School Stakeholders navigating ICT Policy Reforms from a Singapore Context[1]

Vicente Reyes & Catherine Chua
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Abstract

This qualitative research inquiry attempts to explore how school stakeholders cope with incessant and seemingly endless transformations in schools. The central phenomenon to be studied focuses on how school stakeholders "make sense" of educational. In order to do this, an exploratory case study of two target schools taking part in policy reform initiatives directed at ubiquitous use of Information Communication and Technology (ICT) in a Singapore context would be the locus of this inquiry. Using Focus Group Discussions (FGDs), interviews, and observations this inquiry investigates and builds emerging explanations to sense-making experiences of stakeholders. Policy learning narratives of actors involved in the ICT-education reforms would be analysed using the lens of Actor-Network Theory (ANT). Findings from this exploratory inquiry provide insights as to policy learning experiences of school stakeholders in periods of uncertainty.

Introduction

This qualitative research inquiry explores how school stakeholders situated within the island city-state of Singapore cope with incessant and seemingly endless transformations occurring in schools.[2] This article asks one general question: How do Singapore school stakeholders make sense of the introduction of pervasive Information Communication Technology (ICT) usage in schools? The central phenomenon to be studied focuses on how school stakeholders "make sense" of educational reform. Using findings from Focus Group Discussions (FGDs), interviews and observations, this inquiry investigates and builds emerging explanations as to how school stakeholders' "navigate through and make sense" (Reyes, 2010: 397) of the introduction of ICT reforms.

This exploratory inquiry is divided into four sections. Aside from providing the theoretical lens, the first part includes a description of the Singapore context emphasising on how ICT has become a pervasive policy initiative. The second elaborates on the methodological approach. An explanation of the scope and limitations is also included in this section. The third explores sense-making by focusing on how school stakeholders perceive changes and continuities in their experiences. The final section provides a critical reflection on school stakeholders experiences whilst implementing ICT-intensive reforms.

School stakeholders' sense-making experiences

This article assumes that schools, as loosely-coupled systems, (Weick 1976) experience great complexity during reforms. Within a context that is driven by hyper-reforms, the introduction of ICT forces teachers to undergo "fundamental disjunctures" (Appadurai 1990), where skills and knowledge that they have acquired clash with new technologies. This inquiry recognizes that in a context where ICT becomes a fundamental piece of the reform agenda, it becomes an important non-human actor in the way that social relationships in schools emerge. This article contributes to ongoing debates surrounding the role that developed nations -- like Singapore -- play in deliberately connecting education systems with ICT (Selwyn and Brown 2000) focusing on emerging issues confronting education stakeholders. The interactions of human and non-human actors become networks where disjunctures occur and where various actors engaged in the reform undergo sense-making experiences. Sense-making, which is an identity creation as well as a contested, reflected and shared activity among various members of the school system, would be explored under the analytical lens of Actor Network Theory (ANT). Using specific aspects of ANT captures the sense-making experiences of school stakeholders by mapping their narratives as they were "weaving through things they have added to social skills" in order to "render more durable the constantly shifting interactions" that these actors experience in the midst of reform (Latour 2005, 68). ANT posits that causal relationships may not be the most appropriate manner of making inferences in interrogating social relationships. In other words, this inquiry about school change will not pretend to establish how ICT policy *causes* school leaders to behave in a particular manner which then *causes* the school to change in a specific way. Instead, viewing actors as *mediators* who "transform, translate, distort and modify the meaning or the elements they are supposed to carry" which in this particular case would be ICT reform policies, as opposed to *intermediaries* who transports "without transformation" (Latour 2005, 39) would be more meaningful. This article explores the *Actor-Networks* or what Latour describes as the various "traces of interactions" that have occurred consisting of "human-to-human connections" or "object-object connections" and links that have been established as a "zigzag from one to the other" in the midst of carrying out ICT reforms (Latour 2005, 75).

Singapore Context

Singapore is a South East Asian country located at the southern tip of Malaysia. The total land area is about 716 square kilometers, and the current population is about 5.3 million comprising of predominantly Chinese, Malays and Indians, as well as other races (Singapore Statistics, 2013). Unlike some of its neighbouring countries such as Indonesia and Malaysia, Singapore has no natural resources, and hence the government has prescribed education as the way to develop human resources. Consequently, education in Singapore is perceived to be important to the State's economic growth, as it is regarded as a vital component of nation-building. Unlike many of its Western counterparts, the Singaporean government has been adopting a soft authoritarian approach in governing Singapore (Roy, 1994); the government maintains a centralised control over Singapore education system through the Ministry of Education (MOE). However, by the 1990s, advances in technology accelerated the speed of globalisation, in particular, the increasing levels of international trade and competition, and this had affected the education systems in many countries and particularly Singapore.

System-wide reform: ICT policy and implementation in Singapore schools

ICT has been identified as one of the "key contributors to Singapore's economic success" particularly since it has been strategically aligned and deployed "with the needs of the economy and society, as well as the coordinated efforts arising from the national ICT plans" (Koh & Lee, 2008a, p. 167). Singapore initiated two ambitious master plans (i.e. mp1 and mp2) and most recently jumpstarted a third master plan (i.e. mp3) designed to harness the benefits of ICT in harmony with the development objectives of the nation (Koh & Lee, 2008b). In Singapore, the ICT experience as driven centrally from MOE has been the continued provision of "top-down support for ground up initiatives from schools for routine ICT integration into the curriculum, but continues to adopt some form of centralized, top-down approach for novel integration of ICT into the curriculum that pushes the frontiers of teaching and learning" (Koh, Lee, and Foo 2009, 618).

A specific policy innovation that has taken place within the general policy framework of the ICT master plans is the re-branding of the so-called incubator schools into Leading Experimentation And Development or LEAD ICT@Schools Scheme in 2006. This programme supported schools "that conduct research on emerging ICT-based pedagogies" and those "that want to experiment with existing ICT-based pedagogies at a significant scale" (Koh and Lee 2008, 72). Sixty-seven schools were selected to spearhead this innovation. After the launch of LEAD ICT@Schools, another ICT policy innovation followed in 2007: FutureSchools in Singapore or the FS@SG. These schools were targeted to "push the frontiers of teaching and learning practices at a school-wide level, fully harnessing ICT to bring about engaged learning" (Koh and Lee 2008, 72). Five schools chosen to be part of FS@SG performed the vanguard role of being "test beds" in the "seamless journey" of ICT in everyday school life" (Wong 2007, 1). Schools that have chosen to participate in these policy innovations received "additional funds for ICT implementation" (Koh and Lee 2008, 285).

Research on teachers' perceptions of ICT in schools has yielded interesting perspectives. In a five year study encompassing 8,000 participants and twelve schools[2], empirical evidence reveals what teachers perceive as three obstacles in using ICT for learning and teaching: "(1) ICT-based lessons are time-intensive; (2) time allocated in the timetable for the lessons is insufficient; and (3) the use of ICT is not required in national examinations" (Tan et al. 2010, 3). Completed and on-going empirical studies that have been made in an attempt to measure the effectiveness of ICT in Singapore schools have identified the need to do more focused

research into ICT-enabled pedagogy (Looi and Hung 2004) and some have also attempted to evaluate effectiveness from a policy and pedagogy perspective (Lim 2007). However, this exploratory inquiry focuses on school stakeholders' responses to reforms by specifically using ICT policy innovations as the focal point.

Methodology

This exploratory inquiry is primarily qualitative focusing on building explanation from the ground that have been found to be of practical and theoretical usefulness in educational research (Wilson, 1977). This inquiry conducted case studies of two schools that are heavily-involved in on-going ICT integration. These schools were purposefully selected as a theoretical sample -- they represent two examples of leading-edge efforts of schools that explore the interaction of ICT in teaching and learning. A total of four (4) FGDs and ten (10) interviews with selected school stakeholders were completed from 2012 till 2013. Targeted inquiries for school stakeholders were designed to explore dynamics of policy learning as seen from "perspectives of key actors" involved in the "implementation of specific policies" in the midst of periods of reform (Reyes, 2013: 15). These narratives were recorded in audio tapes and transcribed into working transcripts.[3] Extensive review of documentation of reform experiences prepared by MOE, the target schools themselves and external studies made by researchers were used to triangulate the findings.

Table 1. Summary Statistics of selected schools applying ICT policy innovations

School[4]	Student Population	Staff Strength (not including management)	ICT Innovations
Acme Primary	1200	60	One-to-One Computer Access to Allow for Integration of Various Primary School Courses
Zenith Secondary	1500	70	One-to-One Computer Access to Encourage Greater Engagement Among Secondary School Students

Data Analysis

This inquiry assumes that schools or broadly speaking educational organizations are loosely-coupled systems (Weick 1976). Adding to the internal complexity of school organisation are fluctuating external factors that impinge on the operations and functions of schools. The forces of globalization and Knowledge-Based-Economies (KBEs), with its mantra of flexibility and adaptability are just some of the overpowering external factors that have altered how schools and educational systems function. The questions used for this inquiry attempted to explore relationships that transpire between policy diffusion – in this case, ICT innovations -- from school stakeholders' perspectives. Table 2 presents the areas of inquiry explored during the interviews and FGDs:

Table 2. Areas of Inquiry

Areas of Inquiry	Specific Areas of Inquiry
ICT Familiarity	How familiar are school stakeholders with new and emerging technologies?
Perceptions of an ICT-integrated Classroom	What does an ICT-integrated classroom look like?
Impact of ICT in Teaching and Learning	How has ICT made an impact on the teaching and learning practices in classrooms and in schools?
Challenges of ICT in Classrooms	What are the biggest challenges of ICT in classrooms?

After conducting content analysis of interviews and FGD transcripts from the two selected schools, a preliminary analytical map was formulated. Attempts at qualitative research produce insightful thick descriptions (Easterby-Smith 1995) of issues and concerns that occur in schools. The content analyses produced numerous concepts: These are notions or ideas that consistently surfaced out of the narratives of the different respondents across individual characteristics of the different types of school stakeholders and also across group characteristics (the different schools).

School Stakeholders (Teachers)

From the numerous concepts that surfaced during the extensive content analysis those that occurred most frequently were streamlined into fifteen. These were carefully re-read and then arranged and synthesised to fall within three linked categories. Propositions were then raised about these categories: How are they related to each other? What linkages connect these categories with one another? What linkages can be inferentially derived from them? Through an iterated process of abduction (Richardson & Kramer, 2006), these six linked categories were synthesised and led to three components of sense-making experiences. This process of abstraction becomes the basis for building explanation through "specifying conceptual relations" derived from the entire qualitative data analytical experience (Wasserman et al., 2009, p. 378). Table 3 captures what the inquiry has generated from exploratory notions of school teachers' experiences of sense-making of policy reform.

Table 3: Insights from School Teachers

Sense-Making Experiences	Categories	Concepts (Derived from content analyses)
Sense-Making Experiences	*Teachers' Emerging Identities*	• Teachers as Facilitators • Teachers Roles from Content Provider to Manager of Content • Reflective Teacher • *Prevalence of Frontal Teaching even within ICT-enhanced classrooms* • *Persistence of Traditional Use of Classroom environments*
	Teachers' Sense of Agency	• Collaboration among Teachers as a Form of Professional Development • Teacher's Ability to Cater to Differentiated Learning • Teacher's Ability to use ICT to extend students' classroom • *Difficulty in monitoring what students actually learn* • *Increasing issues of cyberwellness*
	Teachers' Sense of Ownership	• Teacher's Enthusiasm to form Professional Learning Communities • Teacher's actively learn by modelling ICT usage • Teacher's champion ICT innovation and initiatives • *Connectivity problems that hamper ICT usage* • *Preparation for High-Stakes Tests override authentic learning*

 Note. (cf. Reyes, 2013)

School Stakeholders (School Leaders)

From the numerous concepts that surfaced during the extensive content analysis those that occurred most frequently were streamlined into twenty. After carefully re-reading and re-arraning they were synthesised to fall within six linked categories. Using the lens of ANT, propositions were raised: How are they related? What linkages connect these categories? Through an iterated process of abduction, these six closely-linked categories were synthesised and led to three components of sense-making experiences. The concept map in Table 4 is an attempt to "trace an actor-network" of mediators and intermediaries (Latour 2005, 133).

Table 4. Insights from School Leaders

Actor-Network Relations	Categories	Concepts (Derived from content analyses)
(Shifting Identities) *Leadership Identities in a Technology world*	Transactional leadership	• Appeasing parents' fears of ICT • Appease teachers unwilling to embrace ICT • Notice (and point out) prevailing practices of frontal teaching even within ICT-enhanced classrooms • Notice (and point out) persistence of traditional use of classroom environments • Leading school towards high-stakes results
	Leadership in an artificial world	• Leaders in an Artificial Environment (School) • Balancing preparation for High-Stakes Tests overriding authentic ICT learning
(Emerging Roles) *Emerging Roles that leaders embrace in the midst of ICT reform*	Monitoring and evaluative leadership	• Difficulty in monitoring what students actually learn • Containing issues of cyberwellness amongst students
	Path-breaking leadership	• Technology as a Cloud and Pushing the Frontiers of Teaching and Learning • Leader of Professional Learning Communities • Drivers of Change (ICT-driven) • Technology-role model (Using ICT in one's work) • Supporting school stakeholders
(Ambivalent Capacities) *Perceived capacities (and recognized inabilities) needed to push for ICT reforms*	Leadership in uncertainty	• Unpredictable future of technology and decisiveness of leaders • Moving forward despite uncertainty of policy innovation • Constant need to take calculated risks • Ability to become a reflective leader
	Redundant leadership	• Technology and the obsolete school leader • Dependence on ICT and unpredictable breakdowns render the leader helpless

Discussion: Sense-making in the midst of policy change

Given the national push for LEAD@ICT schools to perform their roles as "external wings" in leveraging on ICT to push their schools to fly greater heights what were the experiences of these school leaders? What factors do they deem most important, most problematic and most complex as they attempted to implement ICT policy innovations? The analyses of the interviews, FGDs and observations produced illustrative accounts of how school stakeholders make sense of their experiences.

School Stakeholders (Teachers)

Insights reveal that the selected school teachers' sense-making experiences revolved around three key categories: identity, sense of agency and sense of ownership.

Teachers' Emerging Identities

Selected respondents have revealed that in the midst of ICT reform the role of teachers undergo transformations. On the one hand, respondents from both Acme Primary and Zenith Secondary identify the persistence of some traditional teachers who cling on to frontal type of teaching in the midst of ICT-enhanced classrooms (Ms. M from Acme Primary, May 2013 and Mr. L from Zenith Secondary, June 2012). On the other hand, a greater number of teachers in these two schools – as indicated by the respondents – have transformed their roles form purveyor of knowledge towards a more facilitative role:

> …the whole ICT initiative itself is actually moving from teacher-centered and approaching towards more student-centered pedagogy, so actually in a way, the whole process itself is not an easy process and, involves a lot of patience and then also we have to facilitate the process itself how the evolution actually take place, over here. I see how teachers' roles evolved from initially like single, source of authoritative knowledge with content, to now…become the main facilitator for the students' learning (Mr. L. of Zenith Secondary, June 2012).

Teachers' Sense of Agency

Respondents indicated that teachers' sense of agency have undergone changes under the influence of ICT reforms in schools. Some are of the opinion that the fast-paced and seemingly never ending changes brought about by ICT disempower some teachers. Specifically, with the advent of one-to-one computing for both Acme Primary and Zenith Secondary, teachers have expressed difficulties in monitoring what goes on in the classroom and what students actually learn (Mrs. F., from Acme Primary, May 2012 and Mr. C from Zenith Secondary, July 2013). Most respondents however from both Acme Primary and Zenith Secondary posit that quite a number of their colleagues have become empowered by the possibilities that ICT bring along with it. A specific area which manifests empowered teachers can be gleaned from the surge of collaborative learning among teachers in both schools:

> What I think is good about technology would be, collaboration as a form of professional development for us teachers. If we think about the future of technology as living in the cloud, then I think, that has great opportunity far beyond the classroom type learning, it's not just me and my teacher colleagues here, but we have other collaborators, all over the place to create content. So I think that, that is one potential for collaborative learning (Mrs. T of Zenith Secondary., June 2012).

Teachers' Sense of Ownership

The FGDs and interviews of selected participants from Acme Primary and Zenith Secondary have revealed how ICT reform impacts on teachers' sense of ownership. Some school teachers express that the introduction of ICT have somehow increased their perceived levels of isolation from the demands of learning. Whereas, most of the ICT initiatives promote innovation and collaboration among students, some teachers have indicated how the persistence of a high-stakes testing culture diminishes the efficacy of ICT (Mrs. N of Acme Primary., May, 2013). However, there are teachers who have reported that ICT serves as a powerful platform for communities of learning to emerge:

> How then should I use this different platform, in terms of designing our teaching and our pedagogies, … in this way, another teacher uses it that way, and the sharing of, applications and resources, really is also more of a resource bank, sometimes in terms of the podcast and the iTunes use and things that they use (Mrs. K. from Zenith Secondary, June 2012).

These experiences reported by selected school teachers are rife with contradictions. Perhaps one way for school teachers to "make sense" of the seeming paradoxes of school reform would be to strike a balance between "deep learning" as these are mandated by wide-scale change enacted in the discourse of ICT reforms in schools and "adaptation" emanating from the desire to preserve some school teachers believe is what works and to keep to the "tried and tested" approaches.

School Stakeholders (School Leaders)

Content analysis surfaced several issues and challenges experienced by school leaders. From the process of abduction undertaken, three emerging actor-networks have been identified: Shifting Identities, Emerging Roles and Ambivalent Capacities. This section investigates actor-networks embedded in the midst of ICT policy reform and in so doing discover highly-contextualized narratives of sense-making of school leaders which this inquiry argues are a "viable instrument for cultural negotiation" (Bruner 1991, 17). Insights reveal that the selected school leaders' sense-making narratives revolved around three key categories: identity, roles and capacities.

School as an Artificial Environment and the School Leader's Identity

Respondents from Zenith Secondary acknowledged a shift in the identities that they had to perform as the duly-appointed leaders of the school. The introduction of ICT innovations had an impact not only on the roles that teachers played but also on the way that school leaders guided these teachers. Using the ANT perspective, non-human ICT intervention – represented in this inquiry by learning devices (i.e. Apple IPad) became *mediators* making an impact on the social relations that exist between school leaders and teachers.

On the one hand, school leaders had to embrace the purported changes that ICT innovation brought to the school one of which was to move away from "frontal teaching" typified by teacher talk and to move instead towards the use of ICT that encouraged student-centred learning. As transactional school leaders, they were duty bound to point out to their teachers instances where "frontal teaching" still persisted. On the other hand, school leaders recognized that they had to balance the demands of changing pedagogy with ICT innovations with the level of familiarity with new technology and the very real frustrations that may arise on the part of the teachers embarking on these reforms.

> Because you see when you are doing frontal teaching, it's really the teachers reinforcing their self-value and their self-worth, as a teacher. However, with the introduction of ICT innovations, these teachers keep facing a lot of like, failure, like, you know, going to class, adopting an innovation and then the students were not listening to him or that the students were just doing whatever they want, whereas some other teachers don't have that problem. Thus, the teacher does feel a lot of frustration. (Personal Communication, Ms. L. of Zenith Secondary, June 2012).

Acme Primary and Zenith Secondary school leaders recognize the paradox of schooling in an age of ubiquitous ICT. This becomes starkly acute when innovations that seem to flourish in classroom environments that embrace open, student-centred approaches using ICT are forced to take a back seat when pupils (and schools) are faced with the challenge of satisfying high-stakes tests. One paradox that challenges the identities of leaders is whether to champion ICT reforms that promote openness or to resort to traditional approaches of preparing students in the face of high-stakes tests:

> There is a great fear of loss because all this drilling actually has produced excellent results and we obtained so many awards. There is a fear among us of letting go. The challenge is to see whether abandoning "drill and kill" and shifting to learner-centred approaches through ICT would necessarily mean that the results go down. (Personal Communication, Mdm L. of Acme Primary, May 2013)

The move to embrace greater ICT use in schools has also engendered another perplexing implication to the shifting leadership identities of the respondents. As leaders of both schools struggled to search for ICT approaches that were the best, most effective and safest (i.e. cyberwellness), they constantly encountered the realization of the inadequacy of schools to address all the most relevant issues that could face the learning child. Respondents recognize that with the deliberate move towards more intensive ICT-integrated education, the school's trait as an artificial environment becomes much more pronounced. Consequently, in an emerging landscape where ICT and the social learning environment of pupils converge, the challenge is to situate within a shifting context, the appropriate identity of the school leader.

But we have to acknowledge that our kids and the life outside of school interacting with technology in a certain way and their life within school and technology, there is no comparison. The school is such an artificial environment. If we talk about the whole child, a large part of their experiences with technology is parked outside the school. And this is technology is something that the school, our teachers are not even ready to deal with. (Personal Communication, Ms. E. of Zenith Secondary, June 2012).

Technology as a Cloud and the Emerging Roles of School Leaders

Respondents have revealed that in the midst of ICT reforms the roles of leaders have undergone transformations. On the one hand, respondents from both Acme Primary and Zenith Secondary identify the persistence of some teachers who cling on to frontal type of teaching in the midst of ICT-enhanced classrooms (Personal Communication, Ms. M from Acme Primary, May 2013 and Mr. L from Zenith Secondary, June 2012). On the other hand, leaders from both schools have indicated how their roles have changed: From leading a team of teachers who have been deliverers of knowledge towards leading a team of teacher facilitators:

So instead of being the deliverer of knowledge, our teachers today need to be the facilitator, to, teach student how to, gather information and process it so that it becomes knowledge. This is different from the teachers doing the information search and then processing it into data for the students.(Personal Communication, Ms. S. of Zenith Secondary, June 2012).

One of the unmistakeable implications that an ICT-intensive curriculum has created in both schools is the increased exposure that all school stakeholders have towards ambiguity. To be more specific, for both Acme Primary and Zenith Secondary, teaching as well technology staff have been consistently sharing the latest applications (apps) that could be used for the various classes (Personal Communication, Mr. Z from Acme Primary, May 2013 and Mr. A from Zenith Secondary, June 2012). Using the lens of ANT, it can be argued that the constant stream of classroom-based applications that are developed act as *mediators* creating various types of impact on social relationships between school stakeholders. Leaders from both schools recognize this and have described technology as a powerful and borderless platform for collaboration. In such a scenario that is filled with ambiguity, school leaders from the two case studies have adopted the role of path-breaking leadership:

> What I think is good about technology would be, collaboration. If we think about the future of technology as living in the cloud, I think that it has great opportunity for the school to develop beyond the classroom. It's not just me and my colleagues and friends here in school, but friends and colleagues, from all over the place to create content. (Personal Communication, Mr. L. of Zenith Secondary, June 2012)

Unpredictable future of technology and its implications on School Leaders' Capacities

Respondents indicated that leaders' perceptions of their leadership capacities have undergone changes under the influence of ICT reforms. Some are of the opinion that the fast-paced and seemingly never ending changes brought about by ICT disempower some leaders. Specifically, with the advent of one-to-one computing for both Acme Primary and Zenith Secondary, leaders have expressed difficulties in monitoring what goes on in the classroom and what students actually learn (Personal Communication, Mrs. F., from Acme Primary, May 2012 and Mr. C from Zenith Secondary, July 2013). Some leaders have even expressed bleak doubts on whether or not they would still remain relevant or obsolete in the face of all these rapid ICT developments that affect schools:

> I have to really rethink then when the school really has moved the technology, then, the school leaders, what is our role? If all these teachers can go to class and engage the students so well in technology and they're really at that high level of engagement if that day really comes, will I be obsolete or not? (Personal Communication, Mdm. M. of Zenith Secondary, June 2012)

However, most of the respondents from the FGDs and interviews from both Acme Primary and Zenith Secondary posit that quite a number of them and their colleagues have become empowered by the possibilities that ICT bring along with it. A specific area which manifests empowered leaders can be gleaned from the surge of collaborative learning among leaders in both schools:

So I mean the professional learning in terms of sharing among colleagues, I think to be a little bit more innovative, not that we're not innovative. But we're trying to use a different platform now, to, you know, to guide the students in their learning. So it really, you know, causes the teachers to sit in our learning community and think, really, how then should I use

this different platform, in terms of designing our teaching and our pedagogies (Personal Communication, Mrs. K. from Zenith Secondary, June 2012)

> Alongside what has been described as empowerment through their active leading and participation in learning communities, respondents have also mentioned the need to develop leadership capacities that confront uncertainties. One of the school leaders of Zenith Secondary explicitly stated how vital it is for leaders to move even if most of the time "you can't tell what lies ahead, but if you do not jump on the bandwagon you find that you'll be left behind, and eventually you really cannot resist that, advancement, and by that time you would already be left behind" (Personal Communication, Mrs. Q. from Zenith Secondary, June 2012).

How do school leaders navigate educational reform?

This inquiry attempted to map out the sense-making experiences of leaders. In order to sketch this map, narratives of school leaders were used. Combining this with the analytical lens of ANT, this inquiry captures traces of the social and relational interactions of school stakeholders as well as non-human actors (i.e. ICT tools) represented by actor-networks. Narratives are powerful sources of tracing these actor-networks:

> Narrative is a conventional form, transmitted culturally and constrained by each individual's level of mastery and by his conglomerate of prosthetic devices, colleagues, and mentors. Unlike the constructions generated by logical and scientific procedures that can be weeded out by falsification, narrative constructions can only achieve "verisimilitude." Narratives, then, are a version of reality whose acceptability is governed by convention and "narrative necessity" rather than by empirical verification and logical requiredness, although ironically we have no compunction about calling stories true or false (Bruner 1991, 4)

School leaders provided insights on their sense-making experiences represented as actor-network relations: (1) Shifting identities of leaders in an increasingly technology-driven setting; (2) Emerging roles that leaders embrace in the midst of ICT reforms and (3) Ambivalent capacities (and recognized inabilities) needed to push for ICT reforms. These experiences are fraught with tensions and contradictions. Nonetheless, one common thread that permeates the experiences of the two sets of school leaders is the need to move forward in spite of the uncertainties:

> At the end of it really it's a judgment call. Technology is futuristic in a sense and we really don't know what trajectory it would go. I mean a lot of the devices we have now did not exist a few years ago. A lot of the decisions we make is a judgment call. So, I think, for us the really important question is, how do we make decisions, how do you make judgment calls when so many things are uncertain? (Personal Communication, Ms. E. of Zenith Secondary, June 2012).

Policy learning by verisimilitude

By mapping sense-making of school leaders through their narratives, this inquiry provides explanations to policy learning processes. Mechanisms of policy learning have conventionally been described through three patterns. Firstly, it is seen as a product of the contagion effect (i.e. Actor A learns a policy innovation by hearing, seeing or studying what Actor B has successfully undertaken) (See for example Ramirez, Soysal, and Shanahan 1997). Secondly, policy learning is seen as a result of an external principal agent dictating how policy should be transformed or implemented (i.e. Actor Z compels Actor A to adopt

certain policies) (See for example Finnemore 1993). Finally, it can also be understood as an outcome of actors adopting universally accepted norms to further their own narrow interests (i.e. Actor C adopts certain policies and modifies them in order to suit Actor C's agenda) (See for example Cortell and Davis 1996).

How do school leaders navigate ICT educational reform – a futuristic path -- fraught with ambiguities? Based on the findings of this exploratory inquiry, it is argued that school leaders involved in leading-edge ICT-intensive reforms undergo policy learning by verisimilitude. Unlike, conventional explanations of policy learning which operate within relatively predictable parameters, the school leaders in this case study, manoeuvred their respective organizations without the benefit of foreseeable boundaries. The unpredictable nature of ICT developments hindered them from being able to carefully plot their next moves. Nonetheless, based on the hazy and intermittent insights gained through experimentation and "learning by doing" through various stages of ICT reform, the leaders were guided by verisimilitude or what Bruner described as "a version of reality whose acceptability is governed by convention and 'narrative necessity' rather than by empirical verification and logical requiredness" (Bruner 1991, 4).

A serious challenge that faces Singapore and one of its key institutions –MOE and its schools -- in preparing for an uncertain future is the extent of learning and change that it is willing to undertake. One may argue that the organizational learning required is not merely adaptation "muddling through" (Haas 1991, 75) or "incrementalism where decisions are carried out as a mechanical continuation of previous decisions" (Van Meter and Van Horn 1975, 465) but a deep change willing to re-evaluate core beliefs (Sabatier 1988). Experiences of the schools in this inquiry provide an intriguing response to the question of attaining deep learning in schools as a precursor of system wide change. Hopefully, future research about ICT reforms could interrogate and critique findings from this exploratory study. In this way, policy learning – in an increasingly unpredictable 21st century setting – thrives and continues.

Notes:

1. This original research article is based on a manuscript which was published in V. Reyes (2013), "Sense-Making of Teachers in the midst of Information Communication Technology (ICT) Reforms in Schools: An Exploratory Study in a Singapore Context", *TMC Academic Journal*, 8(1): 14-27.

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3. In order to honour the confidence of those persons who were interviewed in the course of this research, their names, and complete job designations are omitted here.

4. In order to preserve the anonymity of the schools their actual names are not provided.

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