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Sustaining Innovations in Singapore Schools: Implications for Research Work

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Abstract. This paper explores the broad issues of why the meaningful use of ICT to engage in deep learning has not been widespread in K-12 schools. We argue a critical reason is the lack of sustainability in the implementation of ICT-enabled pedagogies in schools, arising from a failure to understand the conditions for systemic innovations. We describe the key issues related to sustainability from literature, and contextualized some of these issues using 2 examples of innovations that have been implemented in the Singapore schools. Implications are then drawn with respect to how research work should be conducted with a view of sustainability, how to build up capacity of researchers and teacher implementers to push innovations, and new methods of analysis for studying sustainability.

Keywords: Innovations; Sustainability; Scalability; Professional Development; Research Work

Introduction

Since the advent of information-communications technology (ICT) decades ago, research on how ICT can be used in education has been incessantly conducted. Despite “decades of funded study that have resulted in many exciting programs and advances have not resulted in pervasive, accepted, sustainable, large-scale improvements in actual classroom practice, in a critical mass of effective models for educational improvement, or in supportive interplay among researchers, schools, families, employers, and communities” (Sabelli and Dede, 2001).

Appropriately, many are investigating as to why the adoption and appropriation of good ICT-enabled pedagogies have proven to be so difficult. How is it that businesses such as McDonalds is able to counter cultural and social differences and franchise its product, process and even its culture successfully across the globe; while the adoption of good teaching practices in education seems sluggish in comparison. Although the reasons could be multi-factorial and complex in nature, we believe that the key lies in innovations not being sustained in schools for a period long enough to reap the desired teaching and learning results. Schools either jump from one innovation to another, or that implementations failed to consider the complexity of the educational system, societal needs, policies, curriculum, pedagogy, practices, epistemic beliefs, skills, and others.

At this stage, while we recognize that technology is only one tenet in the complex system of education, it is however the only one tenet that affords the catalytic effect to trigger change in the other components of the system. Thus it is our belief that the effective use of innovations for engaged forms of learning cannot be researched, planned and implemented in isolation but rather, concomitantly with the other components in the system in order for educational reform to be successful.

We begin by understanding from the research literature issues about sustainability and scalability. We then move on to describe two local examples of innovations that have

been implemented, *Knowledge Forum* and *Knowledge Community*. Finally, implications are drawn to how research work should be conducted and how to build up capacity of researchers and teacher implementers with respect to their roles as change agents.

1. Issues and Frameworks about Sustainability

It is our belief that meaning-making for learners should be facilitated with learning technologies or innovations. By innovations, we mean learning technologies that have the catalytic ability to trigger change such that “one innovation will reverberate through other aspects of pedagogic practice and will touch upon the wider realm of a teacher’s daily work so that it too will be changed” (Breen, 1994 p. 104).

How then can the process of change be initiated in schools where innovation is both a catalyst and a facilitator for deep learning? Who should the change-agents be and what should their dispositions, epistemologies, beliefs be? Obviously, change is not easily implemented and sustained as a typical response from a rational human being to change is resistance. One of the issues faced lies in the tension between the desire to scale effective practice, on the one hand, and issues of adaptation and customisation on the other (Honey & McMillan-Culp, 2000). In other words, how hard do we rock the boat? To bring about change thus requires strong leadership and shrewd management. Such daunting task may not seem palatable at the onset to many school and policy leaders.

According to Cohen and Ball (1999), this challenge can be analysed in terms of *specifications* versus *development*. Specification is the degree of details an innovation is described for school take-up such as specified curriculum and learning goals, while development refers to the provision of resources required to enact innovations such as curriculum materials, professional development and others. Specification without development requires teachers to figure out how to enact the innovation in their local setting, which can be a barrier to all but the master teachers. Development without specification provides resources for improvement, but not a clear picture as to what goals are to be attained. Therefore the skill of the adapter is critical is assessing what and how much to adapt an innovation depending on the contextual conditions of the educational environment.

In fact, according to Dede and Wirth, intervention strategies are different for scaling up a single innovation into a school as opposed to a full-scale systemic reform of that educational organization. For the former, designers of innovations, together with their community of practice should design for attenuation as adapters from schools who are not involved in the development of the innovation will enact selected conditions favorable only in their context. In other words, designing for attrition requires identifying conditions for success likely to be attenuated in many contexts, then evolving the design to retain substantial effectiveness under those circumstances (p. 11).

According Century & Levy (2002), changes must be contained within which the core intent and philosophy of the origin reform is still reflected. They have thus defined sustainability to be:

“The ability of a program to maintain its core beliefs and values and use them to guide program adaptations to changes and pressures over time”. (p. 4)

To do so, consideration has to be given to the influential factors (see Figure 1) at any levels of the school system in the progression of each innovation, from establishment, maturation to evolution. At each of these three phases, an innovation has particular goals and particular strategies for achieving those goals. To be sustained, goals must be realized at different levels of the school system, which require multiple strategies employed simultaneously. Thus at any point in the evolution of an innovation, attention must be given to the influential factors at any of the levels in the system such that the stakeholders’ orientation is accurate.

Factors that are related to the concrete element of a program/innovation	Factors that relate to influences on a program/innovation and outcomes that result from the program/innovation
Accountability	Implementation & adaptation
Instructional materials	Philosophy
Leadership	Critical mass
Money	Perception
Partnerships	Quality
Professional Development	History – origins & longevity

Figure 1. Factors summarized from Century & Levy (2002). Sustaining change: A study of nine school districts with enduring programs

The Letus community offers another perspective into the issue of sustainability. If an innovation is not usable, adoption is unlikely, not to mention sustainability or scaling up of technologies. Blumenfeld & team (Blumenfeld et. al. 2000; Fishman 2002; Fishman et al. in press) put forth that the three dimensions within school systems: school culture, capability of practitioners and policy/management are the key aspects to look into, thus the conceptualization of the Usability Framework. Together, the three dimensions when arranged in the form of three axes originating from a common point, they form the three-dimensional space known as the ‘usability cube’. An innovation can hence be placed within the space for gap analysis. Such analysis helps researchers attempting to do such work in understanding the opportunities and processes by which one needs to look into for a sustained success in schools.

Yet another strategy proposed by Hargreaves and Fink (2000) is to use model successes to reculture as well as to restructure schools—adopt the philosophy and intentions into the existing culture of adventurous volunteer schools before enacting the structures for change. The goal of systemic innovations must first be established in the larger cultural context such that it becomes an “entire continent of change” (Hargreaves, Earl & Ryan 1996). In fact, they argued that educators should go beyond the policy makers by making their practice and improvements visible to the public such that a broad social movement for large-scale, deep and sustainable transformation can be created (Hargreaves, in press). Concomitant to this notion, Cuban, in an interview with John O’Neil (2000), highlight that the innovations that have the best chance of sticking are those that have constituencies grow around them. An example he cited is that of special education. When reform efforts reflect some deep-rooted socio concern such as preparing autistic children to lead fulfilling lives, it will be widely accepted over a sustained period of time.

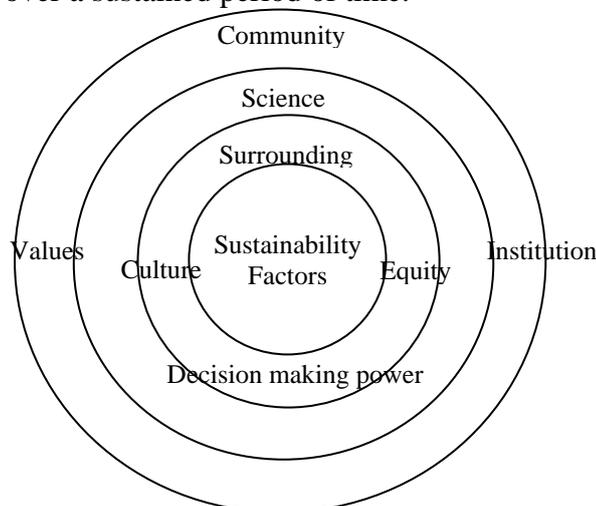


Figure 2. Abstracted from Century & Levy (2002, p.18)

Figure 2 is an attempt by Century and team to map out the complexity of sustainability and scalability in a way that appropriately represents the layered nature and complexity of their interactions. In the center sits the innovation and its influential factors. These factors are embedded in the larger surrounding conditions such as the school culture, decision making power and equity issues. The next ring represents the content area and other correlated issues such as pedagogy, content knowledge, status of science learning, beliefs of teachers etc. Finally, in the broadest ring, there is the community and its corresponding socio-cultural issues exerting pressure on the innovations and the stakeholders' decisions.

2. Innovations in Singapore Schools: 2 Case Studies

2.1 Knowledge Forum

Knowledge Forum (KF) is computer-supported collaborative learning (CSCL) environment for users to engage in collaborative work and discussion, providing a record of the development of ideas and a way of tracking users' contribution for assessment purposes. In addition to providing a computer-mediated communication (CMC) platform, it can model expert thinking and support the processes of scientific inquiry through the use of scaffolds (Scardamalia, 2004; Scardamalia & Bereiter, 1998). As an innovation that facilitates engaged forms of learning, the affordances of KF allow identities to be developed in its users, of which in this context is *learning to be* scientists.

As a research project, Knowledge Forum was implemented across 6 schools over a span of 30 months with an overarching objective of investigating the impact of CSCL technology on students engaging in scientific inquiry. Although the research project had a fairly specified direction in terms of its project goals, curriculum materials, teaching and learning philosophy, the innovation itself is fairly general, allowing for enactment across various school contexts. Viewed from a perspective of usability, the implementation of the innovation is seen to be geared towards success.

Understanding the fact that each school has their own 'personality' due to the different socio-cultural forces acting on it, the research team took on a customized approach in planning the intervention program. In each intervention, the research team studied the classroom needs and constraints in each school by working closely with the teachers involved, whilst having the research goals and directions at the back of their minds. Under such guided-customized approach, not only were many technical glitches solved, enactments were able to be carried out across several diverse schools contexts - primary and secondary schools with students of varying academic competencies (Ibrahim & Tan 2004; Tan Hung & So 2005; Tan, Yeo & Lim 2005; Teo, Chiam & Ng 2004). It was found that students, even at the primary level, were able to engage in knowledge building activities and experienced a change in perception of learning, from one of personal pursuit to that of a social collaborative stance (Ow, Low & Tan 2004). KF in this case, has proven its potential to be scalable across students of varying ages with diverse academic capabilities.

Another contributing factor to the successful implementation is the focus on the teachers' perceptions and philosophy to learning. The research team, upon realizing the import of epistemic beliefs and outlook in learning, changed its strategy from working with teacher advisors in each school to focusing on teachers' perceptions in constructivist, knowledge building type of pedagogy. Training on CSCL and knowledge building strategies were carried out extensively in the pre-service, in-service and Masters Courses, before partnerships for implementation were formed.

Although the research was found to have met its objectives, the sustainability of the innovation in these 6 schools is unknown. Considering the fact that the teacher implementers were trained in knowledge building concepts and strategies, they would supposedly dispose a changed epistemic belief and perception in their classroom practice. However, a translation from belief to practice has yet to be seen which we think is related to the following point.

Another reason, we conjecture for innovation not being sustained in schools could be that the project dealt little with the larger scheme of things such as changes in student assessment, schools' core curriculum, and providing on-going professional development for teachers using KF. The sustainability of the innovations is pretty much left to the availability of teachers to continue in their off-peak periods. Without an expansive holistic approach to implementation, it is currently dependent on the teachers' enthusiasm to continue using the innovation, not to mention expanding the use to other teachers or subjects within each school.

2.2 Knowledge Community

Knowledge Community (KC) (<http://www.globalkc.net>) is another CSCL tool used largely for project building and inter-school collaboration. Through the multimedia workspace, users collaborate with one another by participating in forum discussions. Thinking types such as *My question* or *My analysis* were designed to scaffold users' discussions by prompting them various ways to present their findings and to collaborate with others in the knowledge building process (Kwok & Tan 2004). Similar to KF, KC is designed with constructivist, situated cognition type of epistemology for engaging users in deep learning.

Since its introduction to Singapore in 2002, KC has seen over 50 schools using its platform for different subject domains, ranging from language learning (Ng, Tan & Kwok 2004) to scientific inquiry and project work (Tan in press; Quek, Tan & Chai 2003). Being web-based with a low cost start-up (there is no need to buy server space), coupled with an intuitive user-interface, KC bears good potential to be a catalyst for change in schools. Besides the occasional bandwidth slowdown due to extensive concurrent users, the innovation has good track record and enjoyed successful implementations in both primary and secondary schools. In fact, in one primary school, the success of KC in the learning of a mother-tongue language was extended from an intra-school implementation to an inter-school collaboration.

Although KC is widely known as a platform for project work, there is no fixed curriculum attached to the innovation and as such, teacher-implementers need to craft the project scope, objectives, technology usage, curriculum and others. While this is a good strategy to keep enthusiastic teachers highly involved in the project because of the extent of planning and effort required, thereby increasing the probability of the innovation to be sustained; it is also a deterrent for 'takeup' in some others.

The scalability of the innovation across schools was largely due to the dissemination of its easy use by word of mouth as the distributor of KC believes that true success will come when one convinced user influences another. Take for example, a particular Head of Department (IT) who is so convinced of this new pedagogy, besides sharing with her peers in her school, evangelizing the innovation; she has gone on further to disseminate this ICT-enabled pedagogy in educational conferences, addressing international audience.

However it has been observed that KC, despite having some success in being scaled across 50 schools, has not been sustained longitudinally in schools. Anecdotal feedback has it that there is no concerted body or community formed, looking into the support and professional development of its members in the use of KC. As such, there is little knowledge sharing, even amongst the early adopters who have introduced KC to others. Reasons could be that teachers perceive themselves being transformed from expert practitioners to novices in

what they lack experience and knowledge in; or that they see the change as not requiring them to teach substantially different from what they have always been doing (Seow 1999).

3. Implications for Research Work

Indeed for scalability and sustainability to occur, the effective implementation of innovations has to be planned and executed en masse with the other components in the system. The catalytic effect of such systemic innovations leads to 3 implications for research work. One is the approach in which ICT-research is being conducted and implemented in schools and the other, the capacity development of the researchers and/or practitioners in schools. The third issue concerns with the development of analytical methods for studying scalability.

First, in a systemic approach to implementation, researchers have to consider how large-scale it should be. Such considerations hinges on how receptive or adverse the components of the system are to change. In our opinion, such balancing act of implementing innovations in schools for sustainability is best conducted in tight collaboration with the Education Ministry and related policy-makers who has good knowledge of the 'ground'. By focusing on the contextual conditions of each school, such partnership ensures appropriate policy and decisions made, thereby garnering more support and commitment, either through increased involvement of the teacher-implementers or strong backing from the school leaders. This will also overcome issues of the disconnect between researchers and policy makers that has received considerable attention (Glover, undated; Swope, undated; Lomas 2000).

Second, it is imperative to factor in an effective professional development model such that capacity building takes place both among the researchers and the practitioners. To do so, researchers, on one hand, will need to heighten their awareness of the actual classroom conditions that practitioners face, the epistemic beliefs, pedagogic skills, the level of mastery of the teachers and so on. On the other hand, the right beliefs and dispositions will need to be inculcated in our pre-service and in-service teachers, school leaders, and graduate students, to have expansive mindsets towards students' learning. They would need to recognize that while they stick to what works in preparing their students to do well in examinations, they are also cognizant of the competencies and skills that students need to engender to live in a very different world, often characterized by complex, ambivalent and relativist. All in all, we hope to see a profusion effect, albeit slow in building, that will see a significant percentage of these enlightened practitioners pursuing their ideals and dreams about educational innovation, setting up good practices and inspiring others.

Finally, developing new methods of analysis for studying adaptability and scalability, assessing the scalability of an educational intervention or innovation becomes an important research frontier (Dede, 2004). It is suggested that a generalizable metric be developed that would measure the degree to which the educational effectiveness of the design is robust despite attenuation of its conditions for success. This index could provide prospective adopters a better idea of what the likely effectiveness of an innovation would be in their own context. Such research project can be arduous, requiring strong statistics number crunching and while ensuring that the data analyses are accurate and strongly grounded.

According to Bosco & Bakia (2004), making use of research work generally has had three consequences: 1) Provide better ways to make research accessible to practitioners and policy-makers such as a clearinghouse approach, 2) Develop structures that provide for communication between researchers and practitioners and policy-makers, and 3) Develop and implement a national research agenda. In Singapore, the first Masterplan for IT in

Education, initially implemented in 1997, had progressed into the second Masterplan (II) which spans 2003-2007, focusing on engaged learning through meaning use of ICT in practice. Thus, with a clear and focused national agenda, a systemic approach towards ICT-research partnering policy-makers, and an informed, purposeful focus on capacity development involving both practitioners and researchers to spread the meaningful use of technology; we see that together, they form an effective strategy in achieving the three consequences listed by Bosco and Bakia.

4. Conclusion

In this paper, we described some of the issues related to sustainability and generalizability of ICT innovations in schools and we attempted to contextualize these issues in two examples implemented in schools. We further explored the implications of these issues to how research work should be conducted. Together with an alignment of efforts with various stakeholders at different levels of educational organization, unceasing efforts to build and develop our capacity in the educational workforce and development of analysis through design research for studying sustainability, we hope to see workable processes and technologies supported by research findings in schools.

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