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Beyond Tried and True: The Challenge of Education for Innovation

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Abstract: Singapore and Ontario, Canada, have been rated as among the top education systems in the world in terms of both student achievement and progressive management. This symposium brings together leaders and researchers working in these systems to discuss efforts to go beyond present achievements and to address new imperatives to educate for innovation. Both systems are experimenting with Knowledge Building as an approach to meet this need. How they propose to do this while also upholding other educational goals forms one facet of the symposium. The other facet concerns how this work fits into the larger picture of education for innovation as seen from the points of view of research in the learning sciences and OECD's studies of innovation in education.

Keywords: knowledge creation, knowledge building, technology, innovation, design

Introduction

Century-old controversies in education have taken on new shape and urgency in what OECD has termed an "innovation-driven" society (OECD, 2010). Knowledge creation and innovation are becoming constant, pervasive, and essential and are increasingly dependent on collaborative work with knowledge and ideas. OECD's Centre for Educational Research and Innovation is now turning attention to work in the area of innovative pedagogies—an extension of their longstanding Innovative Learning Environments project. The goal is to identify and understand innovative pedagogies that improve outcomes and engagement of young people, and to build an international community of expertise regarding innovative pedagogies. At the same time, ministries of education worldwide are creating plans and new educational means to advance education for innovation.

This symposium brings the leader of OECD's Innovative Learning Environments project into conversation with Ministry of Education and Principals' Council representatives from two major school systems—Ontario, Canada, and Singapore. According to the McKinsey report (Mourshed, Chinezi, & Barber, 2010), Singapore and Ontario are among the top five education systems in the world. The report labels these systems as "sustained improvers," which means that they have seen "five years or more of consistent rises in student performance spanning multiple data points and subjects" (p. 11). "Sustained improvers," according to this report, have also successfully moved past a centralized system to a distributed model where schools, teachers and administrators take up more responsibility for developing and implementing effective instructional practice grounded in innovation, collaboration and peer-to-peer learning (p. 20). This trajectory of system improvement, as described in the report, "is all about turning schools into learning organizations" (p. 111). Along with other high-performing school systems, Singapore and Ontario are often visited by educators seeking to improve results in their own schools. The focus of this symposium, however, is not on how Singapore and

Ontario got to where they are but on where they are going from here to raise achievement even further and to address emerging needs for innovative and knowledge-creating capacity.

Both of these groups are experimenting with the same innovative educational approach, known as Knowledge Building (Scardamalia & Bereiter, 2014). Its underlying goal is to recreate educational institutions as knowledge creating enterprises; the pedagogy is defined more straightforwardly as producing knowledge of value to a community and continually improving it (Scardamalia & Bereiter, 2003). In contrast to learning, which is an internal change in competence and dispositions (internal to individuals or to communities of practice), Knowledge Building is an overt social process producing public objects such as inventions, designs, explanations, interpretations, theories, histories, solutions, proofs, and plans. The key to doing this in educational settings is establishing *collective responsibility for idea improvement* as a socio-cognitive norm. An important part of Knowledge Building as a research program is developing technology to assist students in exercising such responsibility. Current developments include software usable by students to map "idea threads" in their group discourse (Zhang, et al, 2015), compare their usage of domain vocabulary to that of more knowledgeable groups (Resendes, et al, 2015), identify and organize promising ideas in their online notes (Chen, Scardamalia & Bereiter, 2015), and examine the communication structure in their class or group (Matsuzawa, Oshima, Oshima, Niihara, & Sakai, 2011).

Knowledge Building is synonymous with knowledge creation as carried out in innovative organizations, but it reflects the differences in context and challenge when knowledge creation is carried out with educational ends in view (Bereiter & Scardamalia, 2014). Whereas most knowledge creating organizations can draw on already-developed talent, educational Knowledge Building must develop capacity for knowledge creation within a novice population. Whereas knowledge creation usually has a clear meaning in relation to the goals of organizations that undertake it, in education it often gets lumped together with generic constructivist learning approaches such as inquiry- and project-based learning. This tends to obscure the essential concept of students taking responsibility for idea improvement.

In many school systems, concerns about low achievement are so intense that there is little elbow room for experimenting with novel approaches such as those championed by learning scientists—let alone mechanisms for collaborative innovation networks (Gloor, 2006) and other initiatives that favor creative work with knowledge and ideas. This limits pursuit of important new objectives and practices; in turn, constrained circumstances for exploration limit demonstration of the potential of new pedagogies and technologies. However, both Ontario and Singapore school systems are committed to improving achievement for all students by internationally recognized standards as well as exploring new possibilities. Thus these systems have the potential to serve the world educational community as trailblazers, venturing beyond well-traveled pedagogical routes and developing evidence and know-how that can serve other school systems in their own efforts to pursue increasingly high-level objectives.

School systems that take on this trailblazing role face a number of problems. They face all the well-known problems of systemic change and "scaling up" (Fullan 2012; Looi & Teh, 2015; Bishop, O'Sullivan, & Berryman, 2010); but in addition they face a two-cultures problem, with a practitioner culture and a design-science culture that may share top-level goals but that may differ significantly in vocabulary, in priorities, in the "grain size" of perceived problems, and perhaps most importantly in the way high-level goals are conceptualized. This symposium provides an opportunity for such differences to come into view and to be addressed. The emphasis, however, will be on possibilities for constructive, positive action and progress toward construction of a shared "problem space" (Newell & Simon, 1972). The work to be reported, in both Ontario and Singapore, is in early stages. Yet within each context there are newsworthy advances on several fronts: refocusing education as a knowledge creating enterprise, professional development networks forming that show complex educational change can sometimes proceed at a rapid pace, school-university-government partnerships demonstrating the power of multilevel engagement, and technology supporting self organization around idea improvement, in and out of school.

Plan of the symposium

The plan of the symposium is to devote the first 10 minutes to introductory comment, followed by 40 minutes of presentations from the architects of Ontario and Singapore initiatives, 10-minute commentary on research directions by collaborating learning scientists and 10-minute analysis in light of OECD studies of educational innovations (cf. OECD, 2015). The remaining 20 minutes will be opened to audience participation.

Education for innovation

Marlene Scardamalia, Presidents' Chair in Education and Knowledge Technologies and Director, Institute for Knowledge Innovation and Technology, OISE/University of Toronto

Currently schools face the innovation imperative of meeting governmental and private-sector objectives for developing capacity to live and work in an 'innovation-driven' knowledge society (OECD, 2010). This new challenge does not lessen the longstanding imperative to increase achievement by international standards. In this session the role of Knowledge Building/knowledge creation in international contexts and research programs will be presented, describing how learning scientists with experience in Knowledge Building are working closely with practitioners and administrators in both Ontario and Singapore to craft a practical program that will yield demonstrable results in terms of both knowledge acquisition and knowledge creation.

Ontario, Canada: Knowledge building and leading student achievement

Linda Massey, Associate Director of Professional Learning, Ontario Principals' Council, and Chair of the Leading Student Achievement Project (LSA)
Bruce W. Shaw, Director, Leadership and Implementation Branch, Literacy and Numeracy Secretariat, Ministry of Education, Ontario

Linda Massey will discuss how the work on Knowledge Building is being framed within an evolving LSA Theory of Action. This model of action incorporates information inputs from stakeholders as well as from research and emphasizes the role of leadership, especially on the part of school principals and special-purpose district leaders. In moving forward beyond "tried and true," LSA promotes collaboration across all system levels and working partnerships with universities and with the Ministry of Education's Literacy and Numeracy Secretariat. The three Ontario principals' associations develop and deliver webinars and face-to face programs aimed at better equipping principals as leaders in the pursuit of educational goals at the classroom level. Such leadership in turn requires enabling school leaders and teachers to function at full professional levels. Toward that end, LSA assists in the building of effective Professional Learning Communities within schools and Leadership Networks/Principal Learning Teams across districts. The LSA theory of action (Leithwood, 2014) has been so well received that the LSA model and learning strategies are now being offered to an international clientele and provide a means of sharing home-grown knowledge and skills with a worldwide educational community. LSA sees itself not only as a user of research but also as a collaborator in research. It is not only working closely with Knowledge Building researchers at the school level, but it is also supporting the development of group-level assessment technology to empower students and teachers in 21st-century creative knowledge work. LSA participants share a commitment to both the advancement of learning and to the well-being of all students. This dual goal virtually demands the kind of multi-level and cross-sector collaboration that LSA and the three Ontario principals' associations are seeking to bring about.

Bruce W. Shaw will describe the initiating project. To ensure that all students receive needed support, the Literacy and Numeracy Secretariat of the Ontario Ministry of Education sponsors Student Achievement Officers of the Secretariat to build strong relationships within the education community and to work cooperatively with boards to build capacity within schools and districts to improve student learning and achievement. It was in fact two of these Student Achievement Officers who first brought to the attention of the Secretariat the relevance and promise of Knowledge Building. Their approach to literacy was already based on paying close attention to students' thinking, and Knowledge Building was seen as a way of giving students' thinking an even larger role. Still to be determined is whether a similar focus on students functioning as a knowledge-building community can fit equally well into the advancement of numeracy. That is a matter of special interest in Ontario at this time because, as in with many other jurisdictions, progress in mathematics is lagging behind progress in literacy. However, the interest in Knowledge Building goes well beyond that, to the four top-level goals set for education in the Province: achieving excellence, ensuring equity, promoting well-being, and enhancing public confidence. All four of these goals present challenges that require venturing beyond "tried and true," but at the same time they suggest risks in doing so. To meet the challenges and reduce the risks, the Secretariat is employing the following strategies:

- Full implementation of Knowledge Building in selected sites—with students, teachers, and administrators engaged in decision making—rather than superficial implementation everywhere at once.

- Building effective Professional Learning Communities within and among schools and within boards and across boards to ensure quality implementation.

- Using the group-level analytics in Knowledge Forum technology to provide formative feedback for students and teachers and to foster increasingly high levels of agency.

- Creating practitioner networks that are not only sharing networks but innovation-generating and problem-solving networks.
- Contributing to a progressive program of educational research spanning goals for achievement, innovation and well-being.

Singapore: Learning partnership in educational technology

Shirleen Chee, Divisional Director, Educational Technology Division (ETD), Singapore Ministry of Education
Seng Chee Tan, Deputy Director, Centre for Research and Development in Learning, Nanyang Technological University
Chew Lee Teo, Lead Specialist, Singapore Ministry of Education

Shirleen Chee will discuss ministry initiatives in "Masterplan 4." She will discuss ETD's concerted effort to bring about innovative classroom practice with technology and projects with innovative pedagogies that have shown evidence of improving overall learning outcomes and engagement of students in a formal learning setting as well as professional develop programmes that aim to sustain innovative practice by building capacity of teachers to deepen the pedagogical use of ICT to transform student learning.

Seng Chee Tan will discuss how researchers and teacher educators work with the schools and ministry to develop teachers' capacity in designing and implementing Knowledge Building in schools. The National Institute of Education (NIE) has been offering formal courses, from pre-service to graduate levels, to deepen teachers' understanding in knowledge creation. In addition, researchers from NIE have been working with teachers to design, implement, and examine the enactment of knowledge building in schools.

Chew Lee Teo will discuss Knowledge Building practice in Singapore. Partnerships with schools support principled implementation of Knowledge Building practice within schools, and connect teachers across Singapore in understanding and adapting Knowledge Building practices to bring about positive impact on teaching and learning in Singapore with technologies.

This work will be discussed within the context of ministry initiatives in "Nurturing an Ecology for a Sustained Shift in Classroom Practice with Technology." The Learning Partnership in Educational Technology (LPET) is committed to 21st century teaching and learning with information and communication technologies (ICT) in Singapore classrooms. LPET partner schools create a sustaining culture for this work. Efforts include reframing roles of teachers and students, promoting evidence-based discourse, and fostering new relationships and networks within schools, viewing each player's role in a rich, complex, and synergistic environment.

Partnerships focus on deepening domain knowledge and developing 21st century competencies simultaneously, moving one classroom, one school at a time, supported by school leaders and school teachers. LPET partner schools co-develop ICT practices to bring students' thinking and learning to the center of classroom practices. This heightened understanding of students' emerging learning captured by ICT creates the impetus for teachers to design interactions within the learning experience and environment, deepening domain knowledge and 21st century competencies.

Learning scientists: Research directions

Carl Bereiter, Co-Founder Institute for Knowledge Innovation and Technology, OISE/University of Toronto,
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By undertaking experimental implementations of Knowledge Building, the Ontario and Singapore schools are doing more than engaging in a local school-researcher partnership, important as that may be. They are linking up with and playing a role in an international network of researchers and innovators who can contribute significant ideas and technology and who will in turn learn from the work going on in Ontario and Singapore. Indeed, during 2015 Ontario teachers and administrators have already conducted a webinar with Knowledge Building teachers in Atlantic Canada, and Singapore teachers have taken part in Knowledge Building Summer Institutes in Canada and New Zealand. 2016 will see the launch of the Building Cultural Capacity for Innovation initiative, which will bring a variety of educational institutions from a variety of cultures into a collaborative effort to achieve goals similar to those discussed in this symposium.

Often innovation in schools means *adopting* an innovation already developed and packaged in some form of deliverables. Knowledge Building has been around for several decades, but it is not a package. It

continues to evolve in theory, pedagogy, and supportive technology (Scardamalia & Bereiter, 2014). Reflecting the ferment in the learning sciences as a whole, it is in a period of accelerating change. The three speakers in this segment of the symposium will briefly highlight some of the new directions that should have direct implications for work going on in the connected schools. The role in Knowledge Building of assessment at the group level is an emerging issue in Quebec, and the collaborative model deployed in the Remote Networked Schools (RNS) is now getting attention in both urban classrooms and remote schools in Auvergne, France (Laferrière, Allaire, Breuleux, et al., 2015). Group-level feedback to aid students in knowledge-building discourse is showing that when students are provided with ways to compare the vocabulary of their discourse with that of more knowledgeable groups they use this feedback in conceptual growth; that they similarly take advantage of tools to identify and focus discussion on promising ideas and to extract and display threads of ideas. Semantic network analysis is also being put within students' reach (Matzuzawa, et al., 2011).

Other aspects of knowledge building inviting further development are embodied cognition, hands-on knowledge building, intellectual engagement, and emergent and rotating leadership in student groups. Learning analytics, a development that is raising interest throughout the learning sciences, is being investigated with a view to using automated analyses to support students' epistemic agency, as distinct from the prescriptive uses to which such analyses are often put. A learning challenge that has been identified but not yet pursued is transliteracy—the ability to construct coherent knowledge out of the bits and pieces of information common in internet media. On other fronts, progress is being made in moving practitioner networks from being limited to sharing and social support to being productive innovation networks. An important problem on which we expect progress to be made in the ongoing work with Ontario, Singapore, Quebec, and other schools is defining an optimum role for teacher guidance and instruction within a classroom knowledge building culture. The premise is that knowledge creation—which means students not only generating ideas but taking collective responsibility for idea improvement—can actively promote literacy, numeracy, and subject matter mastery, but that the teacher constitutes a unique resource in this process and needs to play a role that maximizes long-term benefit both to the students and to the society that will depend on them.

OECD pedagogical innovations: Reflections and next steps

David Istance is a senior analyst in OECD's Education and Skills Directorate, Centre for Educational Research and Innovation (CERI). He heads CERI's Innovative Learning Environments project and is developing new work on innovative pedagogy. His most recent OECD publication is *Schooling Redesigned: Towards Innovative Learning Systems* (2015). He earlier headed the Schooling for Tomorrow project, designed and wrote the initial volumes of *Education Today: the OECD Perspective* and *Trends Shaping Education*, and edited an international reader on lifelong learning with Tom Schuller and Hans Schuetze (Open University Press, 2002). Other significant works include *Trends Shaping Education*, OECD, 2008 and 2010; *The Nature of Learning: Using Research to Inspire Practice*, OECD, 2010; *What Schools for the Future?* OECD, 2001; and *Education and Equity in OECD Countries*, OECD, 1997. He headed OECD's review of *Scotland's Curriculum for Excellence* and is currently working with the policy review division on Aboriginal education. As suggested by these important and highly relevant works, David is uniquely qualified to reflect on the Ontario and Singapore initiatives, to provide perspective from his work with educators worldwide, to discuss challenges and opportunities for the creation of an international design lab to advance education for innovation, and to compare the work reported in this symposium to innovative learning environments and pedagogies he and his team have investigated.

Issues for discussion

The following are issues that may be introduced as questions to guide the audience discussion:

- What constitutes "tried and true"? Have project-based learning and inquiry, for instance, become well enough established that they are part of "tried and true" rather than innovations?

- To what extent should a school system's involvement go beyond "try it and see if it works" to "try it and make it work"?

- How much lead time should be allowed for an innovation to succeed before established criteria of success and failure are applied?

- What are the prospects for adopting a new approach that achieves important new objectives but does not do quite as well or at least does no better than the existing approach on common measures of achievement?

- How much weight should be given to outcomes that can only be assessed qualitatively or by self-report— for instance, intellectual engagement, epistemic agency, well-being, and knowledge creation?

- What is the place for assessment at the group level (of discussion quality, for instance, or collaborative knowledge building or maintenance of intellectual and disciplinary norms) as distinct from assessment at the individual level, which now dominates educational assessment?

- Can practitioner networks be transformed from sharing networks to innovation networks (Gloor, et al, 2012)?

- What are the prospects for collaboration between high-performing school systems and struggling school systems? How could such collaboration be a win-win?

Significance of the symposium for the learning sciences community

Both of the education systems involved in the symposium have had long-standing working relations with research-intensive academic institutions (the National Institute of Education in Singapore and the Ontario Institute for Studies in Education in Ontario), with movement of personnel between organizations not uncommon. Nevertheless, the collaboration that figures in this symposium is distinctive in the extent to which learning science research is involved. This symposium speaks in direct and concrete terms to a concern voiced by many ISLS members: How can the learning sciences have more influence on educational policies and practices?

Significance of the symposium for system-level educational policies and practices

The symposium will address the following issues:

- Overall approach to educational improvement and the perceived potential of Knowledge Building within the larger plan.

- How scaling up from pilot experiments to full-scale implementation is best managed.

- How to provide for continuing design improvement after large-scale implementation.

- Promising ideas on the horizon that have not yet been translated into usable innovations.

- Risks inherent in carrying out research-based design experiments in actual schools, how serious these risks are, and what measures can be taken to minimize them.

- Next-generation software and analytic tools: How intelligent can they be? How intelligent *should* they be?

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