Imagining Canada’s Future:
New ways of learning for Canadians to thrive in an evolving society and labour market
Getting closer to the wind!

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A Review of recent and current Research on Ways of Learning prepared for SSHRC

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Introduction

SSHRC’s Imagining Canada’s Future consultation led to three potential drivers for change and social transformations in a variety of areas, domestically and internationally: 1) changing demographics, 2) increased global forces, and 3) rapidly evolving and emerging technologies. Canada’s education systems are called upon to contribute. How they may do so is debated in scholarly works as in the grey literature. At the heart of the matter is what learning can be in an interconnected world.

The lines between formal, non-formal and informal education are blurring. Formal education, be it at the elementary, secondary or post-secondary level, has its own connected learning environments, and students their own digital tools at home. Learning affordances are expanding, and outcomes revisited. While tradition-minded scholars do not see the relevance of re-questioning what an educated person is to be, innovation-oriented scholars are focusing on knowledge and skills required for the 21st century. Both sides agree regarding improving graduates numbers, decreasing dropout rates, giving access to adult learners, fostering deeper learning, etc. There is disagreement as to whether students are “digital natives”, and therefore savvy of a high level of ICT use during class time, and so on… Regarding what an enhanced learning environment should be, the debate manifests realist and relativist world views. As the tension between teacher-centred and learner-centred approaches remains, history is repeating itself. Innovation in the classroom differs in terms of how content is structured, and how much agency is released to students.

Given that change theorists favour incremental change in education, this research review is taking a moderate perspective, thus acknowledging the weight of tradition in education. Scholarly views and research results of a transformative nature will not, however, be neglected. While we may individually agree that Canada is “at a tipping point in the way its education system, especially higher education, is conceptualized, structured and delivered in light of the knowledge and skills required”, one is well-advised to consider that the campus-based teaching/research community as a whole has not endorsed this view, and is not even questioning itself regarding “the best way to deliver learning”.

This brief addresses the state of the research environment on the new ways of learning, particularly in higher education, that Canadians need to thrive in an evolving society and labour market. A literature review was conducted with an eye to 1) identify the current capacity, and developing a profile of current state of trends related to the future challenge number one; 2) identify potential future contributions from disciplinary, multidisciplinary, and cross-sectoral perspectives (i.e. public, private and not for profit sectors); 3) assess whether capacity can be built within a reasonable timeframe (e.g. five years), where there is little existing capacity. A major theme emerged in this effort to suggest (strategic) action informed by data, information, and knowledge: Getting closer to the wind! This metaphor is meant to help the reader make sense of this review.

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1 UNESCO, 1991
2 M. Prensky (2001); S. Bennett, K. Maton & L. Kervin (2008)
Methodology

The purview here is research that informs practices for enhancing teaching and learning. With a focus on innovation, we began by sketching our best responses to the question and subquestions related to the first challenge identified by SSHRC’s Imagining Canada’s Future initiative. We then put them aside — bracketing says the phenomenological method —, and checked the literature for sound as well as frontier research covering primarily but not exclusively the 2007-2013 period.

A search using descriptors “technology and learning” returned almost 90,000 references, including slightly over 70,000 ones regarding academic journals — four EBSCO databases were searched (Education Source, ERIC, Academic Search Complete, Psychology and Behavioral Sciences Collection) over the past seven years (2007-2013). One out of a thousand were in French (descriptor used: Technologie et Apprentissage). There were 63 returns for “ways of learning” — same parameters used and exact duplicates removed.

Searching on EBSCO Information Services we applied descriptors such as “learning and digital age”; “learning environments and computers”; “digital tools”; “e-learning”; “digital and learning”; “workplace and learning”; “learning and work”; “knowledge creation”; “digital and citizenship”; “apprentissage et numérique”. 725 apparently relevant results were retained. We added 427 other results searching on EdITLib and ProQuest — five ProQuest sub-databases were searched: Canadian Research Index, Canadian Business & Current Affairs (CBCA) Complete, ERIC, FRANCIS, Sociological Abstracts and ProQuest Dissertations and theses. Closer examination led to the identification of 202 relevant results, out of which 28 (14%) were Canada-based. See Appendix A for details regarding this search and others.

The process of subtraction/addition also involved looking for seminal works and insight from best-cited recent studies and evidence strength of results, browsing Google Scholar, and chasing articles’ citations and footnotes for insight. Tables of content of recent/upcoming handbooks and journals’ special issues were scanned through as well as executive summaries of reports and white papers. Current research was surveyed on websites and webpages, including those of SSHRC, FRQSC, SSHRC Canada chairs, research centres and groups, and others relevant national and international organizations or research groups.

Overall, we kept revisiting categories (the four commonplaces of the educational situation in formal, non-formal and informal settings) and going back and forth from the singular to the comprehensive for identifying emerging themes, patterns, and meanings contributing to 1) the current state of trends related to the six subquestions, 2) potential future contributions, and 3) time frame for capacity building.

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4 A meta-analysis was considered but first review procedures — as defined by Cooper, Hedges, & Valentine (2009) — did not deliver a sufficient mix of findings. The Campbell Collaboration and What Works Clearinghouse database were scrutinized. The best-evidence synthesis approach (Slavin, 1986) was also discarded. See Appendix A, section 2.

5 Handbooks were from a variety of knowledge communities, including AECT (Association for Educational Communications and Technology, Computer-Supported Collaborative Learning (CSCL), EDUsummIT. See Appendix A, section 3.

6 See Appendix A, section 4.

7 See Appendix A, section 5.

8 See p. 5. These four commonplaces (who is teaching what to whom in a given context/who is learning what with whom in a given context) were the basic categories for classifying materials that led to the identification of trends and future contributions.
When applied well, points Dede (in press), the Learning Technologies Chair at Harvard, co-writer of the Teaching and Technology chapter in the upcoming edition of the Research on Teaching handbook, digital tools “can empower factors we know are powerful for learning: student engagement, deep content, guided learning by doing, valid assessments, and links between classrooms and life. But this can succeed only if people use powerful infrastructures of tools to enhance learning in sophisticated ways.”

In the United Kingdom, technology-enhanced learning (TEL) is gaining momentum over the integration of information and communication technologies (ICTs). It is a manifestation that the focus is shifting from technology integration in the classroom to classroom learning. With more powerful learning tools, and environments, more is expected of teachers and students. Deeper learning and deeper understanding are expressions that capture the thinking of scholars regarding the new ways of learning afforded by digital tools and platforms.

A greater diversity of pedagogical principles now informs practice in learning environments and technology-enhanced learning environments (TELEs). Sfard’s (1998) suggests two guiding complementary metaphors (the acquisition metaphor, AM, and the participation metaphor, PM). Laurillard (2009) encapsulates teachers’ choices by referring to the instructionist and constructionist pedagogical approaches. The plethora of scientific articles that evidence the value of either one or the other is such that one would be ill-advised to apply dualistic thinking by narrowing the channel of possibilities for learners to the four commonplaces of the educational situation (formal and informal settings): Someone teaching something to someone in a given context (Schwab, 1983). Its counterpart is also of great relevance: Someone learning something with someone in a given context (Bracewell et al., 1998).

It should be acknowledged that teachers and students are challenged, onsite and online, by the affordances digital tools and platforms bring to the educational situation. On the one hand, for learners to be ready to thrive in an evolving society and labour market, elementary, secondary and post-secondary formal learning environments have to release some control to students. On the other hand, students’ agency needs to be cultivated and manifest in order for them to take advantage of flexible learning, open learning, and networked learning — the forms of learning retained to address the central question of this research synthesis. **Flexible learning** provides some control to the learner over context (time and space), **open learning** some control over content, and **connected learning** some control over who to learn with (connections with peers, teachers, experts, and mentors).

Therefore, *la médiation des connaissances*⁹ becomes a key research question, and that whether teaching/learning is *en présence ou à distance*: How is knowledge mediated in an “information-driven and highly interconnected society”? Subquestion 1 will allow further development on knowledge and mediation.

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⁹ Mediation is conceptualized as the main process of a life-wide learning structure – *l’apprentissage tout au long de la vie disent les Québécois.*
In response to Subquestion

a. What knowledge, skills and delivery methods are required in order for the public education system to create an innovative, resilient and culturally rich society?

Current State of Trends

In an evolving society democracy is not to be taken for granted, and education for democracy has its place and obligations. This is one of the two main reasons why participation is key in what research on learning uncovered over the past 25 years. The other reason pertains to the merits of social interaction for deepening the student’s understanding of a learning object.

_How people learn_ (Bransford, Brown, & Cocking, 2000) is considered the seminal work of the learning sciences (sciences de l’apprendre). Learning scientists’ influence is obvious in the _UNESCO ICT Competency Framework for Teachers_ (2011) that brings forth the following three competencies: Technology literacy, knowledge deepening, and knowledge creation. The one-page executive summary mentions: “UNESCO’s Framework emphasizes that it is not enough for teachers to have ICT competencies and be able to teach them to their students. Teachers need to be able to help the students become collaborative, problem-solving, creative learners through using ICT so they will be effective citizens and members of the workforce”. OECD (2013a) is aligned on the same learning outcomes (see also Griffin, McGaw, & Care, 2012). The PISA 2015\(^{10}\) will assess fifteen year-old students on two knowledge domains: science and collaborative problem solving (computer-supported).

_Teachers challenged to design rich onsite/online learning environments for all students_

In school “computer intensive” settings, Morrison and Ross (2014) observed 1) student-centered, cooperative, and higher-order learning; 2) student skills in writing, problem solving, and using technology; and 3) positive attitudes toward technology as a learning tool on the part of students, parents, teachers, and school leaders. In impoverished socioeconomic settings, computers tend to be used for drill and practice — another manifestation of the digital divide. Digital tools can deliver instructional materials via the Internet (flexible learning), thus providing time to teachers for being attentive to personal factors such as student motivation and transliteracy skills, interpersonal factors such as challenge, control, fantasy, and curiosity, as well as interpersonal factors such as competition, cooperation, and recognition. Fishman & Dede (in press) stress that in modern work and citizenship problem finding, tapping tacit knowledge for recognizing a problem and identifying resources and knowledge needed to resolve it (open learning) are gaining in importance.

_Teacher education programs are challenged to deliver on innovation_

Having to prepare teachers for the classrooms they will enter as they begin their careers and for conditions yet to stabilize (e.g., Internet access, curriculum) teacher education programs struggle to include technology in a meaningful way for student teachers. The changes required are philosophical, structural, and content-based (Pellegrino _et al._, 2007; Stahl, 2006; Warschauer, 2008), and let alone preparing teachers for teaching online (Barbour & Reeves, 2009).

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\(^{10}\) OECD (2013b)
Potential Future Contributions

Under an umbrella infrastructure for coordination and leadership, SSHRC could consider the following teacher-centred research foci:

1. **Focus on The next generation of teachers.** “Our understanding of expertise has expanded from something “stored in the head” and documented by its retrieval in sequestered testing to instead include a collection of elements accessible via technologies (such as mobile devices, search engines, and augmented reality) that enable finding necessary information rather than remembering it.” (Working Group on Postsecondary Learning, 2013; see Appendix B). The U. S. ran the PT3 program — Discretionary/Competitive Grants offered by the Dept of Education meant to transform teaching and learning11. In Canada, a program dedicated to the study of formal education through the lens of the teacher work in elementary, secondary and post-secondary settings would be a lever.

2. **Focus on Effective teacher learning.** For models of teacher professional development to be relevant and effective, teacher learning needs to be meaningful to a teacher’s practice, is social in nature, and is distributed (Greeno, 1998). Teacher learning therefore cannot be limited to formal professional development only, but takes place in all the arenas in which the teacher participates: the classroom, the community of (student-) teachers, and the school environment (Borko, 2004). It is not enough for Canadian researchers to report on what is not happening or on local variables taken out of context (e.g., students’ perceptions, satisfaction level, and the like).

3. **Focus on Cultivating student agency (agentivité).** With all the information available on the Internet and for students to connect with people capable of contributing to their projects and different endeavours, guided practice during schooling is expected. There is substantive literature on 21st century competencies and skills (OECD, 2008; Griffin, McGaw, & Care, 2012), and learning to work creatively with knowledge (Bereiter & Scardamalia, 2003).

4. **Focus on Collaborative learning as content.** Many of the 70 learning scientists who participated in the Computer-Supported Collaborative Learning (CSCL 2013 pre-conference workshop on PISA 2015, Madison, WI) agreed with J. Pellegrino that the collaborative problem solving assessment strand is likely to generate substantive research in the years to come.

5. **Focus on Digital educational resources.** Developers flood the educational market with technology products and open educational resources multiply. Those with little or no educational value cohabit with those that are research-supported. There are issues with regard to relevance to education programs in place as well as sustainability and scalability concerns.

6. **Focus on The digital era’s demands on the lives of professional educators.** As access issues to digital tools diminish with mobile devices (computers, tablets, smart phones), educational administrators and teachers face a variety of pedagogical and classroom organization and management challenges. Which pedagogy to apply, when and for whom? How to ensure appropriate online behaviour when students are allowed to use their device? How to help learners shift from rote assimilation to reflective interpretation? How educators’ lives are affected when large initiatives are taken? For instance, in the U.S., the National Writing Project conducted its own survey (Purcell et al., 2013) within the limits of its own context.

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In response to Subquestion

b. What aspirations and expectations will a diverse and global citizenry bring to work environments, jobs and labour markets of the future?

Current State of Trends

Learners’ aspirations and expectations are digitally empowered

The word is spreading that Millennials (Gen Y) will constitute 75 percent of the global workforce by 2025. The Net Generation of Millennials for whom Canadian D. Tapscott (2009) has been a strong advocate favours online activity. College graduates pounder job security and high wages against open access to Internet (e.g., CISCO’s surveys 2011, 2012). The Programme for the International Assessment of Adult Competencies (PIAAC, OECDc, 2013), which found lasting problems in basic literacy and numeracy in Canada’s workforce, show evidence of its strength as regards digital skills and problem solving in technology-rich environments.

Let me decide at work, feel connected, and grow my career

Greater flexibility as to when and where to work is advocated by Gen Y mavericks (Burnstein, 2013). Innovation-oriented workplaces may have to create a flexible work culture, increase transparency, and build a sense of community — some of the lessons learned from the PwC’s NextGen study (2013), see also HASTAC (2013) and Griffin, McGaw, & Care, (2012). Perceiving movement from the information to the “conceptual age”, Pink (2006) is calling for “a new breed of empathizers, pattern recognizers, and meaning makers”.

Let me use my own device, and be connected

There are opportunities but also issues ahead for managers of Millennials: lack of attention and of deep understanding (Carr, 2011), social inclusion (Furlong, 2012), stress (APA, 2013), and “hands-on guidance and direction” (Howe & Nadler, 2012), and greater demand for learning to be immediate (just-in-time) through mobile computing and online communities of practice. Workplaces that are considering “bring your own technology” policies, are facing issues regarding control (work vs. play, Rosen, 2010), collaborative platforms (Morgan, 2012) and, of course, security and ownership.

Take me as I am

“Generation Me” has been described as overconfident and narcissistic (Twenge, 2006; Twenge and Campbell, 2009). In the U.S. three out of five are working, and half of those working are part-time. The link between education and civic engagement is shifting as those without a college degree are found to be more likely to help their neighbours on a regular basis (NCoC, 2013). In spite of the ways of learning available through formal education rates of failure are too high (Lessard et al., 2013), thus creating severe consequences for non successful learners and Canadian provinces. As pointed in SSHRC’s technical report, “the risks of prolonged unemployment for certain groups and/or communities and significant skills shortages experienced by communities and organizations are significant concerns”. It is the educationally privileged youth, with effective learning supports at home, who is best positioned to take full advantage of the new digital learning opportunities, and successfully raise their career aspirations and expectations (Ito et al., 2009).
Potential Future Contributions

Under an umbrella infrastructure for coordination and leadership, SSHRC could consider the following learner-centred research foci:

1. **Focus on Digital literacies.** Rheingold (2012) identifies five fundamental digital literacies: (1) attention or mindfulness, (2) participation, (3) collaboration, (4) critical consumption of information, and (5) network smarts. Transliteracy/Translittératies, which refers to wide-ranging research in the humanities examining the implications of the shift from a closed to an open informational world, is also worth high lightening (Abiteboul et al, 2011; Frau-Meigs et al, 2011; Martinand, 2003; Thomas et al, 2007).

2. **Focus on Expanded provincial school curricula and innovative post-secondary programs.** Such programs are partly devoted to Inquiry learning — “an educational activity in which students individually or collectively investigate a set of phenomena—virtual or real—and draw conclusions about it.” (Kuhn, Black, Keselman, & Kaplan, 2000). Such research will have to move beyond the debate between explicit instruction and inquiry learning that keeps dividing the educational community.

3. **Focus on Real-world apprenticeship.** It may be guided project- or problem-based experiences in classroom settings. It may also be dual vocational training system combining apprenticeships with formal schooling12 or participation in a research team. Such approaches are often associated with 21st century skills but they can also be associated with cognitive skills — as Vygotsky (1978) noted, concepts form when everyday and scientific knowledge grow into one another.

4. **Focus on The network-empowered-workplace’s learners.** For Thomas and Brown (2011), the “new culture of learning” is centring on collaborative, adaptive, and demand-driven rather than supply-driven forms of learning. The network is seen as ‘the outcome’ of learning (Ito et al, 2013). Collaboration in context, however, is not a given. Group psychologists know that team members encounter difficulties, and researchers on the Net Generation in Higher Ed (e.g., Charsky et al., 2009; Kennedy et al, 2009) share the concern. Network-lagging-workplace’s learners would be an important contrasting case to investigate.

5. **Focus on Graduates’ working lives and citizenship in the digital age.** Technology has become a central part of virtually everyone’s life and has transformed reading, writing, communicating and even thinking for most people (Collins & Halverson, 2009). At work, performance evaluation will require a new basis. In the U.S., the National Research Council 2012 report, Education for Life and Work, stresses: 1) “Cognitive competencies have been more extensively studied than interpersonal and intrapersonal competencies, showing consistent, positive correlations (of modest size) with desirable educational, career, and health outcomes; 2) Among interpersonal and intrapersonal competencies, conscientiousness (a tendency to be organized, responsible, and hardworking) is most highly correlated with desirable educational, career, and health outcomes. It recommends: “Foundations and federal agencies should support further research designed to increase our understanding of the relationships between 21st century competencies and successful adult outcomes” (p. Sum-4).

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12 See T. Laferrière & coll. FAST project (FRQ-SC, 2011-2014)
In response to subquestion

c. What conditions are needed for new models of research—particularly, co-creation of knowledge with the public, private and/or not-for-profit sectors—to flourish?

Current State of Trends

Research paradigms are cohabiting in harmonious ways, adding scope to educational research

One finds more openness in teaching, learning, and programming (open source digital tools). Strong rationales now exist for research approaches ranging from (a) highly controlled basic-research studies of cognitive processes induced from interactions with computers; to (b) descriptive and exploratory studies of how learners use information and communication technologies as educational tools; to (c) contextually-specific “design-based research” studies of how particular technology products function in certain environments; to (d) applied research on solving specific problems that face major education providers in our society, such as schools and training organizations (Ross, Morrison, & Lowther, 2010).

Researchers who are paying attention to relevance

The notion of relevant research implies the condition of respect for practitioners and policy makers. The head of the Institute of Educational Sciences in the U.S. stated: “For future research contributions to address problems and issues of contemporary importance in education, well-designed studies that directly help practitioners to improve teaching and learning in applied contexts are needed” (Viadaro, 2009). And attention to “relevance” is necessary for external validity of research findings.

Researchers mindful of context engaging in partnership-based collaborative research

Researchers focus on systemic change of school-based learning environments themselves, and how digital resources and tools may support them in order to improve student understanding (Cilesiz and Spector, 2014; Cornelissen et al., 2010). However, the literature review revealed clear disproportion between discrete research results, systemic or ecological approaches as suggested by Davis (2008) and Zhao (2003).

Design-Based Research (DBR)

DBR is defined not by its method but by the partners as they defined their object of study. It is specially suitable for innovation purposes. “Design research is constituted within communities of practice that have certain characteristics of innovativeness, responsiveness to evidence, connectivity to basic science, and dedication to continual improvement” (Bereiter (2002, p. 321). It is adaptive because the intervention design and sometimes also the research design are often modified in accordance with emerging insights. Variations include Design Experiment (Brown, 1992; Collins, 1992), Expérimentation de devis (Breuleux et al., 2002), Educational Design Research (McKenny & Reeves, 2014), Design and development research (DDR) (Richey & Klein, 2014), and Design-based Implementation Research (DBIR, Fishman et al., 2013).

Inquiry cycles for collaborative knowledge creation

The development of a shared problem space takes time, human interaction, and data analysis (Barab, 2006). From iteration to iteration, a basic characteristic of DBR, the problem definition gets better understood by researchers and practitioners refine their decision-making process and action.
Potential Future Contributions

Under an umbrella infrastructure for coordination and leadership, SSHRC could consider the following context-focused research foci:

1. **Focus on Addressing stubborn challenges.** There are challenges in education for innovation in the digital age that require macro-, meso-, and micro-level analysis as in economic studies (Selwyn, 2013). Technology-centred studies cannot help in themselves, even at the proof-of-concept stage of implementation or, preferably, *mise en œuvre* in a specific context. Design-based research (Dede, 2005), inclusive of mixed research methods (Richey & Klein, 2008), would be well suited for exploring a model (working hypothesis) in depth, and inform a systemic change process of its possibilities and limitations. Satisfying outcomes are to be improvable and sustainable in the education system, if not scalable. Limitations, often double-binds, identified and progressively overcome — from iteration to iteration and by identifying, documenting and removing tensions (Allaire *et al.*, 2006; Engeström, 1987; Barma, 2011) can lead to lasting innovation.

2. **Focus on Learning from previous research partnerships.** Former partners would be invited to participate in Change Lab sessions, engaging retrospectively in a reflective process similar to Engeström’s formative intervention method (2011) in order to identify encountered hurdles, ways they were overcome or ways that could have been applied to overcome them.

3. **Focus on Celebrating the agency of the instructor.** How to use technology reflectively and scientifically to make teachers and curricula more effective in a given context is a different research focus as the participant would be in charge of “the treatment” which has traditionally been driven by the researcher in search of strong generalizable causal evidence (Alsop and Tompsett, 2007; Savoy & Carr-Chellman, 2014). Teaching and research would be integrated, and a small grant ($30,000 per year) available and renewable for another and a third iteration. All main forms of technology applications — technology as a tutor, a teaching aide, and a learning tool (Ross, Morrison, & Lowther, 2010) — would be promoted. Tapping into the inquiry mind of the post-secondary teacher would augment and enhance what teachers can do to personalize learning (orchestration and adaptation of instruction) to individual needs, and guide collaborative problem finding and solving. The research grant would be tied to a professor’s teaching at both content and process levels, and integrated into the academic structure (program, department). Such a boundary-spanning research program is thought to be necessary as there are signs (e.g., the attractive flexibility of online learning, Bell & Federman, 2013) that campus-based teaching in higher education is on moving sands.

4. **Focus on Promoting collaborative research.** ICTs are placing new demands on teachers working in formal education to prepare today’s students with knowledge and skills not necessary to the same extent for prior generations. Collaborative research in its various forms (cooperative research, participatory action research, partnership research, DBR, DBIR, *recherche coopérative, collaborative ou partenariale, expérimentation de devis*, etc.), likely to help make a difference, is gaining acceptance by the larger scientific community.
In response to subquestion

d. What roles will emerging and/or disruptive information and communication technologies play in learning for individuals, institutions and society?

Current State of Trends

A marginal role for years to come if change is not approached from a systemic point of view

The vast majority of studies of the effectiveness of technological innovations in education shows “no significant differences” over traditional teaching methods (Hattie, 2009). Therefore, those inclined to use ICTs are legitimized, and those inclined not to adopt them keep saying, “Show me the evidence”. For instance, to provide laptops or tablet computers when no class time is devoted to higher-order discussion and for deeply exploring real-world applications is bound to be deceptive (ISTE, 2009). In spite of some promising results, the continuous development of ICTs (e.g., game-based learning, Tobias & Fletcher, 2011, and now 3D printing) may compromise teacher learning as they attempt to make effective use of those they know about. This means that as long as the energy is on getting equipment or learning about a new trend or tool, second-level barriers (e.g., fraud and cheating or the unique challenges faced by low-income and disadvantaged students, Bell & Federman, 2013) in transforming to a 21st century educational system are not in sight. Barriers are not conceptual, technical or economic, but instead psychological, political, and cultural (Dede, in press, cited by Fishman & Dede, in press; for example, see Ertmer, 2005). Furthermore, as long as evaluation procedures and assessment of learning outcomes stay the same, new modes of assessment and feedback for teachers and learners (e.g., attention to student interests; attention to teaching self-regulated learning, Zimmerman & Schunk, 2011) makes it challenging for teachers to establish baselines and protocols for grading (Quellmalz & Pellegrino, 2009).

An effective catalyst or enabling role under certain conditions

Fishman and Dede (in press) emphasize: “Technology is an effective catalyst only when used to enable learning with richer content, more powerful pedagogy, more valid assessments, and links between in- and out-of-classroom learning”. The U.S. Department of Education’s study (Means et al., 2010) evidenced the value of blended/hybrid learning. In its National Educational Technology Plan (2010) the U.S. Department described how new technology infrastructures could enable new forms of learning, new organizations of teaching, and new forms of assessment for K-12 education. Handheld technologies, online forums (Steinkuehler and Duncan, 2008), integrated digital learning environments, flipped classrooms are all used onsite/online for personalized learning and collaborative learning (Deslauriers, Schelew, & Wieman, 2011). In higher ed, MOOC (Massive Open Online Courses) development challenges once more content delivery, and how to support learners adequately becomes the issue (Bogost, 2012; Working Group on Postsecondary Learning, 2013). Originally, it was meant as an alternative to how learning tends to be mediated: the cMOOC model (collaborative MOOC) was invented by Canadians.

A transformative role when Internet-based digital tools and platforms turn the classroom into a connected learning environment

Networked learning (Harasim et al., 1995) and connected learning (Ito et al., 2013) are powerful concepts as regards the transformation of formal education to meet individual, institutional, and societal challenges. It means the use of online instructional materials to augment or extend face-to-face teaching, flip the classroom or connect with events, teachers, peers, experts.
Potential Future Contributions

Under an umbrella infrastructure for coordination and leadership, SSHRC could consider impulsing some structural effects in formal education with the following research foci regarding campus-based networked learning environments:

1. **Focus on Evaluation and learning analytics.** The availability of assessments for 21st century and other “soft” skills will be an ecological factor — e.g., CPL, OECD, 2013b. It means the development of robust systems for teachers and learners to record and share information and certification about learning, such as with badging systems (Hickey, 2012) that have the potential to support self-directed (informal) learning activities and help link it back to formal learning. Learning Analytics is an emerging discipline, and includes tools for capturing, aggregating, analyzing, reporting, and sharing data on learning, and balancing personal data protection with teaching and learning opportunities (Bienkowski, Feng, & Means, 2012; Buckingham Shum, 2012; Siemens, 2012; Suthers & Verbert, 2013).

2. **Focus on K-12 integrated, digital learning environments (ILEs).** Considered a next step to support education by instructional designers, such online spaces are built based on research on the use of games and simulations, forums, web logs, and online scaffolding as instructional tools (e.g., Quest Atlantis, a digital learning environment designed to improve elementary school students’ understanding of science through methods in which students develop solutions to difficult, persistent environmental problems, (Barab, Gresalfi, & Ingram-Goble, 2010). These digital ILEs afford flexible learning as compared to open learning environments (OLEs, see Hannafin, Land, & Oliver, 1999). The thrust is to move beyond the use of isolated technology tools and create a thematically unified experience for learners (Working Group on Postsecondary Learning, 2013).

3. **Focus on Higher ed technology enhanced learning environments (TELEs).** “Next generation” models are characterized by moving beyond place-based, time-based learning (flexible learning); by centering learning on the needs and interests of individual students rather than on a curricular framework or an instructional method (open learning); by focusing teaching on participatory, collaborative, guided learning, involving many types of people as “teachers” in various life-settings of students, and infusing deep content rapidly updated as knowledge evolves (networked or connected learning) (NSF, 2008). To focus on what students could not learn on their own. It is increasingly clear that emotion or affect impacts knowledge acquisition in terms of the overall climate of the learning environment itself (how welcomed and safe the learner feels within the learning context), the learner’s predispositions about the content under study (how interested and confident the learner feels going into the learning task), and the dynamic affective states the learner undergoes throughout the experience (failure/success, boredom/engagement, frustration, and the like) (Graesser & D’Mello, 2011; Pekrun, 2011). See also Allen and Seaman (2011, 2012), Jaggars and Bailey (2010) and Lack (2013) for instructive input on the state on online learning in higher education.
In response to subquestion

e. What role should individuals, institutions and governments play in promoting and supporting the life cycle of knowledge, including creation, accessibility, retention and mobilization, across sectors, both domestically and internationally?

Current State of Trends

Online learning is definitely an option for Canadian learners

Referring to Rogers’ innovation adoption bell curve (2005), recent statistics of different organizations reveal that online learning is still an emerging practice. Depending on context (formal/non-formal/informal education, online/hybrid school program), levels of adoption range from early adopters (13.5%) to early majority (34%), and to late majority (34%). The perceived relative advantage of “flexible” learning (time and space) is growing but perceived compatibility with learning/teaching/administrative existing practices remains low, except for parallel education/training systems. Rogers adds other predictive attributes to adoption rates (complexity, trialability and observability), and his innovation theory applies to educational settings (Murphy, 2005).

Canadian researchers continue to have a leading role in distance education in the digital age

Athabasca University and TELUQ have highly contributed to the development of the field on the international scene and, domestically, to the democratization of education (see pioneers Linda Harasim, Terry Anderson, D. Randy Garrison, Gilbert Paquette and France Henri). The TeleLearning Network of Centres of Excellence (1995-2002, Canada), which has been funded by SSHRC, contributed, and now the Canada Research Chairs program (e.g., T. Anderson, & N. Friesen).

Design for online collaboration has been a strength, and is an asset for learners/workers

New ways of learning with the support of digital tools and platforms are categorized as personalized or collaborative learning (Spector et al., 2014; Abrami et al., 2006). Computer-supported intentional learning environments such as CSILE/KnowledgeForum, developed by Canadian researchers Scardamalia and Bereiter (1994) afford scaffolds for collaborative learning and knowledge building/knowledge creation at a deep level. Innovation is fuelled by ideas, and Canadian youth is exercising its capacity to generate and improve ideas in classroom-based knowledge-building communities (Scardamalia & Bereiter, 2010).

The stewardship of the principle of equality of opportunity is another key role to maintain

New technology tends to exacerbate accessibility issues (Resta et al., 2011). Digital equity and intercultural education (Resta & Laferrière, 2013) are issues for Canadian First Nations, rural communities requiring better bandwidth, and city schools where student diversity keeps growing. For an inclusive approach to keep prevailing — see SSHRC’s technical report on the bridging of systems of knowledge between Aboriginal and mainstream communities —, this review supports, and extends to representatives of all educational actors to be concerned, the regional panels’ arguments that Aboriginal people must play a leadership role in defining Aboriginal research agendas (ARP, p. 25) and that this would be viewed as integral to the tradition of participatory action research (WRP, p. 6).
Potential Future Contributions

Under an umbrella infrastructure for coordination and leadership, SSHRC could consider impulsing some structural effects in formal education by giving attention to the following elements when it comes to funding research activity on teaching and learning:

1. **Role clarification in the co-creation of knowledge.** Research partnerships, a growing strategy in the social sciences, meets SSHRC’s commitment to fruitful engagement with its partners in the academic, public, private and not-for-profit sectors. A Pan-Canadian ethnographic/phenomenological study on the experience of being a research collaborator would bring insight into the conditions and dynamics of collaboration likely to benefit future SSHRC research partnerships. There is a need for awareness of the social processes through which research is produced and used, analogous to recent work exploring policy as a process (rather than understanding it purely in terms of produced texts (Albero, 2013; Ball, 2008, cited by Spector *et al.*, 2014).

2. **Research partnerships involving ministries of Education and CMEC.** Ed systems are prone to technology fads. On the one hand, promising ICTs will go unnoticed if there is failure to follow through with policy. On the other hand, “what works” can rarely, if ever, be reduced to a relationship between two variables. And, as regards e-learning, Conole, Smith, and White (2007) remarked: “Research has a tendency to follow policy directives and technological developments, rather than informing them” (p. 53). The building of “a robust and flexible infrastructure in classrooms and in society that allows for, and encourages, the simultaneous development of human capacity to enact transformative teaching and learning” is a key recommendation of the U.S. Department of Education (2013).

3. **Ways of overcoming the growing tension between onsite/online learning.** The disjuncture argument between the needs of the Net Gen and their educational institutions lacks substance for change in higher ed argue Bennett & Maton (2010). The same year, the U.S. Dept of Ed, in its national technology plan, asserted that to meet the demands of teaching in an interconnected world isolation is no longer possible and may represent poor practice. Important research questions remain to be answered (Resta *et al.*, 2011) about online learning — as a disruptive technology affording personalized learning in classrooms (formal education) and life-wide/lifelong learning outside of school (informal education).

4. **New models of teacher education for the digital age.** It is difficult for teachers to see themselves working collegially with other teachers and with their students (Lei, 2009; Pellegrino *et al.*, 2007). Collective intelligence (Lévy, 1994) about *pédagogie universitaire* has to evolve given what is known about learning, instruction (van Merriënboer & Kirschner, 2012) and today’s technologies and contexts affording them. An initiative that would build on the lessons learned from the T3 program in the USA would be instrumental.

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14 See the Institute of Educational Studies’ What Works Clearinghouse in the U.S. (http://ies.ed.gov/ncee/wwc/)
In response to subquestion

*f. How can we harness Canada’s strength and innovation in the arts, digital media and cultural industries to build social, economic and cultural well-being?*

**Current State of Trends**

*Equality of opportunity, a key principle for considering creative activity*

The “creative class”, as opposed to routine work and emphasizing knowledge-centered and creative pursuits, was put forward by Canadian researcher Florida (2002). The research base of the notion was challenged by Lovink and Rossiter (2007). Similar critiques occur in education when creativity, collaborative problem-solving and the like are stressed as 21st century competencies. The debates stress inequality of access for the less fortunate, all things considered.

*Student engagement, a variable found key*

Canada research chair K. Egan offers a solution by putting the focus on engaging students’ imaginations in learning and teachers’ imaginations in teaching for making knowledge in the curriculum vivid and meaningful. It applies to onsite/online learning. Conventional instructional designers (Richey, Klein, & Tracey, 2011; Dick, Carey, & Carey, 2009) are challenged, for instance, by research findings showing lower achievement (course grade and course completion as dependent variables) in online courses taken by at-risk student — as defined by population demographics.

*Learners’ agency to be considered on the research agenda*

Given the dropout high rate in massive open online courses (MOOCs) that is at about 90%, DeBoer et al. (2013) are reconceptualizing the issue by suggesting that researchers expand the ways in which they define familiar variables (enrollment, participation, curriculum, and achievement). Users’ individual goals and different modes of participation are evoked, thus reminding instructional designers of online courses that intentional learners may or not be interested in postsecondary credits or may differ in their emotional responses to a task. Brand-Gruwel et al. (2014) foster synergy between instructional approaches (direct instruction and interest-driven inquiry) with research on helping learners acquire the necessary self-direction to profit from more open learning environments.

*Teachers’ as learning designers*

Johnson (2013) suggests that technological change threatens professional autonomy through exclusion from decision-making processes, increased workloads, and delimited teaching and research roles. Professional autonomy is highly valued by teachers working at all levels and across disciplines, and the debate regarding teaching as an art or a science is still going on. “Enabling”, not “disruptive”, ICTs support the teacher as a learning designer, an emerging notion (Laurillard, 2012). However, teachers and professors are not used to think of themselves as designers, or orchestrators (Dillenbourg, 2013; Shelton, 2013), let alone engaging in co-design (Voogt et al., 2011). Canadian artists and cultural industries are the ones familiar with the activity of design. Supported by home-grown or carefully selected digital media mixed teams (teachers and “native” designers) are bound to be instrumental in the creation of tomorrow’s learning environments which will afford flexible learning, open learning or connected learning. This would help teaching teams “get closer to the wind” as they perfect “their course”.
Potential Future Contributions

Under an umbrella infrastructure for coordination and leadership, SSHRC could consider impulsing some structural effects in formal education programs by giving attention to the following foci:

1. **Focus on Mastering the arts for teaching.** Online learning outcomes are equivalent to other delivery media when instructional conditions are held constant (Bell & Federman, 2013). Online teaching tends to take traditional lecture and recitation pedagogies and transplants them to the new medium (Means et al., 2009). How interdisciplinary design teams integrate content with communication skills and digital media for delivery that generate learners’ attention, motivation and engagement (Cox, 2008, 2012; Chen, Lambert, & Guidry, 2010) and considering their individual differences (Goodyear, 2011) is a research question relevant to the coming of age of flexible learning.

2. **Focus on Enhancing TEL environments with digital medias.** E-learning (electronic learning) is known to refer to the use of electronic tools and resources either online or onsite. As ICT integration in education is becoming less of an issue the “E” becomes associated with Enhanced learning (JISC/HEFCE, 2009). In a technology-enhanced environment (TEL), there may be onsite lectures combined with personalized or collaborative online activities, some of which being prescribed and others leaving way to open learning. The socio-technical designs of TEL environments call on teachers but also on architects, ergonomists, educational technologists and media specialists learned in the affordances of digital medias, so that teachers’ lecturing, computer-supported personalized learning as well as collaborative learning cohabit for the well-being of students and teachers going to the campus.

3. **Focus on Nurturing cultural connections.** Learning is situated in a social context (Lave & Wenger, 1991) and cognition is socially distributed within a community (Salomon, 1993). The concept of cultural connections is here anchored in the present — e.g., networking clusters in the labor market that stimulate individual creativity (United Nations, 2010), learning cities that engage in reflexive innovation activities (Landry, 2000), online communities of inquiry (Garrison, Anderson, & Archer, 2000), and classroom-based knowledge-building communities (Scardamalia & Bereiter, 1994). The emerging forms and shapes that connected learning and community-based knowledge creation may take require interdisciplinary inquiry.

4. **Focus on Designing with and for synergy.** Educational psychology/technology research advances (e.g., Allaire, 2006; Bereiter, 2002; Laurillard, 2009; Lowyck, 2014, Merrill, 2012; Mishra & Koehler, 2006; Spector, 2012) as well as arts, digital media and cultural industries have design as shared object (networked learning environments, immersive interfaces, games and simulations, etc.), let alone communication and creativity, important processes in the creative economy (CBC, 2008; CCA, 2008; UNESCO, 2013). Commensurability is being claimed within the sub-disciplines of educational technology (Czerniewicz, 2010). From neuro-imaging to adaptive learning technologies, art and science may join forces through design.

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15 The same in the workplace where trainers rely on direct instruction for the acquisition of specific skills.
Summary and time frame for capacity building

New ways of learning have been put forward: flexible learning, open learning, and connected learning. Drawing from the scientific and grey literature, substantive justification for these three choices is provided. Their presence in formal, non-formal and informal educational settings does not signify a change of course per se but some movement onboard for “getting closer to the wind, and stay the course! Serrer le vent afin de maintenir le cap” is the metaphor that encapsulates action required for responding to the challenge. Regarding each of the six subquestions that had to be considered, emerging themes show the scope and depth of what scholars and other concerned citizens tend to work on. The potential future contributions associated to each subquestion are most relevant but feasibility is an issue as research capacity needs improvement — see Appendix C.

These potential future contributions are clustered in the figure below for decision-making purposes regarding the three ways of learning identified and appearing underneath a magnified octant. Flexible learning is expanding, especially in higher ed, and the building of the research capacity in this area could focus on the triptych design — implementation — evaluation during the 2014-2018 period. Research on open learning could be emphasized over a shorter period (2015-2018). Capacity building for connected learning requires more transformation of habits, more design research cycles, and would need to be envisioned over a longer period of time (2016-2024). With such a strategy, SSHRC would make a difference in enhancing Canadians’ capacity to thrive in an evolving society and labour market.
References *


Dede, C. (in press). Opportunities and challenges for educational transformation via learning technologies. In J. Guthrie (Ed.), A bigger bang for education’s bucks: Schools America must have at costs America can afford. Dallas, TX: George W. Bush Institute.


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* References with an asterix have first or second author working in Canada.
Appendix A

Assessment of the Existing Canadian Research Capacity on Ways of Learning in (higher) Education

With the intent to inform SSHRC regarding the Canadian research capacity on the three ways of learning identified in this review, which extended to the international literature in order to pinpoint trends and potential future contributions, the following operations were conducted:

1) Searches in CBCA Complete (ProQuest)
2) Identification of relevant meta-analyses conducted by Canada-based researchers
3) Identification of handbooks in relevant fields
4) Identification of special issues of scientific journals with a substantive presence of Canada-based researchers
5) Mapping the research activity in British Columbia, Alberta and Quebec

1. Searching CBCA Complete (ProQuest)

The Canadian Business & Current Affairs (CBCA) Complete includes scholarly journals and dissertations in science and technology, social sciences, and education. It is Canada’s most comprehensive and diverse full-text online database. Available through the ProQuest® Web interface, the content of CBCA Education is described at http://tls.proquest.com/tls/servlet/ListForward?productID=1086&productName=CBCA+Education&format=formatHTML&IDString=1086&all=all&lh_opt=lh_all

For comparing Canada-based scholarly work with the international production, we relied on EBSCO and the four following databases: Academic search complete, Education source, ERIC and Psychology and Behavioral Sciences Collection. Searches were limited to the Scholarly (Peer Reviewed) Journals/Academic Journals, and we obtained the following results:

<table>
<thead>
<tr>
<th>Descriptors</th>
<th>1995-2004</th>
<th>2005-2014</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Flexible learning</td>
<td>550</td>
<td>1,406</td>
<td>1,956 (5)</td>
</tr>
<tr>
<td>Open learning and Technology</td>
<td>299</td>
<td>771</td>
<td>1,070 (4)</td>
</tr>
<tr>
<td>Connected learning or Networked learning</td>
<td>163</td>
<td>274</td>
<td>437 (21)</td>
</tr>
</tbody>
</table>

Legend: Numbers in parentheses ( ) are CBCA results (articles published in Canadian scholarly journals or ones reflective of the Canadian situation). However, the reader ought to be aware that there are Canadian scholars who publish in international or other national journals. Therefore, the Canadian research capacity is “stronger” than what appears in this table.

Within the CBCA database, the descriptors “E-learning” and “elearning” account, going back to 1999, for 3% of the international production of Scholarly (Peer Reviewed) Journals/Academic Journals (259 academic articles of 9,603 found on EBSCO). The descriptor “knowledge building” accounted for 2% (20 out of 908), and the descriptor “knowledge creation for 1.8% (18 out of 996).
2. Identification of relevant meta-analyses conducted by Canada-based researchers

To explore further the presence of Canada-based researchers within the international production of knowledge and examine the Canadian research capacity on the ways of learning identified in this review, we searched for relevant meta-analyses.

Meta-analyses is a methodology at which researchers from Concordia University, Montreal, are highly performing. Going back to 1999, twenty-four (24) relevant meta-analyses were identified\textsuperscript{16}, and they revealed that 20% were conducted by Canada-based researchers, all related to Concordia University — 33% were conducted at the post-secondary education, 16.6% at the K-12 level, and 11% at both levels.

Here are the details:

2.1 Meta-analyses regarding post-secondary Education


2.2 Meta-analyses regarding K-12 Education


\textsuperscript{16} Meta-analyses conducted by Canada-based researchers are identified with the asterix *. 

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3. **Meta-analyses regarding K-12 Education and Post-Secondary Education**


3. **Identification of handbooks in relevant fields**

We considered handbooks as another indicator as they are major contributions in a field and related fields. Not one Canadian researcher was involved as editor or co-editor of the following handbooks:


We looked at the tables of contents of the nine (9) handbooks in order to identify Canadian researchers having written a book section or a chapter, and found Canadian contribution percentages ranging from 2% and 18%.

Here are the details:

- **Handbook of neuroscience for the behavioral sciences**: The chapter “Neuroanatomy/ Neuropsychology” was written by B. Kolb & I. W. Whishaw, U of Lethbridge; the chapter “Varieties of attention” was written by Amir Raz, McGill U; the chapter “Reasoning and problem solving” was written by V. Goel, York U (three of 66 chapters).

- **The international handbook of collaborative learning**: The chapter (one of 28 chapters), “Metacognition and Computer-Supported Collaborative Learning” was written by P. Winne (SFU), A. Hadwin (U of Victoria), & N. E. Perry (UBC).

- **The Routledge International Handbook of Lifelong Learning**: The chapter “Literacy and lifelong learning” was written by P. Bélanger, UQAM; the chapter “International aid and development” by C. Dragne & B. L. Budd, U of Victoria; the chapter “Sociology” by K. Rubenson (UBC); the chapter “Economics” by H. G. Schuetze also from UBC (four chapters out of 45 chapters).

- **Handbook of research on learning and instruction**: The chapter (one of 22 chapters), “Learning mathematics” has as second author Indigo Esmonde, U of Toronto.

- **Handbook of research on educational communications and technology**: The chapter “e-Books for Educational Uses” was co-written by A. L. Davidson and S. Carliner from Concordia U; the chapter “Adaptive technologies” by S. Graf & Kinshuk from Athabaska U; the chapter “Technology-Based Instructional Design: Evolution and Major Trends” was written by G. Paquette, Télé-université du Québec (three out of 74 chapters).

- **International handbook of information technology in primary and secondary education**: The chapter “Use of Wireless Mobile Technology to Bridge the Learning Divide” was written by M. Ally, Athabasca U; the chapter “Gender and Information Technology” by E. D. Looker, Mount St-Vincent U; the chapter “Multimedia Cases, Teacher Education and Teacher Learning” was co-written by J. Wallace & E. Pedretti (2nd and 3rd authors), OISE/UT; the chapter “Meeting the Learning Needs of All Learners Through IT” was co-written by J. Treviranus & V. Roberts, U of Toronto. The section IT and the digital divide was co-edited by T. Laferrière, Université Laval (six out of 75 chapters).

- **Handbook of self-regulation of learning and performance**: The chapter “Cognitive and Metacognitive Factors in Self-Regulated Learning” was written by P. Winne, SFU; the chapter “Investigating self-regulated learning using in-depth case studies” by D. L. Butler (UBC); the chapter “Studying self-regulated learning in classrooms” by N. E. Perry & A. Rahim (UBC); the
chapter “Socially-shared regulation of learning” by A. Hadwin and M. Miller, 1st and 3rd authors (U of Victoria); chapter “Use of hypermedia to assess and convey self-regulated learning” by R. Azevedo who recently worked at McGill for a couple of years (five out of 28 chapters).

4. Identification of special issues of scientific journals with a substantive presence of Canada-based researchers

To pursue our exploration of the existing Canada research capacity while accounting for the fact that Canadian scholars publish in academic journals that are from outside Canada, we looked at special issues with some link to the three suggested ways of learning.\textsuperscript{17}

We went on EBSCO (same four databases), and identified 2103 special issues related to learning and technology, published within the 2000-2014 period. As for the same time period, CBCA Complete had 51 (2.4\%) special issues when we searched with “learning” as single descriptor. On FRANCIS no special issue was identified. Closer examination, cross-referencing with descriptors such as “telelearning”, “learning technologies”, “flexible learning”, “open learning”, networked learning” and “connected learning” and direct searches into, for instance, Francophone journals, suggested the following four distinct categories of results:

Fourteen (14) special issues edited, in all cases except one, by Canada-based researchers. These issues were published in Canada-based journals, and included articles written, except in one case, by Canada-based researchers:


- *International Review of Research in Open & Distance Learning* (2008), vol 9(1). “Role of Distance Learning in the Right to Education”. Editor B. Spronk (Athabasca U) (1 article out of 7 by Canada-based researchers).


\textsuperscript{17} The *International Journal of Computer-Supported Collaborative Learning (IJCSCL)* (impact factor 1.7 (2012), ranked 17 out of 219 in subject category Education and Educational research, Journal Citation Reports® (JCR), Thomson Reuters) has no special issue, and neither the *Revue internationale des technologies en pédagogie universitaire*, a Canada-based Francophone journal, edited by a Canadian researcher, T. Karsenti.

\textsuperscript{18} The *International Review of Research in Open & Distance Learning* is the only scholarly Canada-based journal part of JCR. Within the category Education and Educational research, it has a 0.60 impact factor (2012), ranking 103 out of 219.


Nine (9) special issues in journals outside Canada, edited by Canada-based researchers, and with articles by Canada-based researchers:


• Internet and Higher Education (2013), vol 18 (July). “Blended learning policy and implementation: Introduction to the special issue”. Editor R. Owston, York U (2 articles out of 9 by Canada-based researchers). (2.01 impact factor (2012), rank 15 out of 219 in JRC’s subject category Education and Educational research)

• Éducation et francophonie (2013, 41(1). TIC et éducation : avantages, défis et perspectives futures. Édité par T. Karsenti (U de Montréal) & S. Collin (UQAM) (10 articles out of 11 by Canada-based researchers)

• American Behavioral Scientist (2013), vol 57(10). Introduction to the Special Issue on Learning Analytics. First co-editor, C. Haythornthwaite, UBC (2 articles out of 9 by Canada-based researchers). (0.62 impact factor (2012), rank 46 out of 92 in JRC’s subject category United States: Social Sciences, Interdisciplinary)


Special issues in journals outside Canada, with articles by Canada-based researchers:


Special issues in journals outside Canada with no Canada-based editor or writer:

- **Research & Practice in Technology Enhanced Learning** (2013), vol 8(2). “Practical applications of mobile and Internet educational games”. (0 article out of 6 by Canada-based researchers).


- **Journal of Computer Assisted Learning (JCAL)** (2013), vol 29(1). “Knowledge transformation, design and technology”. (0 article out of 7 by Canada-based researchers). (1.63 impact factor (2012), rank 20 out of 219 in JRC’s subject category Education and Educational research)

- **Journal for Educational Research Online** (2011), vol 3(1). “Technology to enhance learning: Problems and promises”. (0 article out of 5 by Canada-based researchers). (0.91 impact factor (2012), rank 78 out of 219 in subject category United States: Educational research)

- **Computer Science Education** (2009), vol 19(4). “Web-based technologies for social learning in computer science education”. (0 article out of 6 by Canada-based researchers). (No JCR ranking)


- **British Journal of Educational Technology** (2006), vol 37(6). “Collaborative e-support for lifelong learning”. (0 article out of 7 by Canada-based researchers). (1.31 impact factor (2012), rank 37 out of 219 in JRC’s subject category Education and Educational research)

- **Instructional Science** (2003), vol 31(1-2). ”Advances in Research on Networked Learning”. (0 article out of 6 by Canada-based researchers).


In short, this search identified a total of 24 scholarly journals’ special issues related to the three ways of learning retained in this review, and 13 (54%) of them had at least one article written by a Canadian researcher. The highest proportion of publications by Canada-based researchers (52%) is found in the special issues published in Canada-based journals and edited by Canada-based researchers. In
special issues of journals based outside Canada, also edited by Canada-based researchers, the proportion is 42%. It is of 17% when at least one article from a Canada-based researcher is included in a special issue edited by a non Canada-based researcher and published in a scholarly journal from outside Canada.

All the JRC-referenced journals mentioned in this search are in the first half of the ranking system (N=219). Half (4 out of 8) special issues, inclusive of articles by Canada-based researchers and edited by Canada-based researchers in journals from outside Canada, are JRC-referenced journals. The Canada-based *International Review of Research in Open & Distance Learning*, that produced over half of the special issues edited by Canada-based researchers and published in Canada-based journals, is at rank 103 (out of 219). For comparative purposes, the highest ranked journal is *Computers in education* (2.77 impact out of 219 (rank 7 under the subject category Education and Educational research). In this journal, Canada ranks #8 (out of 20 countries) with 43 primary authors having written in this journal over the past five years — United States is #2 with 168 authors, and #1 is Taiwan with 245 authors. For the 2002-2014 period, the journal produced 15 special issues, and Canadian researchers were five (5) involved in the writing of two articles out of 180 articles (1%).

5. Mapping the research activity in British Columbia, Alberta and Quebec

The last operation conducted for assessing the research capacity on ways of learning was to relate suggested future research contributions with the research activity of a subset of Canadian provinces’ research chairs, centres, university-based individual researchers, and other organizations. The original intent was to map the research activity from all provinces. The Google search engine was used to make an initial survey using the keywords “learning technologies” and “Canada”. The first twenty results were scrutinized and categorized by province and type of result (research chair, researcher, research center or organization). Universities’ websites were reviewed as they provided the most relevant research activities. It was time consuming and, after mapping the research activity in British Columbia and Alberta, we decided to map the activity in Quebec while leaving open the possibility of doing the same with regard to Ontario if time permitted.

The mapping of the research activity in the three provinces serving as evidence — see the Complementary document— and the author’s knowledge of research activities conducted in Ontario and elsewhere in Canada suggest the following remarks:

- There is a substantive number of Canadian researchers aware of the affordances that the tools and resources of the digital era are bringing to learners.
- There are Canadian researchers engaged in relevant research activity regarding ways of learning.
- There are Canadian researchers expressing interest in and/or conducting research activities that could match the research agenda suggested in this review.
- SSHRC’s funding (NCE, Research Chair, INE, individual grants) has empowered researchers to conduct socially and scientifically relevant research activity regarding Challenge 1 of Imagining Canada’s Future.

In a condensed form

Five (5) indicators were used for assessing the Canadian research capacity on ways of learning in (higher) education:

**Indicator 1**: The search within the CBCA database reported 3% of all scholarly (peer-reviewed) articles in the area of e-learning and 1.8%-2% of those having to do with knowledge building or
knowledge creation. This first operation seized partly the scientific production of Canada-based researchers as many of them publish in scholarly journals based outside Canada.

**Indicator 2:** The search regarding meta-analyses revealed that 20% were conducted by Canada-based researchers, all from Concordia University.

**Indicator 3:** The search for handbooks edited or co-edited by Canada-based researchers led to zero results. Looking into the contents of the nine (9) handbooks it was found that the contribution of Canada-based researchers having written an article in a specific handbook ranged from 2% to 18%.

**Indicator 4:** The search for articles related to the three ways of learning, written by Canada-based researchers in 24 scholarly journals’ special issues led to the finding that one such article or more were included in half (545) of the special issues.

**Indicator 5:** The mapping of Canada-based researchers from three provinces revealed impressive interest in and research activity on ways of learning with (new) technology, and related topics.

One point of attention is that most established Canada-based journals, likely the ones that receive SSHRC’s funding, include a very low level of articles pertaining to ways of learning with (new) technology (e.g., *Canadian Journal of Education/Revue canadienne de l’éducation, Revue des sciences de l’éducation, McGill Journal of Education, Alberta Journal of Educational Research*).

Another point of attention is the fact that on the international scene, the research capacity is also expanding. In this review Canadian authors, identified with an asterix (*), represent 15% of the References section (23 out of 158 references). Though this is not a low percentage given that the number of internationally known researchers and the estimate that 90% of all North-American research and beyond is produced in the United States, it remains that, while conducting this review, we developed a sense of a lack of Canada-based leading-edge research. And we all know that this may impair innovation.
Appendix B


- **Moving from thinking about expertise as something an expert “knows” and can articulate, to a complex mix of tacit (i.e., non-conscious) and conscious competencies:** This evolution has major consequences both in how we identify critical competencies that experts exhibit, and in how we design instruction to reach those competencies. Simply asking experts to “teach” whatever comes to mind, whether in an online format available to millions or in their own classrooms, is not enough to efficiently bring many students to expert performance levels.

- **Moving from knowledge and skills localized in a student’s mind to distributed understandings and performances:** Our understanding of expertise has expanded from something “stored in the head” and documented by its retrieval in sequestered testing to instead include a collection of elements accessible via technologies (such as mobile devices, search engines, and augmented reality) that enable finding necessary information rather than remembering it. Mastery involves decisions about when to make use of such resources as well as when these are not sufficient. Understanding how to apply distributed knowledge and skills in real world and novel contexts therefore requires demonstrations via sophisticated, authentic performances adapting to complex situations, rather than traditional rote recall of a small amount of what experts comprehend and do in routine situations.

- **Moving from a focus on memorizing and applying facts, simple concepts, and straightforward procedures to “higher level” conceptual and analytical capabilities deployed adaptively in diverse contexts:** By increasing the accessibility and affordability of experiences with higher level problem-solving, complex decision making, and learner-based experimentation and exploration, technology-based instruction and practice substantially increases opportunities for learners to focus their attention on the conceptual and analytical capabilities that underlie the deep understanding, retention, and transfer of learning needed to deal with life-long, real-world applications. These capabilities are key to the development of expertise and promotion of innovation that, in turn, lead to an expanding economy prepared to meet the many rapidly evolving science and technology challenges of the future.

- **Recognizing how, beyond the conceptual and procedural aspects of learner competencies that are often described as “cognitive,” complementary aspects of learner competencies, so-called “non-cognitive factors,” are instrumental to successful postsecondary learning, work, and citizenship.** Extensive research from social and developmental psychology has documented how learner orientations such as persistence grit, engagement, “mindset” about intelligence (as either improvable through effort or as a non-malleable personal attribute), stereotype threat, and related constructs are consequential for learning.