# Chapter 16
# Learning Networks in Supporting Innovation Diffusion


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**Abstract** This chapter will comment on the value of the learning networks in supporting innovation diffusion. Learning networks refer to any group of connected educators who collaborate to leverage this connectivity to improve practices in and across schools. Through the explication of learning network practices demonstrated by two exemplar schools that have successfully leveled up their school-based innovation, we argue that a ubiquitous collaborative network infrastructure is most important and that pro-innovation diffusion schools should work toward building stronger learning networks efforts. Apart from this, the challenges in building learning networks are discussed and various other mechanisms, particularly the larger cultural, resource, and leadership forces that shape the learning networks need to be considered.

## 16.1 Introduction

Much has been written about the changes in the cultures of work and learning brought about by the emergence of information and communication technologies, technological innovations, and social tools that reduced temporal and spatial constraints (Trust et al., 2016). For instance, tools such as blogs, Twitter, social bookmarks, and many, many more-extend our reach into global conversations via text, audio, and video and allow us to build global learning networks to pursue our intellectual or creative passions or needs with others who share them. We can turn to all sorts of professionals and collaborators from anywhere in the world to help us with problem-solving, connect us to relevant content and resources, or just share their own experiences with us. Tasks that were previously the domain of teachers are now under the control of learners: searching for information, creating space of interaction, forming learning networks, and so on (Siemens & Weller, 2011). Through blogs, wikis, online video, podcasts, and open educational resources, learners are able to

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access content from leading lecturers and researchers around the world (Siemens & Weller, 2011).

There is a clear recognition that with the rapid growth, and the old order is no longer functioning as well as they had done. To remain viable in such an uncertain and changing environment, organizations and individuals alike rely on an ability to learn (Edmondson & Moingeon, 1998; Senge, 1990). Learning has become increasingly important. The growing awareness of the need for learning has also yielded a wide variety of alternatives to formal training arrangements that can contribute to individual and team learning. Different lines of research found themselves committed to addressing different learning issues including looking at platforms for establishing collegial relationships that help people to share and improving organizational culture and organizational spaces to create a "culture of development" (Hannan & Silver, 2000).

In the education sector, much as elsewhere, there is much talk about the rapid and profound changes in our educational practices brought by the rapid changes in work, the way work is organized and the changes in organizational ethos (McNay, 1995). Commentators have noted that there exists an inherent pressure for schools, educators, and researchers to *transform* and implement technology-transformed learning mediated by pedagogical innovations that bring about improvements to overall teaching and learning (Toh et al., 2015). As Senge, Schneider, and Wallace (2014) aptly reminds us, while "business is the most powerful institution today, education (institution) is the most important. How we go about educating children shapes the next 50 to 70 years of our society. It is the only institution in modern society that has that long a time horizon" (Senge et al., 2014, p. 12). That means schools will need to embrace a form of learning that is fundamentally different from the one they have known.

Although there is this awakening, what is not talked about is the role of learning networks in supporting learning, innovation diffusion of schools, and education. And this is a gap that this book chapter will try to demonstrate as part of the practical finding that came from working on a meta-study project involving 11 Singapore's eduLab innovation projects, where we saw that it was the communities characteristic or what we prefer to call as learning networks of people that enabled innovation to diffuse and this has practical implications to efforts for innovation diffusion.

## 16.2 Theoretical Framework

Four concepts derived from the literature on social networks are particularly relevant as the theoretical framework for understanding the creation and performance of learning networks in supporting learning and diffusion of innovations, namely, networks concept, learning networks, benefits, and challenges of learning networks.

### *16.2.1 Networks Concept*

In its basic definition, the network has been defined as *connections* between entities (Siemens, 2005).

Networks function on the simple principle that people, groups, systems, nodes, and entities can be connected to create an integrated whole (ibid.). Ogden (2018) for instance has defined it as *nodes of links of elements* of different kinds (individual people, groups, schools, other kinds of organizations) that are tied together (consciously or unconsciously; experienced in person or virtually) in some larger patterns by one or more types of connectedness—the passion to learn, values, views, interest, ideas, friends and acquaintances, likes, exchange, communication channels (Richardson & Mancabelli, 2011; Siemens & Weller, 2011).

The power of networks resides in the connections and how connection and flow contribute to life, liveliness, and learning. Nodes that acquire greater social qualifications profile such as reliability will be more successful at acquiring additional connections (Ritter & Gemünden, 2003; Siemens, 2005).

In this regard, the placing of a value on certain nodes over others is a reality. The social network literature for instance notes that identifying the relevance in the learning interactions is important with some nodes becoming more important than others.

The diversity of the network's membership is a core consideration for the reasons for communication and that diversity has considerable innovative potential. It has been explicated that as humans have a herd mentality, and it is easy for learners to gather with others who share their passion to learn, views, and interest, thus causing networks to have a "birds of a feather" effect (Siemens & Weller, 2011). Iterations of interaction between a group of actors also lead to a convergence of norms, values, beliefs, and behaviors (Steward & Conway, 2000). This process of convergence or "isomorphism" leads to the formation of densely connected groups of learners, terms "cluster" or "cliques". And the "homophily (the similarity of learners) and effective communication breed each other" (E. Rogers & Bhowmik, 1971) that can also lead to the pooling of ignorance. Interactions that lead to innovation are often those that are between "heterophilous" learners that meet less frequently (Steward & Conway, 2000). It has been argued that ideas and information that pass between "sociometrically distant" or "heterophilous" (dissimilar) actors are more likely to be 'new' and 'fresh' (Granovetter, 1973; Rogers & Kincaid, 1981). This would suggest that to some extent, quality in networks requires us to seek those who respectfully disagree and make them part of our network. This also suggests that we should aim to improve understanding and tolerance within the network, without reducing the innovative potential of diversity, as the innovation diffusion literature has shown us that innovation diffusion is best facilitated by "open" networks, providing bridges to other cliques (Conway, 1997; Granovetter, 1973; E. Rogers & Bhowmik, 1971).

Networks in the education context are seen as models of organizing education. The networks' movement is part of a larger "general shift, beginning in the second half of the twentieth century, away from individualist, essentialist and atomistic

explanations to more relational, contextual, and systemic understandings" (Borgatti & Foster, 2003). The idea of networks as structural models for education and learning is not new. Ivan Illich has suggested in 1971 that school was not the sole avenue for learning and showed that learning webs "can provide the learner with new links to the world instead of continuing to funnel all educational programs through the teacher" (Illich, 1971, p. 73).

Networks are generally not under the control of an individual organization but are more of self-organizing systems that permit learners to explore and define their own learning space in which order emerges from the local interactions taking place (Wilkinson & Young, 2002). Networks can thus take various shapes depending on both learners' dynamics and work characteristics. Networks are defined by attributes of autonomy, reduced resistance to information flow, ease of connectivity, organic growth, and self-directed strategies that include discussions and reflections, testing of new strategies, rapid iteration and improvement of ideas and concepts as well as ease of scalability (Siemens & Weller, 2011). These attributes are antithetical to the traditional model of education, where the structure is defined by the centrality of the educator and the structured, and generally the one-way flow of content from the teacher. Others have also noted that collaboration in networks can be challenging as it does not involve the use of legitimate authority and order in the network emerges from the local interactions taking place (Wilkinson & Young, 2002; Yström et al., 2019).

In this regard, commentators have noted that there is much to be said about the "strength of weak ties" (Granovetter, 1973) upon which most of our network interactions will be built. Weak ties are links or bridges that allow short connections between information, and this has great merit in the notion of serendipity, innovation, and creativity (Siemens, 2005). Connections between disparate ideas and fields can create creative outcomes for innovation problems and create innovations (Yström et al., 2019). These alterations within the network have ripple effects on the whole (Barabási, 2002; Richardson & Mancabelli, 2011).

### *16.2.2 Learning Networks*

Richardson and Mancabelli (2011) have defined learning networks as "the rich set of connections each of us can make to people in both our online and offline worlds who can help us with our learning pursuits" (p. 21). Actors in the learning network can each have their theories and strategies in organizing work-related learning. Hence, learning networks can take various shapes depending on both actor dynamics and work characteristics. The literature notes that the Internet pushes the potential scope and scale of learning networks to unprecedented heights. Others have noted that *learning networks* are often used interchangeably with a few other common terms such as *communities of practice (COPs)*, *professional learning communities (PLCs)*, *collaborative learning communities*, *professional learning groups*, *critical friends groups* (although terms such as *professional learning groups*, *critical friends groups*

are typically applied to smaller teams of teacher—usually between four and eight, although group sizes vary) (Great School Partnerships, 2014; Reinelt, 2007), research or data use teams, multisite lesson study teams, teacher design teams, whole-child support teams, and so on (Poortman & Brown, 2018). It is also trite to note that learning networks can also vary in composition, nature, and focus: they may consist of teachers and/or school leaders from different schools, teachers with local or national policymakers, teachers and other stakeholders, teachers in a partnership or involve joint work with academic researchers and many other potential combinations. Indeed, the loose usage of the terms and subtle distinction between the terms use is potentially confusing.

While these terms are often used interchangeably in a very loose way, others have made a distinction between the terms. For instance, Wheatley and Frieze (2006) described that *communities of practice* evolve from networks. Richardson and Mancabelli (2011) meanwhile explicate that while connections in learning networks are social, they go beyond the popular "social networks" moniker that has been applied to Facebook, MySpace, and others. "Social networks" are personal spaces where people connect to people they already know and love, friends, or friends of friends where they share their hobbies, likes, and dislikes through their profile. As Richardson and Mancabelli (2011) explained, learning networks are very different both in form and purpose in that in learning networks, people connect to people they do not necessarily already know, and these can be strangers who share their passion for a particular topic. The connection made on learning networks is not just to keep in touch, but rather *to help one to learn.*

Learning in learning networks has been touted as a big departure from the conventional learning spaces that require a shift in teachers/tutors and learner's perspective. The role of teachers shifts from control to subtle influence and/or initial shaping (Siemens, 2010). Instead of the legacy of the one-way information flow model of teacher-centric pedagogy, learning in networks requires peer-management, collaborative sharing, autonomy, and for learners to have a well-developed sense of *self-direction* and *self-responsibility* as networked learning is not linear. For instance, in the case of web learning networks, the conversations and content that learners immerse in are distributed all over the web, glued together with the judicious use of links by the people the learner is connected with (Richardson & Mancabelli, 2011).

Learning in networks begins with the learner's *passion to learn* and those connections start with *sharing*, which is the lifeblood of the learning network (Richardson & Mancabelli, 2011). The literature notes that once the learners in the network start connecting, it is all about the *quality of the connections the learner makes and not the quantity*. This idea pertains to choosing connections carefully as well as choosing diverse connections. The knowledge resides in these networks (as even though one may not be connected at a given time, invariably others in the network are, and they are reading, filtering, and thinking) and that an integral part of the learning process is to be able to find and synthesize the most current information and recognize connections between ideas that may be found in many different places from any different people (Cross, 2007). To this end, good listening, collaboration skills and not getting too attached to the idea that everything is going to work fine have been suggested

as beneficial for the lifelong learning journey (Senge et al., 2014). Members of the network thus become a part of an *ongoing flow of learning*. As they participate in these spaces, they become one node, one actor/learner of many in the network that in aggregate is constantly learning (Richardson & Mancabelli, 2011).

In these learning spaces, people may share links using participative tools like Twitter or Edmodo, offer one's thoughts on one another's blogs, act as critical friends, push one another's thinking, and collaboratively create new knowledge to share with the world. These are primarily intellectual exercises, not social ones. The interactions are often engaging and in many cases can be friendly, but it is not uncommon for members of learning networks to keep these learning and social spaces very separate (Richardson & Mancabelli, 2011). *Regular reflection* is needed to prevent getting lost in the sea of information and conversations and to improve the "signal to noise" ratio to shift practice and allowing learners to grow and deepen in their learning, increase overall efficiency, offer increased participation, increased information flow, and ease the generation and sharing of content. This helps the learners to build their problem-solving capacity, be better prepared for life, and work in the twenty-first century (Richardson & Mancabelli, 2011).

In a learning sense, the likelihood that a concept of learning will be linked depends on how well it is currently linked (Siemens, 2005). Nodes that have gain recognition for their expertise have greater chances of recognition, thus resulting in the cross-pollination of learning communities. Here in this paper, we define learning networks as *any group of connected educators who collaborate to leverage this connectivity to learn more than the current state of knowledge and improve practices in and across schools that may potentially result in higher levels of student learning.* This capability to connect and learn from the knowledge shared by the different parties within the network to achieve "collaborative advantage" (Huxham, 1996) becomes critical when facing rising and multifaceted demands (Chesbrough & Teece, 2002; Inkpen & Li, 1999). They learn actionable knowledge for them to change—that is "the alteration of one state to another, to make different, to exchange, to replace, to transfer, to transform" (Goodman & Kurke, 1982, p. 2).

### *16.2.3 Benefits and Challenges of Learning Networks*

Research evidence has suggested that the use of learning networks can be effective in supporting school improvement. The idea is that the shared competence manifest in the dynamic functioning of learning networks and the cognitive socialization which would enable the learners to productively participate in their knowledge work.

Studies have suggested that effective learning networks are those that meet the necessary criteria for successful professional development (Stoll, Bolam, Wallace, & Thomas, 2006). Teachers' collaboration in learning networks can lead to improved teaching practice and increased student learning (Borko, 2004; Vescio et al., 2008). Analyses of three case studies by Panckhurst and Marsh (2011) have demonstrated that learning networks allow learners a sense of freedom, encouraging learners to

be more independent, and take more responsibility for their learning. The learning network works for a couple of reasons.

Part of the equation is the act of making a public commitment, as Ian Ayres, author of Carrots and Sticks, says about motivation: "Other people matter. Mindfulness matters and participation matter" (Ayers, 2010). Ayers, an economist and professor at the Yale Law School, was quick to point out how public commitments are a terrific way to sustain changes that would otherwise be forgotten. Commenting on the post in the learning networks, sharing a plan with a group of peers, or posting ideas raises the level of commitment people have to this kind of learning.

The other half of the equation is that these learning networks can also provide an opportunity to participate in the reflective dialogue that allows learners to scaffold on each other's learning (Vygotsky, 1978), leverage on experts power, knowledge, support, and experiences and helps learners to develop new approaches to teaching and learning and relate to the innovation ideas and concepts and to see the success of innovation being repeated allows one to re-frame and see a new future or way forward, which are the elements of successful change recommended by journalist Alan Deutschman (2009) in Change or Die. Being part of the network provides an ideal structure for individual ownership (rather than being told to do so) to support the changes in mindsets as relationships in the network helps one to learn new ways of thinking about the situation, practice, and master the new habits and skills that one will need and ultimately makes one amenable to look at the world differently.

However, it is noted by Poortman and Brown (2018) that participation in learning networks does not automatically improve practice and that the effects can sometimes be small and results have been mixed (Chapman & Muijs, 2014; Lomos, 2011).

The literature has noted that harnessing the benefits of learning networks is not without challenge (Hubers, Poortman, Schildkamp, & Pieters, 2019). An earlier paper by Hubers et al. (2017) has shown that it can never be assumed that knowledge will automatically flow through the team, network, or organization. This indicated that dissemination of knowledge is something that will require *explicit attention*, focus, and considerable effort. In that research, it noted that learning network teams who increased their knowledge sharing had quality managers on their team who were willing and able to share their knowledge, who were actively involved in their team's progress, and regularly discussed their ideas and beliefs about the educational problem. In contrast learning networks that decreased in their knowledge brokerage relied exclusively on written communication or did not undertake any activities at all. It takes a lot of repetition over time before new patterns of behavior become automatic and seem natural and until one accepts the innovation without even thinking about it (Richardson & Mancabelli, 2011).

## 16.3 Research Methods

As alluded at the outset, this chapter will try to demonstrate as part of the practical finding that came from working on a larger project involving 11 Singapore's eduLab innovation projects. In this regards, the 11 eduLab innovation projects were part of Singapore's ambitious eduLab programs, a key program for Singapore teachers, researchers and Ministry of Education Head Quarters officers to develop Information Communication Technologies (ICT) innovations for learning that can potentially be adopted and adapted by different schools across the system (Ministry of Education of Singapore, 2017; National Institute of Education, 2019). It was launched as an initiative of Singapore's Ministry of Education (MOE) with its sole teacher training institute, the National Institute of Education (NIE) which was supported by the National Research Foundation (NRF) in 2011 to facilitate the diffusion of technological innovations. From 2016 to 2018, it was funded by MOE and administered by NIE (ibid.). The eduLab program has since ended but provided a good frame of reference, as it reflected an important move away from traditional change policy instruments based on the 'linear model' of innovation, to those based on the 'interactive model', where diffusion is no longer considered a distinct last phase of the innovation process, but integrated into the education process as a whole. Through the explication of learning network practices demonstrated by two exemplar schools that have successfully leveled up their school-based innovation, this chapter argues that a ubiquitous collaborative network infrastructure is most important and that pro-innovation diffusion schools should work toward building stronger learning networks efforts.

The next section tries to unpack what has been discovered about learning networks in supporting innovation diffusion, as demonstrated by the case of an innovation that started at two schools that have successfully spread to five schools. Data were collected through purposeful interviews to identify key stakeholders that could provide significant insights into supporting the innovation diffusion efforts. Additional conversations with research participants were often serendipitously arranged with the voluntary assistance of, and invitation by, prior interviewees.

## 16.4 Case Study the Innovative Knowledge Building (KB) Pedagogy

At the inception of the innovation project, the innovation facilitator of the innovation project was very cognizant about the kind of operational infrastructure and resources that must be put in before the two schools join her project. Her experience in following a teacher learning network of a lab school overseas had helped her to see what might be involved in designing a KB classroom. Her requirements were minimally two teachers (of which must include the Head of Department) to join the team of innovation implementers, and that the teachers to be committed and be involved

in the project to understand what the KB principles look like and be fully involved in the innovative technology to see the benefits of the innovation. This came from her previous experience as a classroom teacher who had previously enacted KB principles in her previous secondary school. Hence, when she approached the two schools Principals for participation in the innovation project, she simplified the model, just telling them the theory behind the pedagogical innovation, the possible value that could be gained from the pedagogical innovation, what she planned to do, the operational requirements and the kind of commitment needed from the teachers, what possibly a classroom practice with the innovation pedagogy will look like, the weekly meeting that will be involved and the kind of analysis that could be derived from participating in this project and gave the school leaders the authority to choose the teachers who will implement the innovation in the school.

While it was a new concept that might perceivably have resistance in getting buy-in, the co-principal investigator of the innovation project's association as the Lead Specialist of the Learning Partnership in Educational Technology Branch that provides the strategic direction on information communications technologies in education in Singapore and the fit in pedagogical innovation the school was trying to aim for had contributed to her success in getting the buy-in from the two schools Principals to participate in the project and each of the schools managed to provide her with two teachers (one HOD and one teacher).

So, it was always the three of them involved. At the inception, the HODs of both schools did not have professional learning teams (PLTs) as the schools only started the principle-based community approach of PLTs to support these teachers' professional development much later. However, the investigator of the innovation project knew very well that PLTs needs to have more than a pair of participants and cannot be just one person as they needed to scaffold on one another's idea when things did not work out. At that point, the three of them worked quite closely and met on weekly basis. They allocated an hour each week to design the lesson in such a way that they could study the notes that students post on the innovative technology platform. The investigator shared the theoretical concepts and the examples from overseas and so forth as she was very cognizant on the need for the teacher to be open of the innovative technology platform and to talk about it or other means of archiving students' ideas and understanding what it means to work with students' ideas. They were very clear it was a very ideas-centered approach. She also went in to observe one lesson a week and this usually took place on the days she was in for the discussions with the team. The HOD and teacher in each school need not write any lesson plan, they will scribble things and the investigator will collect those and then record the conversation and all that. Hence, activities in the PLTs may involve sharing the first viewpoints, systematically analyze and discuss students' ideas, examine KB principles and research, discuss issues and challenges, identifying promising ideas based on the broader curriculum or real scientific ideas, share practices or strategies used in the classroom. This was the same for the two schools that participated, with the investigator being the constant denominator. Half a year into the intervention, she will write knowledge stories out of the PLTs conversations as trigger activities for the teachers to reflect on. Every teacher at the PLTs will get their own knowledge

reading story, and they will reflect and the research team will pose a few questions for the members of the learning network to reflect on at the end of the term. The investigator also shared that part of the reporting process, she kept the Principals updated at least every half a year of the progress of the innovation project as the Principals do not come into the class at all. She shared she updated the Principals every half a year and analyze whatever learning insights gained till that point in time.

Time was highlighted as a major barrier to adopting the innovative pedagogy in schools and mismatches with norms and established practices to improve education, especially in a climate of accountability and high-stakes testing, as evidenced in data from our interviews:

> Sometimes [the teachers] see the benefits [of innovative pedagogy], but they're just scared to go on full board, especially the upper secondary teachers. They're still worried about *time, they are practical*, so we're still trying to convince them that, if you do all these practical skills, actually all these skills can be integrated…So some of them give suggestions like, can we go down to lower secondary? Play around with lower secondary?
>
> (Interview with Teacher S)

> Because of the curriculum, …because of the education in Singapore, we felt that we need to also fulfill the curriculum content. So, the time is a constraint for them… so it's important to teach it in the fastest possible way, so [teaching] content … is the fastest possible way to deliver the content.
>
> (Interview with learning designer)

The investigator and teachers we interviewed also shared the importance of the role played by school leaders such as the senior leaders (i.e., Principals and Vice-Principals) and middle managers (i.e., HOD). The senior leader's willingness to allocate teachers time to partake in this innovative pedagogy was cited as an enabling factor in the implementation of this innovative pedagogy. As one of the teachers put it "I think before anything first, the support from management is crucial. That's the first step" (Interview with Lead Teacher M). Another teacher similarly puts it:

> I think you need the Principals and Vice-Principals to be supportive in this whole thing. They have to believe in this, in that they must be able to give the teachers the *time* and *space* to plan lessons. Very important…At least there must be a *time-tabled time given to the teachers.* To sit down and talk about how they want to carry out the KB lessons in the classrooms. That at least plan lessons. That's the first step.
>
> (Interview with Lead Teacher P)

It was revealed that after one of the Principals of one of the schools left the project; the project faced some problems.

> …to tell you the truth that not all the principals will be very receptive, because in my, ah, stay in the school, we have two principals and the first Principal is very supportive …But the second Principal, ah, is a bit resistant because she felt that it may be spending too much time for the teacher's part and maybe also taking too much time of the student's part...
>
> (Interview with Teacher K)

In this regard, it again highlights that Principals have a crucial role to play in stimulating focus and providing support for the innovation diffusion within the school

and learning network. This challenge for learning networks, therefore, is how participants might engage effectively with and maximize the benefits of having access to the range of knowledge, experience, and expertise present within the learning network. For instance, we saw how the departure of an innovation supportive Principal to an innovation resistant Principal initially brought some problem in diffusing the innovation in one of the schools. Nevertheless, we saw how the strong learning networks was able to keep itself going and slowly the "knowledge broker" who has a structural position in the network (as Educational Technology Officer, ETO) was able to influence the new Principal in operating strategically and accept the innovation, albeit it takes time. An implication from this is the need to have a middle man as a "knowledge broker" between our central MOE and schools to reconcile any tensions:

> I have to be the middle man, ah, between HQ and school, trying to bring in KB, bit by bit during [second Principal's] leadership in the school. So let her see, knowledge building has true usefulness and is in line with a 21st-century education, how it helps students to learn and develop collaborative skills and IT skills. And so I convince her also because during my stay there I conducted a few talks when visitors visited our school. People from Australia, professors from Australia as well as Hong Kong. And also, during the school open house, I conducted it for primary school teachers who came to my school with their students. So, in a way, I help spread the culture, not within the school but also out of the school. So, she sees that this one has been intensive and deliberative and she buys in this slowly and um, ask me to conduct such talks when the visitors who are coming into the schools.
>
> (Interview with Teacher K)

Throughout the project, sharing events across schools were also conducted quarterly to allow the inter-school KB community to exchange ideas and build knowledge about the KB practice. There was evidence of the positive impact of KB learning networks as teachers and students were sharing on the impact of the KB community on teachers' professional development and students found effects on deepening of their inquiry process, respectively.

It was worth noting that in School P, and it was the structural facilities along with students' bottom-up initiative that helped spread the innovation. Of interest is that the students acted as innovation drivers as they took an active role in organizing their learning and acted as champions to spread the innovation from Science subject and suggested that all subjects should to it.

> Okay. In School P's case, right, so the Science 1, I mean the school has all this structure, right. In June, they'll have their learning festival, December, whatever right? Then they get the students and teachers to share. So, in School P, *the students went to share and say that all subjects should do it.* So then, it's their internal effort, lah. So, which means that they share there, the humanities, hey pick this up and then came on.
>
> (Interview with the innovation facilitator)

The core PLT Science KB group was critical in sustaining teachers' KB practice. From the initial PLT Science KB membership of three teachers, it spread to six teachers and gained momentum and traction. Soon the whole Science department participated. Through these activities, the teachers found it deepened their inquiry process. A second PLT was formed for the Humanities, and a third was later formed for English. Out of the three PLTs, only the Science and Humanities sustained.

In School E, the PLT started with three Science teachers and then spread to five teachers in 2011 as at primary school the Science teachers were usually also teaching English, so this helped it to scale to English subject and by 2012 it spread to 8 teachers.

In this regard, the interview revealed that it is vital that there be a set of ubiquitous infrastructures that have been determined to be the commitment level necessary for something to work to be in place or an avenue for achieving collaborative professional development. This needs to be engineered to ensure those good ideas are brought out to the next stage and to ensure the things that will make the KB momentum happen in the community grows.

> Teachers are the driver. The Professional Development part must come in, to keep the momentum going. Have *structures to facilitate* and make it happen. Information Technology people also come in to help with technical issues.
>
> (Interview with one of the Principals)

In 2016, this emerging cross-school learning networks became an official structure known as KB Network Learning Communities (NLCs). What started as an innovation initiative in two schools seeded the innovation conversations and helped spread it out to five schools. Although getting buy-in from the school leaders for innovation diffusion was important, we think that learning networks have the highest leverage point in supporting innovation diffusion as the initial innovation adopter school acted as champions to help spread the diffusion of the innovation through its learning network relationship, as gleaned from our interview:

> School P's teachers were in some sharing. And they knew each other so they decided that this is the thing to adopt. So of course, then the teacher from School P went to talk to School M teachers first. Then after that, we say that they are interested in coming in then I went down to talk to them and started the PLT. School M was because every school has PLTs and this is not like you know, we are going to do something very different. But explaining to them what the principle is about, what the practice is about. By the time when School P is more established in that kind of classroom, I would, I mean it's kind of KB classroom in Singapore. That school that listens to it, the 4 schools that listen to it is so easy already. Because they know what it looks like and what it feels like. It's only the initial 2 years that it was so hard to get new people in. so it was more internal.
>
> (Interview with the innovation facilitator)

In this regards, we also recognize that there is a need to *deliberate*ly demonstrate or highlight innovation success that can be observed in the actions of experienced individuals, teams, and schools in facilitating the innovation diffusion, such as in the case of the enactment process of the pedagogical innovations in School P and School E which has taken roots quite deeply so that those teachers from schools at the infancy stages of the innovation can learn from them and then "personalized" (Leadbeater, 2004) it in their own department/schools.

> …the schools are doing a lot more to explain the practice to other schools. ..We get School P and E teachers to open up their classroom and open up their PLTs where other schools will go and visit. So we have been doing this since this year. So like January to now, we have at least 3 classroom visits and PLC visits. So, for example, the new, the other three new schools…they have actually gone into School P's PLTs, sat down and listen to what

> have they discussed, going to the classroom to see what happened and then go back and then tweak such things.
>
> (Interview with the innovation facilitator)

> Yeah. [I've opened up my classroom for the science teacher to see KB enactment]. As and when he wants… I will work with him first… the first step we need to do is sit down together, look at the syllabus first, he needs to know the entire syllabus in terms of the content, the concepts, all that is needed. I believe that's very important…. Once you're able to see the big picture, then we're able to tell him, how do you plan to carry out a lesson that way? So, the different steps and possibilities. Then he will try it out, and we will have debriefed accordingly. Once he gets used to the idea of KB, maybe just [using] *one KB principle*, then maybe we ask him to just share with his department
>
> (Interview with Lead Teacher M)

This demonstration process of showing what a KB classroom enactment looks like by the teacher who has had experienced using the innovative pedagogy to new team members is akin to an apprenticeship process that helps establish a risk-free environment for the new members to observe the principles of KB and how it is possible for them to weave the innovative pedagogy. As the new team members continue to plan, practice co-teach, learning in context and receiving feedback, reflect, and collaborate with the teacher who has experienced in the innovation, new teaching habits will become routine and beliefs on the innovative principles will solidify. Immersion by those new to the innovative pedagogy in the apprenticeship activity focuses on the new learning and helps builds social trust among those involved. They will in turn take the initial knowledge and demonstrations back to their classrooms and reproduce them with their students.

We found from our interviews that adopters of the innovation journey appreciated the sharing and demonstration by those who are more experienced in the learning networks. Receiving encouragement and positive feedback that builds the expectations of success also appeared to be helpful.

> Actually, throughout these 2 years *M, HOD, and subject head [school leaders]* …when I carried out lessons, there were lesson observations. About 3 times, M pops in as and when he likes. They do encourage me, especially when they see students questioning more. So that gives me confidence. *The support is very important*. Because while I don't have full control of my classes, because I give the ownership to the students, that's when *their support that I"m on the right track is very [important]*…the school support is very strong.
>
> (Interview with one of the teachers)

In this regard, the literature noted that in implementing innovation, people often experience a social-psychological fear of change as well as the reality of any lack of skills to make the change successful. Also, people often desire to retreat to previous practices during this time because it seems as if no progress is being made. To offset any potential innovation implementation dip, school leaders may need to remember that "change or improvement efforts are a process, not an event" (Fullan, 2001). For instance, in peer coaching of the PLTs, positive change often requires time and acceptance of potential setbacks. In this regard, the innovation facilitator who acts as an instructional partner helps encourage support and guide the teachers toward

sustained change as they attempt to use the best instructional practices for their students' learning (Gassenheimer, 2013).

In our case study, these efforts may also not be limited to just local efforts in Singapore but may include extended efforts done by others enacting the same innovation overseas to learn from them.

> …we have like *study trip* to Hong Kong then we have *video conferencing* with [overseas experts]. You know they came in and presented their classroom. Yeah. So, all these are important points where they come together as an inter-school.
>
> (Interview with the innovation facilitator)

These cross-network learning are beneficial in providing opportunities for generating and sharing knowledge and enabling teachers to direct their development, as one of the teachers puts it:

> We've shared at different platforms, heard from different schools. Like Bali International Conference, I went there to present as well. So, I managed to learn, come back, lead the team.
>
> (Interview with Teacher P)

Our findings from the two schools have also consistently shown that school leadership support is a vital supporting condition required for learning networks. Once the school leaders are committed to the innovation, it is usually natural that the rest of the members of the school will comply and accept the innovation, as exemplified from the following interview snippets:

> Culture has to start somewhere, from the *senior leaders* to the SMCs.
>
> (Interview with one of the Principals)

> *First level of change must come from key personnel*. Once they are bought in and know what the school stands for, teachers will come in. It's only sustainable when there's a critical mass of people who do this and impact other people through this community of sharing.
>
> (Interview with one of the Principals)

Our findings also revealed that in supporting innovation diffusion, it is also instructive to examine the cultural-historical perspective of participating schools. For real and deeper transformation toward innovation, the capacity and capabilities of the learning networks are also influenced by the cultural-historical perspective of the school, which means we should also be cognizant of the innovation being introduced is "right" for the participating schools, given their particular context, history, and needs. In this regard, schools that had school leaders (Principals) who were already sensitized to Knowledge Building classroom through their learning journeys visits and workshops, were the initiators of the innovations and had proved to be the change agent within the learning architecture of the innovation diffusion.

> And then the other structure that other new schools that we are working on now are because *they have been using knowledge building classrooms as a learning journey for the school leaders* and all that right. *So when the Principal sees it and they assign someone to come and talk to us, so we have all these new schools coming in.*
>
> (Interview with the innovation facilitator)

For instance, in School E the carryover effects of having to move toward transformative assessment have helped the school leader in legitimizing the assessment change process and making the status quo more difficult to protect, which helps the KB innovation to flourish.

> Teachers get support from HOD for transformative assessment (integrating a 30% KF component in students' final year assessment). I must say, before that our HOD is fairly aligned to what we mentioned because we were moving towards a formative assessment. So, this [innovation] obviously aligns very nicely with formative assessment. So, our HOD allows us to evaluate this aspect.
>
> (Interview with a Middle Leader)

## 16.5 Discussions and Concluding Remarks

This chapter has narrated on actual process and practices of how the principled KB pedagogy innovation has spread from individual schools subject to cross-subjects and to cross the boundary to other schools through learning networks. Although we recognize that marrying interview data with the impact data provided by the innovation facilitator, teachers, and school leaders does not necessarily enable us to establish a definitive "cause and effect" relationship of the impact of the learning network in supporting innovation diffusion, it does provide a compelling case that learning networks can be a high leverage focus and can have a significant impact on not only supporting innovation diffusion but sustaining it. These findings support the literature that has indicated that learning networks can support school improvement efforts (Chapman & Muijs, 2014).

We thus argue that pro-innovation diffusion schools should work toward building stronger learning network efforts that allow education stakeholders to speak to one another. Learning networks offer a pragmatic, low-overhead approach to making time and space for organizational learning habits to grow. Having seen how learning networks help diffuse innovation case, so what would our schools look like if every school implementing innovation embraced in learning networks? Well frankly, each school would probably look exciting but unique. In this evolutionary process of building a stronger learning network, we are cognizant that learning networks are not a one-size-fits-all solution that works for the diffusion of innovations for each school in the same way. We have seen how innovation implementers have to work with existing structures of the participating schools, adjust, and adapt in the innovation journey. The case study illustrated how schools do not simply adopt the innovation but negotiate a response to the systems of relationships in which they reside rather than at a discrete level.

We can see from our case study how systems of relationships and negotiated meanings take place between individual, team, community, cultural norms, values, resources, and power of the actors (students and leaders). For instance, it was clear to us that the influence of the innovation facilitator as Lead Specialist might have influenced the uptake of the innovation at the initiation stage and we also saw that

the students' bottom-up suggestion to spread the innovation across other subjects had a consequence in spreading the innovation. Besides, even though both schools were trying to roll out the same innovation and had the same innovation facilitator/coordinator, the diffusion of innovations was never a linear, orderly, or easily coordinated process. It also raises several immediate questions. Hence, one might ask, might it be more fruitful efforts that learning networks to be enforced from top–bottom or from bottom-up? Is there a case that we may need both a top-down and bottom-up approach in building a learning network?

A variety of factors need to be in place before the learning networks can be successful. In this regard, the elements of the affordance of ubiquitous collaborative network infrastructure are most important to allow the teachers to function well. The ubiquitous collaborative network infrastructure we are referring to refers to boundary objects, tools, mechanisms, platforms, and resources to enable others to take on an innovative practice that promotes people to share their knowledge such as through availing professional development courses/workshops, resources for video-conferencing, study trips, learning journeys visits, and learning festivals. Innovation adopters should communicate their ideas freely as they never know who might hear them and be influenced. As we have seen in the case study, we saw that the principals who went on learning journeys to the classroom enacting the innovation could understand how to meaningfully support the participation within their school. Hence the original context, intentions, and activities undertaken by individual schools before the innovation being introduced and the extent of the learning impact achieved from participating in learning networks should be examined in future studies.

In this regard, a pro-innovation mediator/facilitator (such as the role played by the innovation facilitator who is passionate and intimately experienced in KB) in monitoring, guiding the collaborative inquiry, facilitating the exploratory learning by ensuring some structures are put in place in the KF view and coordinating the student learning is also critical in supporting the innovation diffusion. It was also evident to us that her dual experience of having worked as a teacher and later as Lead Specialist of the Learning Partnership Division of the Educational Technology Division at the central headquarter of MOE which has central control of schools had created favorable conditions that helped her to spread and diffuse the KB innovation. In our interview, we were cognizant that because of her background and experience, she understood the system and leveraged her power to make decisions on what were the necessary commitments, get the Principals' support, and create conditions necessary for the innovation to work such as ensuring that teachers have time to do what they needed to do.

It becomes clear to us while reading the narratives of our case study the political nature of supporting innovation diffusion would require the *school leadership support* (such as in the case of adapting the assessment structure component from formative to transformative assessment with the inclusion of 30% for KF that helps legitimize the innovation). Leadership was instrumental in ensuring support to make such changes in practice were provided. As noted from our case study, the school leader's support for the innovation was also influenced by school-level goals of moving toward transformative assessment. Our case study has also suggested that it is easier to build

support for innovation diffusion the more that the benefits of an innovation map onto the interests, values, and power of the actors in the adopting schools. For instance, we saw that the decision of the school leaders to adopt the pedagogical innovation somehow relates to the school's interest and values in moving toward transformative assessment) and it could be inferred from the evidence that their previous learning journey experience that exposed the Principals to the innovative KB pedagogy had provided an impetus for them to consider the innovation. Hence, profound changes are needed in the current culture and practice of education; also, a great deal of support is necessary for innovation adopters' attempts to surpass challenges that may arise from the innovation adoption learning journey.

In closing, we are cognizant that there can be a variety of reasons for schools to decide to participate in the innovation project and for the participating schools' members to participate in the learning network. Practical implications associated with this notion are the need to encompass individual learning, group learning, organizational learning, and system contexts within which learning networks operate to support the effective development and use of the learning network for diffusing innovation. We also note that the best plan in the world will falter if the people implementing it do not have a passion for the plan. We hope that we have succeeded in our aim of highlighting the possibility of learning networks being 'productive'—a term deployed here knowingly—and giving rise, potentially, to more meaningful professional collaboration and dialogue between local educators, policymakers, and communities. We hope that this paper will contribute to a richer debate on learning networks in supporting innovation diffusion that moves away from thinking about learning networks in supporting innovation diffusion generically and toward greater specificity and conceptual clarity.

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