

# Digital Skills as the Foundation to a National Digital Economy Strategies

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## Abstract

Countries around the world are developing strategies to position themselves for the “digital economy” and ensuring citizens have appropriate “digital skills” is considered critical to their full participation. While the term “digital skills” is widely used, there is no common understanding of what this means or its implications to post secondary education in information systems. This paper explores the ways in which digital skills are conceptualized, measured and promoted, based on a large-scale review of international literature in French and English. Using textual analysis tools and well-established approaches to meta-analysis, two sets of standardized search terms were used in database and general search engines to collect academic articles and grey literature in both English and French. More than 3000 documents were systematically analysed and synthesized to examine the ways in which digital skills are defined and to discuss the implications of this to post secondary information systems education.

## Introduction

In its recently released digital strategy, the Government of Canada (2010) has identified four dimensions: the use of digital technology to fuel innovation, increasing access to that technology by building a comprehensive digital infrastructure, growing the information and communication technology (ICT) industry, and increasing digital content creation. But as the Media Awareness Council (2010) notes, investments in digital literacy programs and skills development may cost ten times as much as the technological investment in infrastructure. Almost one hundred countries around the world have developed similar strategies. While virtually all the strategies stress the importance of developing digital infrastructure (typically broadband internet access), less than half of them explicitly mention the need to develop digital skills (Cukier, et.al. 2010) even though . However, few of these have explicit definitions of what they mean by digital skills. (Cukier, et.al. 2010). While virtually all the strategies stress the importance of developing digital infrastructure (typically broadband internet access), the evidence is clear: increasing access to information and communications technology (ICT) and digital infrastructure does not guarantee usage. Boothby et al., (2010) suggest that technology adoption by both consumers and organizations is driven by training and skills development. In other words, digital skills, arguably, must underpin any digital strategy.

For more than twenty years there have been discussions worldwide about the information systems skills shortages. Historically these definitions have focused on shortages of engineers and computer scientists but more recent discussions have broadened the definitions to include a wider range of skills (Valliancourt, 2003; Wolfson, 2003; Gunderson et al., 2005; Luftman,

2008). However, in spite of the considerable discussion of these issues, it is apparent that there are major differences in how these skills are to be defined, measured and advanced.

### Methodology and Approach

Our methodology included textual analysis tools and well-established approaches to meta-analysis. Our corpus is comprised of academic literature as well as grey literature, or reports produced by governments and industry associations.

We began our project by searching for documents and compiling them in a database. To ensure standardized results, we consistently used the Boolean search string “(*digital* or *ICT* or *information technology*) AND (*skill\** or *literac\** or *e-Skill\**)”. We searched four databases – Academic Search Premier, CBCA Complete, ProQuest Research Library, and Web of Science – for English language documents. These searches produced 18,452 non-unique documents. To identify French language documents, we again used a Boolean search string: “(*numérique* or *TIC* or *technologies numériques*” or *technologies* or *fracture numérique*” or *didactique l’Information*)” AND (*alphabétisation* or *compétence* or *habileté*). We searched selected academic databases (ProQuest Theses and Factivia) as well as the federated search engine Google Scholar, creating a database of 1,892 unique results. In total, our database of French and English documents consisted of 20,344 non-unique results. The databases were then scrubbed to remove all duplicate results, leaving us with 17,488 unique results in both English and French. From this, we systemically coded the results, eliminating all non-relevant documents, and were left with 2,829 academic articles in both French (1,892) and English (937). A table representing these findings, by year, can be found below.

**Table 1-0: Article Search Results Summary, by Year and Relevance**

	1980-1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010-2011	Total
<b>Relevant</b>	312	88	97	113	112	180	208	324	244	426	387	238	2,829
<b>Non-Relevant</b>	3,399	706	837	823	838	1,046	1,177	1,338	1,446	1,681	1,378	887	17,448

We then searched grey literature for relevant documents and examined digital economy strategies from over 100 countries; only 81 international, national, and regional reports were used in our analysis. In total, we systemically reviewed 3,017 documents in both French and English from both academic and non-academic sources. Table 1-1 illustrates the breakdown of the reviewed literature.

**Table 1-1: Total Relevant and Unique Documents**

<b>Academic Articles</b> <i>French: 937, English: 1,892</i>	2,829
<b>Grey Literature</b> <i>International Strategies: 81, Digital Economy Consultation (Canada): 107</i>	188
<b>Total:</b>	3,017

## Definitions of Digital Skills:

Based on our review of the grey literature and the academic literature it was apparent that there was a lack of a standardized definition of digital skills. Most often, digital skills are defined as basic literacy skills needed to access digital technology but access is not enough; it is also important to ensure that the population have the skills needed to navigate and interpret the information that they access (George, 2004). The Educational Testing Service (ETS) (2007) defines digital skills as the ability to access, evaluate, manage, integrate, and create information using digital technology. However, some definitions (Bresnahan et al., 2002) of digital skills include progressive categories of skills and abilities and, at each stage, there is an increase in the level of required technological expertise and complexity. The European Commission differentiates among digital literacy, digital management, and specialized or deep ICT skills using such categories (Ala-Mutka, 2009). Based on our extensive systemic review of the grey literature on the subject, we have summarized the definitional categories of digital skills in Table 1-2.

**Table 1-2: Overview and Definition of Digital Skills Categories, Grey Literature**

Skill Category:	General Definition:
Basic User Skills/Digital Literacy	Ability to use a computer and basic productivity software (e.g., word processing), access and use of the internet and e-mail.
Job-Specific User Skills	The ability to use specific hardware and software during the course of one's job (e.g., graphic design software).
Creation Skills	The ability to create new content, which can then be used and developed by others.
Deep ICT Skills	Highly specialized or advanced skills that typically result from post-secondary training.
e-Business Skills	The ability to understand and apply ICTs to business processes to improve productivity and to, ultimately, increase an organization's competitive advantage.

### Basic Digital Literacy

Similarly, our findings revealed that, while definitions of basic digital literacy vary (Danish Technological Institute (DTI), 2009), the majority of definitions of digital literacy are conceptually similar, involving three key skills: the ability to use, to understand, and to create using ICTs (Media Awareness Network, 2010). According to the ITU, digital skills are:

a skill set that every citizen needs in order to make effective use of digital media. It is the 21<sup>st</sup> century version of the 3Rs – reading, writing, and arithmetic. Digital literacy includes understanding the nature and uses of various digital media and technologies, how to communicate effectively via digital media, creativity, etiquette, safety, health, etc. (ITU, 2006)

A close examination of the various definitions two main definitional tracks: an intellectual understanding of ICTs on a larger scale and a breakdown of the definition by job skills, differentiated by levels of complexity and expertise. Some definitions of digital literacy in the

academic literature (Sharma & Mokhtar, 2005) emphasize the cognitive steps of information search and processing or on levels of interaction with the digital environment. Others emphasize other concerns, including: media and information literacy (Fernandez-Villavicencio, 2010); protection from cybercrime and cyber-bullying (Media Awareness Network, 2010); knowledge of intellectual property rights, learning ethical digital behaviour, and respecting content creators and their right to profit from ownership of their creative works (Ontario Media Development Corporation (OMDC), 2010); their inclusion in learning outcomes (Lemke, 2003); and the connection of multiple translations, definitions, and significations of literacy in other languages (Le Deuff, 2008). Based on our systemic review of the academic literature included in this study, we have summarized the definitional categories of digital skills in Table 1-3.

**Table 1-2: Overview and Definition of Digital Skills Categories, Academic Literature**

<b>Skill Category:</b>	<b>General Definition:</b>
Technological Literacy	The skills to interact with hardware and software.
Informational Literacy	The ability to access and interpret information by applying technological literacy.
Media Literacy	Skills and competencies to deal with digital media
Digital Presence	The ability to monitor and establish a digital identity, to actively define it and use it to interact with others digitally.
e-Awareness	This is related to being aware of how the world and our position in it – as a person, as part of a group, firm, institution, nation, etc. – varies because of our use of digital technologies.

Adapted from Peña- López, 2009

### **Digital Business and Technology Skills: The Hybrid Skill Set**

Beyond basic digital literacy, digital business skills include “the knowledge, skills, and personal qualities to lead and support the effective, competitive use of information technologies” (CCICT, 2010, p. 8). Research (Boothby et al., 2010) has demonstrated that organizations that invest in developing business and technology skills at the same time they invest in new technology have greater productivity gains than those who do not. Digital business skills, also called the hybrid skill set, can be conceptualized as those skills needed to facilitate and support the use of ICT effectively in business, successfully leveraging the benefits of integrating technology with business practices. Britain’s digital economy strategy describes professionals in possession of this skill set as “Technology-capable business people, who understand the strategic implications of technology and have the ability to realise its potential for business innovation, productivity, and competitiveness” (e-Skills UK, 2009).

### **Deep Technical Skills**

Traditionally, digital skills have been associated with training in science, technology, engineering, and mathematics (STEM) disciplines as previous benchmarks for assessing digital skills included measuring the production of advanced degrees in these areas (DTI, 2009). However, the traditional skill sets of ICT professionals are changing, becoming more complex, sophisticated, and specialized. Studies (Gantz, 2000; Galt, 2007; Eckhardt & Rosenkranz, 2010)

have suggested that outsourcing and globalization of traditional ICT careers is fueling demand for hybrid skill sets.

### **Creativity and Content Creation**

While Canada's consultation on the digital economy report (Government of Canada, 2010) recognizes the critical importance of digital media content creation, traditional taxonomies rarely recognize content development skills, creativity and entrepreneurial skills as components of a digital skill set and are rarely included in definitions of digital skills (e-Skills UK, 2009). However, Singapore (Asia Competitiveness Institute (ACI), 2009), like Canada and Britain, has begun to expand on their previously technology- and science-focussed definitions to include creative and entrepreneurial activities. With an increased focus on content creation, design, and design thinking, several organizations (OMDC, 2010) have identified these activities as key indicators of digital skills.

### **Innovation and Entrepreneurship**

As mentioned above, skills that encourage creativity, innovation and entrepreneurship are closely linked to those skills required for content creation (CHRC, 2009; SAT, 2010). Often developed in an experiential learning environment, inclusion of these concepts in a definition of digital skills, like those skills related to digital content creation, is extremely limited. Increasingly, there is reference to the need to promote innovation through the development of general entrepreneurial skills, the "entrepreneurial mindset" (Sexton & Upton, 1987; Henry et al., 2005).

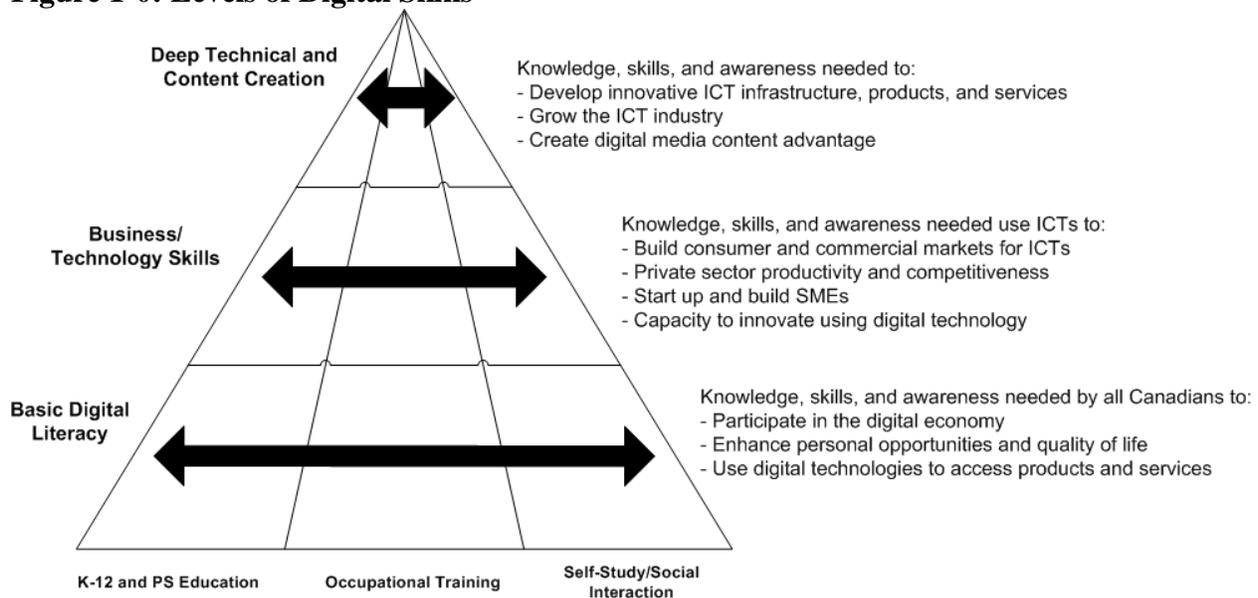
### **e-Learning Skills**

While our general focus has been on developing digital skills for ICT professionals and other workers, our review noted that digital skill development is important to support learning across disciplines. Many studies (Messmer & Schmitz, 2004; Unwin et al., 2007) indicate that lifelong digital skill training and development – from every level of education to every profession – will increasingly rest on e-learning.

### **A digital skills schema**

Based on the above research, we conclude that digital skills be understood at three basic and distinct levels: basic digital literacy that equips Canadians to participate in the digital economy; business/technology (or hybrid) skills to build consumer and commercial markets for ICTs; and deep technical and content creation skills, enabling the development of an ICT infrastructure, ICT products and services. This conceptualization is reflected in Figure 1-0 below.

**Figure 1-0: Levels of Digital Skills**



Adapted from Media Awareness Network, 2010

### **Benchmarks to Assess Digital Skills:**

A number of benchmarks have been developed to measure progress on the different dimensions of digital skills, specifically basic digital literacy and deep ICT skills.

#### **Measurement of Digital Literacy**

During our meta-analysis, we identified a weakness across the body of reviewed literature related to ICTs, the digital economy, and digital literacy: it does not address concrete ways of measuring digital literacy. We conclude that the lack of a single, unified, and internationally consistent definition of digital literacy prevents the creation of benchmarks to evaluate levels of digital skills within a population. Instead of determining skill levels within the population, there is an emphasis on measuring access to mobile and broadband technologies and frequency of use (e.g., Commission of European Communities, 2009). Further, while some data is available regarding the completion of training programs run for private citizens and within companies, there is no data on the level of knowledge retained from even the most general training course (Morris, 2006). Ala-Mutka (2009) reports that digital literacy is often benchmarked using simple questionnaires that measure usage or by self-reported data but research (van Dijk, 2006) indicates that these are inaccurate measures.

#### **Measurement of Business/Technology Skills**

Our research has revealed that a number of benchmarking studies on information literacy as it applies to the work environment have occurred, such as the one by Henrichs and Lim (2010), which measured skill levels associated with the use of Microsoft Word and PowerPoint in an organization (see also: Hohlfeld et al., 2010). The tool developed by Skills Framework for the Information Age (SFIA) (2010) measures the skills needed to develop Information Systems (IS) that make use of ICTs (see also: Huang et al., 2010). We conclude that the proliferation of benchmarking tools for the hybrid skill set is due, in part, to a fairly standardized and shared

definition of the hybrid skill set. The definition of e-business skills as “related in particular to innovation management, rather than technology-management” (Korte et al., 2007) and include the ability to apply analytical techniques; the ability to apply theoretical knowledge; effective communication skills; solving problems on a timely basis; managing risk and uncertainty, handling data gaps and conflict; facility in human relations; achieving implementation; identification of new technological opportunity; and the ability to integrate ICT with the organization’s overall business strategy (Mallick & Chaudhury, 2000).

### **Measurement of Deep Technology Skills**

Internationally, rates of deep technology skills have been historically benchmarked by measuring the production of advanced degrees in engineering and computer science or by measuring basic digital skills (ACI, 2009). In other words, the measurement of a country’s digital skills is reflective of the number of graduates from the STEM disciplines.

### **The Digital Divide**

A paradox surrounding the discussions of digital skills shortages surrounds the under-employment of high qualified internationally educated professionals. Exclusionary practices – such as failing to recognize international credentials and experience – and discrimination or bias has resulted in under-employment of Internationally Educated Professionals (IEPs) with these deep skills (Lysecki, 2006; Esses et al., 2007; Creffier, 2008).

There is also evidence of disparities among industrialized countries, there are also disparities within industrialized countries and extensive research on the “digital divide” has explored knowledge, skills, and access gap among certain groups based on:

- Geography (Noce & McKeown, 2008);
- Visible minority status (Cukier et al., 2009) and recent immigration (Esses et al., 2007);
- Gender (Messmer & Schmitz, 2004; Divjack et al., 2010; Hargittai, 2010);
- Aboriginal status (Parsons & Hick, 2008);
- Age (Marquie, 2008);
- Socio-economic status (Dwivedi & Lal, 2007);
- Disability (Vicente & Lopez, 2010); and/or
- Education (Noce & McKeown, 2008; Chen, 2010).

### **Overall Conclusions: Building the Digital Skills for Tomorrow**

Our systematic review of this literature raises as many questions as it answers. Clearly, digital skills are fundamental to a critical part of a national integrated digital economy strategy but there is little consensus on what these skills are, how to benchmark or to promote them. Different definitions of digital skills create a series of challenges in developing either a digital skills or a digital economy strategy. While historically there has been a focus on STEM education, it is less and less clear that this is sufficient. Critical skill sets such as content creation and entrepreneurial skills have been neglected despite indications that these are essential to innovation and economic development. As a starting point, we propose a framework with three distinct levels of complexity and knowledge: basic digital skills, business/technology skills, as well as deep technology and content creation skills to encompass the range of skills needed to support the development and use of advanced economy and technological infrastructure.

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