that all parties within the network will have to grapple with. These tensions can be identified and overcome by teachers and other educators' pivotal actions aimed at transforming the conditions in place and removing design and implementation barriers to innovative practices in schools and classrooms (Sannino, Engeström, & Lemos, 2016; Laferriere & Hamel, 2012).

**Methodology**

The case studies included in this international collaborative effort to understand innovative networks are: The Self-Directed Learning in Science (SDLS) project in Hong Kong; The Remote Networked Schools (RNS) for Learning and Knowledge Building in Quebec; and the Knowledge Building Community in Singapore. Each network is analyzed regarding its bigger context (tensions and roles). By comparing (1) the tensions addressed for moving the network forward in achieving its goals (from the perspective of the UN partner in the SUNG partnership) and (2) the tensions addressed by the three SUNG partnerships (which members could be changing over time), we pinpointed whether the designed network activities were in fact addressing (or able to address) the key tensions. A crucial aspect of a self-organizing network is its Architecture for Learning (AfL), referred to as the environmental conditions conducive to learning across boundaries (Law et al, 2018). Table 1 (in Annex) presents the analytic framework used in this study.

Throughout the analyses, special attention was given to laterality, defined as the propensities to network and engage in peer-to-peer learning (Shaari & Hung, 2017), and alignment across levels in the network (Law et al., 2018). This analytical approach is built on an ecological perspective versus a hierarchical perspective of learning and socialising.

**Results**

***The Self-Directed Learning in Science (SDLS) project in Hong Kong***

Context: The SDLS project is a three-year University-School Support Project funded by the Education Bureau in Hong Kong that focuses on network-based capacity-building and knowledge co-creation for scalable implementation of SDL in primary and secondary school science classrooms. The Network Level AfL to support within- and cross-school learning includes
- Teacher workshops on designing for self-directed learning, which includes scientific investigations, assessment as learning and feedback.
- Lesson co-planning for teachers in school clusters.
- School based co-planning workshops.
- Peer observations of teaching and debriefing.

- Joint-school student fair and awards.

Tensions & UN partner roles: Using data sources that include offline and online records of these activities and interviews with network participants, we observed six prominent kinds of tensions among the different levels of actors. These and the analysis of the roles played by the UN partners in the network are presented in Table 2 of the Annex, accompanied by descriptions. The results reveal that SDLS invested a lot of efforts into resolving teacher (classroom) level tension (red text in Table 2), which have been found to be effective. Some of the network activities also address the tension between teachers and school mid-level leadership (defined not as a tension between actors but tensions at the school level that can only be resolved if the relevant middle management personnel are involved in understanding and resolving the tension.) The analysis also shows that the network activities are much less effective in addressing this cross-level tension. Most importantly, there are tensions involving school top level leadership and system level policies that the SDLS network had no mechanism to address as far as the Network was constituted within the Hong Kong context.

### *The Networking Remote Rural Schools (RNS) For Learning and Knowledge Building in Quebec*

Context: The RNS Network was launched in 2002. Over 350 small remote schools belonging to 50 school districts that are accountable to the Ministry of Education. The RNS network offers orientation and support to school principals and teachers as they engage in collaborative teaching activities and guide their students through collaborative learning projects and collaborative inquiries. To these ends, a socio-technical infrastructure is in place: onsite orientation meetings, online design teams, continuous online assistance, and scheduled professional development activities. The UN team has been stressing the concept of knowledge building communities (KBCs, Scardamalia & Bereiter, 2003) as it performed research-based formative interventions (Engeström, 2011; Sannino, Engesgtröm, & Lemos, 2016).

Tensions & UN roles: Ethnographic data show that key tensions involved the IT teams based at the school district, teachers' preferences regarding choice of e-learning software, the UN team (which favored research-based use of ICTs, especially Knowledge Forum), and the Government. These tensions kept resurfacing with the arrival of new administrators and teachers and the availability of new digital technologies. Where lateral relationships were established, teacher networks became forceful in expressing their pedagogical interests and professional development needs. On the contrary, when teacher teams acted on their own, the UN team had to voice the relevance of advanced pedagogies within the network, and especially those conducive to classroom-based knowledge building. In both cases, tensions

arose, and they became creative tensions when the resolution process was based on codesign. The detailed analysis of the tensions and activities designed to resolve them are presented in Table 3 (Annex).

### *Knowledge Building Community (KBC) in Singapore (school-school network)*

Context: The KBC is one of the informal networks amidst an educational landscape that is strong in network learning culture. Schools in Singapore are grouped into clusters. The Academy of Singapore Teachers (AST) also structures teacher's professional learning in subject-chapters (subject-based learning communities). There are also concerted efforts to connect teachers as designers on ICT use (a Facebook community of teachers collaborating on ICT-supported innovations). Thus, although the KBC network does not have formal supporting structures from the system, the participants are not new to the concept of network learning. In such a thriving network culture, the researcher has an advantage in using the existing network structure to develop knowledge building capacities in teachers.

Tensions & UN roles: The analyzed data include interviews with school leaders and teachers involved in the KBC (Table 4 in Annex). In this case study, an important driving agency of the network comes from an Education Technology Specialist (ETS) working at the MOE HQ level, who serves simultaneously as a conduit for system level policies to scale innovations, and a change agent to build networks among teachers for innovations. For example, teachers in the knowledge building community noted that the ETS "helped us a lot with the lesson development. And she was the one who will be personally trying to help us progress." The role played by the ETS helps address tensions of curriculum alignment with school-based efforts. The ETS was a former teacher and so she is able to support a "structural congruence" between the school curriculum and the pedagogical innovation required for knowledge building. While the UNiversity role played by researchers on the KBC bridges the teachers' understanding of development of ideas from facts to concepts to theories by connecting novice teachers with expert teachers. At the same time, the school leaders and teachers noted that the ETS is not a permanent resource and have learnt to build their own internal capacity to continue the school improvement efforts associated with the innovation. This leads to the development of various lateral leaderships within the schools and systems, and points to the shift in ownership of the innovation as the pedagogical instruction goes deeper within a school.  However, the analysis shows that the tension revolving high-stake exams remained largely unaddressed within the community, except for one individual school within the network that started to align their school-based assignment according to the topics covered in the Knowledge Building classrooms.

**Discussion**

These three innovation networks across different systems demonstrate that networks behave differently based on context, design and development. The analyses led to the identification of new avenues and challenges to network development. For instance, when laterality was observed – interactions across a school-based network, interactions with international communities – participants were encouraged to turn tensions into new ways of using digital technologies and school improvement practices. UN roles not only help overcome tensions but they also create some (e.g., the RNS case). Therefore, researchers and teacher educators may be seen as exercising "verticality" or as part of the hierarchy. The building of lateral networks across schools is therefore seen as crucial for teachers to own the innovation, and for the diffusion of innovative pedagogical practices among teachers as well as to the professional development of teachers.

**6.      Conclusion**

The theme of the annual meeting being "Leveraging Education Research in a 'Post-Truth' Era: Multimodal Narratives to Democratize Evidence" is addressed by examining tensions and UN roles with regard to school improvement. The results of this comparative study make headways into the concretization of the abstract notion of tension resolution as design, sustainability and scaling for innovation networks.

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**Annex**

Table 1  The framework used to analyze the key within- and cross-level tensions in a SUNG network and the tensions that the network activities address.

| Within and cross-level tensions to be resolved to achieve network goals | | | | | | Network activities & the tensions they address |
|---|---|---|---|---|---|---|
| | student | teacher | HOD/SMT | Sch Head/Sch | System | |
| student | | | | | | |
| teacher | | | | | | |
| HOD/SMT | | | | | | |
| Sch Head/Sch | | | | | | |
| System | | | | | | |

Table 2. Summary of the key tensions and the roles played by the UN partners in SDLS.

| Within and cross-level tensions to be resolved to achieve network goals | | | | | | Network activities & the tensions they address |
|---|---|---|---|---|---|---|
| | student | teacher | HOD/SMT | Sch Head/Sch | System | |
| student | | | | | | |
| teacher | | Pedagogical belief & classroom practice change | | | | · Teacher network workshops<br>· Lesson co-planning (cluster)<br>· Sch-based co-planning wkshop<br>· Peer teaching obs. & debrief |

| | | | | | |
|---|---|---|---|---|---|
| HOD/SMT | | Sch routines, infrastructure, org support | Diff. priorities, beliefs, practices | Sch priority alignment, appraisal | | · Sch leadership workshops<br>· Peer teaching obs. & debrief<br>· Jnt-sch student fair & awards |
| Sch Head/Sch | | Sch priority alignment, appraisal | | | Multiple & changing sys. level demand | |
| System | | | | | Diff. policy priorities, resp. to comm. press. | |

N.B.   1. The red coloured text represents teacher-level tensions to be addressed, or the activities designed to address such tensions.

2. The green coloured text represents cross-level tensions between teachers and school mid-level leadership (e.g. HOD, Head (acad. dev), or the activities designed to address such tensions.

3. The blue coloured text represents cross-level tensions between teachers, school mid-level leadership and/or school head. No network level activities have been designed to resolve these tensions.

4. The black coloured text represents tensions involving system level actors.

5. The thickness of the text represents the importance of the tension or the effectiveness of the activity in addressing the tension. Those underlined are more effective than those not underlined

Table 3. Summary of the key tensions and the roles played by the UN partners in RNS

| | | Within and Cross-level Tensions to be resolved to achieve network goals | | | | Network activities & the tensions they address |
|---|---|---|---|---|---|---|
| | student | teacher | School Principal | School District | System | |
| student | | Students introducing substitute teachers to the use of online tools | Open door activities for parents | | | **The UN team production of iterative results regarding innovation conditions, uses of ICTs, and student learning outcomes** |
| teacher | | **Classroom Belief/practice change** | | **Lateral interaction with teachers from other schools (same district** or across district, inc. international activities**)** | | **Online technical and pedagogical assistance** <u>**Online/onsite co-planning/design of activities**</u> Communities of practice **Annual knowledge transfer session** |
| School principal | | **Orientation and Support** **Conflicting priorities** | Diff. priorities, beliefs, practices | **School/school district priority alignment, appraisal** | Multiple & changing sys. level demand (push for accountability) | **School leadership workshops during the annual knowledge transfer session** Community of practice **Online orientation and support** |
| School District | | | | **IT personnel choices Curriculum counsellors' beliefs and practices** | IT and curriculum counsellors own networks' beliefs and choices | Annual research reports subtle discussion of these tensions |
| System | | | Teacher co-planning of activities during school time as the network expands (teacher union revendication) | | Changes of government officials Different understandings of what is at stake and ways to address challenges | Socio-technical infrastructure (onsite orientation meetings; online design teams, continuous online assistance and scheduled professional development activities) |

N.B.   1. The red colored text represents teacher-level tensions to be addressed, or the activities designed to address such tensions.
2. The green colored text represents cross-level tensions between teachers and school principal, or the activities designed to address such tensions.
3. The blue colored text represents cross-level tensions between teachers, school principals, and school district personnel. Insufficient network level activities have been designed to resolve these tensions.
4. The black colored text represents tensions involving system level actors.
5. The thickness of the text represents the importance of the tension or the effectiveness of the activity in addressing the tension. Those underlined are more effective than those not underlined

Table 4. Summary of the key tensions and the roles played by the UN partners in KBC

| | | Within and Cross-level Tensions to be resolved to achieve network goals | | | | Network activities & the tensions they address |
|---|---|---|---|---|---|---|
| | student | teacher | School Principal | School District | System | |
| student | | Students drop in performance when switching to innovative pedagogy | | | | |
| teacher | | **Teacher belief systems (performative pedagogy to idea centred pedagogy)** **Lack of a community effort and authentic collective inquiry experience.** | **Lack of support (insufficient school based structures to support deepening of practice)** **Lack of authority and rank to negotiate for additional support and structures for sustainability of innovation** | | High stakes examination | **Knowledge building community with open classrooms and sharing sessions. Interaction with expert/KB leads who are also practitioners.** **Teachers belong to an across school KB community for capacity building and training in KB innovation.** |
| School principal | | **Changes in school vision and direction** | | | Accountability structures that include student grades and performance. | **Knowledge building community and ETS engages school leaders when enacting innovation in the school.** **The lines of communication remain open between teachers and school leaders within the school which is brokered by ETS.** |
| School District | | | | | | |
| System | | | | | Lack of manpower | Funding programs to hire additional manpower for innovation projects |

N.B.   1. The red colored text represents  teacher-level tensions to be addressed, or the activities designed to address such tensions.

2. The green colored text represents cross-level tensions between teachers and school principal, or the activities designed to address such tensions.

3. The blue colored text represents cross-level tensions between teachers, school principals, and school district personnel. Insufficient network level activities have been designed to resolve these tensions.

4. The black colored text represents tensions involving system level actors.

5. The thickness of the text represents the importance of the tension or the effectiveness of the activity in addressing the tension. Those underlined are more effective than those not underlined