

Chapter 2

Twenty-First Century Skills and Global Education Roadmaps

The twenty-first century is characterized by its rapid technological advancement. Our lifestyles and ways of interacting with people have changed significantly as digital technologies turn ubiquitous in our life. The twenty-first century, being described by Castells (2010) as a period of intense transformation, is an unprecedented era as business operations have become so globalized that core business competencies place greater emphasis on knowledge, mobility, and collaboration (Dunning 2000). Such businesses now call for a human workforce with expert thinking and complex communication skills (Levy and Murnane 2004) as machines replace human beings in routine and manual work. Today more than ever, education plays an integral part in preparing learners to become global and conscious citizens, and also to be ready for challenges associated with the highly mobilized and technology-dominated society (Berry 2010; Castells 2005). Scholars in the field of education have thus advocated the need for modifications to be made to the education system to support the development of the requisite skills and literacies (Dunning 2000; UNESCO 2003; Levy and Murnane 2004; Pigozzi 2006; Kozma 2008; Black 2009).

A range of international, national and more localized technology and information literacy frameworks have emerged to provide outcome benchmarks for the needed curricular reforms. In this chapter, we review a number of these frameworks for the twenty-first century and digital skills that have been adopted in different education policy environments around the world. We also look at education reforms in response to twenty-first century skills frameworks put forward by various organizations. While the thinking behind such frameworks proposed is certainly forward-looking in terms of learning outcomes, our study shows that the frameworks do not give a clear indication of how such valuable skills could be attained. Similarly, policy makers who decide to incorporate twenty-first century skills education into their curricula need to back up the changes with a well-articulated execution plan. By mapping out the current landscape of twenty-first century skills development, we will see these skills have a stronger presence in curricula and that

there is an even stronger need for a detailed, well-researched approach to guide educators, school administrators, and policy makers through the intricate process of implementing twenty-first century skill education.

2.1 Frameworks Developed for Twenty-First Century Skills

Although the term “twenty-first century skills” might sound modern, some of these skills are “not new, just newly important” (Silva 2009, p. 631). Vital capabilities such as critical thinking and problem solving have always been essential. However, nowadays, because of the emergent demands of knowledge-based economies, these capabilities have gained increasing importance (Levy and Murnane 2004; Rotherham and Willingham 2009). Having said that, there are certain skills that are specific to the information era we are now living in. For instance, OECD (2004) and Pedró (2006) opine that due to the exponential growth of information any content may become obsolete in a few years’ time; continual updating is the only way to meet the demands of the twenty-first century. It is expedient that everybody needs to be prepared for and convinced of the need to be lifelong learners to keep pace with the evolution of technology (Medel-Añonuevo et al. 2001).

UNESCO’s Delors Report (1996) issued by the International Commission on Education for the Twenty-First Century analyzed the developmental trends of the century and concluded that continuing education would go far beyond what it was in 1996. Acknowledging the salience of continuing education in the twenty-first century, UNESCO recommended that education be built upon four key pillars: learning to know, learning to do, learning to live together and learning to be. These four pillars contribute to the notion of learning throughout life, which was defined as “taking advantage of all the opportunities offered by society” (p. 38). While this framework presented by UNESCO’s Delors Report was the first of its kind that puts forward the central education functions in the twenty-first century, many other frameworks have subsequently been established to suggest how education should be adapted to meet the newly arisen needs induced by fast-paced technological progress in a knowledge-based economy (Enright 2000). Almost two decades after, UNESCO revisited the issue, this time investigating how the four pillars of education (how termed transversal competencies) (UNESCO 2015) are realized in schools.

With the aim of strengthening one’s understanding toward twenty-first century skills, many frameworks have been drawn up under the support of international organizations, governments and consulting firms. Among the vast range of frameworks, three of them have been chosen to illustrate the emergence of the main ideas and notions. The three frameworks have been selected on the basis of their geographic origins and nature of their funding bodies. It is hoped that these frameworks would represent the different perspectives one holds toward

twenty-first century skills understood by both western and eastern societies, as well as by different education institutions and business corporations.

Before we embark on the discussion of these frameworks, please note that in a more general way, with reference to the capabilities that are deemed especially crucial for the twenty-first century, some organizations and scholars have been using the term ‘competency’ (Ministry of Education-Singapore 2010a; OECD 2005; UNESCO 2012) whereas others are more inclined to be using *skill* (Partnership of twenty-first Century Skills [P21] 2009; Voogt and Pareja Roblin 2010). As there is no standardized term coined for the sets of knowledge and skills induced by the twenty-first century (Ananiadou and Claro 2009), both terms are used interchangeably in this book.

2.1.1 *International Frameworks*

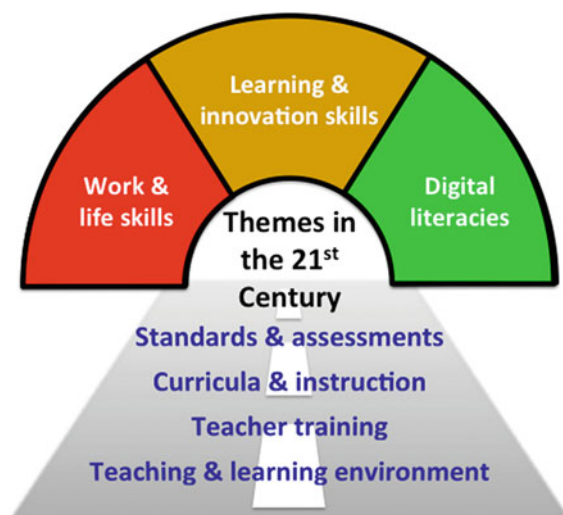
Framework based on Organization for Economic Cooperation and Development [OECD] countries (2009)

Developed by Ananiadou and Claro (2009), the OECD framework was detailed in a document entitled “*twenty-first Century Skills and competences for New Millennium learners in OECD countries.*” In an attempt to provide clear definitions and understanding of the skills and competencies related to the twenty-first century, the authors examined and critically reviewed the effects of Information and Communication Technology (ICT) on young people, together with the consequential changes in the teaching and assessment systems of some OECD countries (including Australia, Austria, Belgium, Canada, Finland, Ireland, Korea, Mexico, Netherlands, New Zealand, Norway, Poland, Portugal, Slovak Republic, Spain, and Turkey). Ananiadou and Claro also put together a framework based on the competences and skills found in those countries in relation to the role of ICT in education. The three major dimensions of the framework include (1) Communication, (2) Information, and (3) Ethics and Social Impact.

Assessment and Teaching of twenty-first Century Skills [ATCS] (Griffin et al. 2012)

The Assessment and Teaching of twenty-first Century Skills [ATCS] is an international research initiative headquartered at the University of Melbourne and sponsored by Cisco, Intel, and Microsoft (<http://www.atc21s.org>). The group aimed at identifying and helping learners acquire the necessary skills needed to be successful in the twenty-first century workplace. The research group devoted its effort to analyzing the roles of standards and assessments in promoting learning, taking into consideration the use of technology in transforming assessment systems and education. The ATCS categorized twenty-first century skills into four prime types, namely (1) Ways of thinking, (2) Ways of working, (3) Tools for working, and (4) Living in the world.

Fig. 2.1 Rainbow illustration of the partnership for twenty-first century skills framework (adapted from P21 2009)



Partnership for twenty-first Century Skills [P21] (2009)

This American organization founded in 2002 (<http://www.p21.org>), formed by business leaders, consultants, and educators, conceptualized a framework for twenty-first century skills. This framework has become well-known in the field of information technology (IT) in education (P21 2009). It consists of eleven competencies which are classified into three gist elements including (1) learning and innovation skills, (2) information, media, and technology skills, and (3) life and career skills. The framework also entails a support system that embodies standards, assessments, curriculum, instructions, professional development, and learning environments (see Fig. 2.1).

2.2 Twenty-First Century Skills in Comparison

Using a similar approach adopted by Dede (2009) who took the P21 framework as a baseline for a comparative analysis of various twenty-first century frameworks because of its detailed coverage of skill sets and wide adaptation, we attempt to discern similarities across different frameworks, and put overlapping and identical ideas together so as to provide readers with a convenient way of understanding the core ideas in these frameworks.

In Table 2.1, similar ideas from different frameworks are placed in the same row in accordance with the P21 skill sets. The first common skill set is related to Learning and Innovation skills, which include communication and thinking ability.

Table 2.1 A comparison of twenty-first century skills frameworks in accordance with the P21 skill sets

P21 (skill sets)	OECD (dimensions)	ATCS (categories)
Learning and innovation skills	Communication	Ways of thinking Ways of working
Information, media and technology skills	Information	Tools for working
Life and career skills	Ethics and social impact	Living in the world

The second shared set of skills puts emphasis on the importance of mastery of information technology (IT) skills, which involve both traditional IT skills, such as keyboarding, web surfing, word processing, and information literacy skills (IL), comprising some more advanced use of information such as searching for, evaluating and citing information found on the web appropriately and ethically. The third and last skill mentioned in all the frameworks refers to one’s general ability to live and work in the rapidly changing world of the twenty-first century. The skill focuses on the ethical aspect of citizenship, requiring people to take individual, national as well as global responsibility toward the world. It was found that all of three reviewed frameworks considered at some length similar sets of skills and competencies.

2.3 Twenty-First Century Skills in Detail

To take a closer look at what twenty-first century skills entail, Table 2.2 is an adapted version of the P21 framework with the three skill sets and twelve components laid out. While going through the book, readers may refer to Table 2.2 as frequently as needed to review the definition of twenty-first century skills we have employed.

Table 2.2 Capabilities for each set of twenty-first century skills (adapted from P21 2009)

3 skill sets	Learning and innovation	Digital literacies	Life and career skills
12 components	<ul style="list-style-type: none">• Core subjects• Critical thinking and problem solving• Communication and collaboration• Creativity and innovation	<ul style="list-style-type: none">• Information literacy• Media literacy• Information and communication technology literacy	<ul style="list-style-type: none">• Flexibility and adaptability• Initiative and self-direction• Social and cross-cultural interaction• Productivity and accountability• Leadership and responsibility

2.3.1 Skill Set 1: Learning and Innovation

The Learning and Innovation skill set includes four major components covering both knowledge and skills related to learning. “Core subjects” point to the core subject knowledge that is indispensable for all learners in the twenty-first century, which can be vaguely summarized by three “Rs,” namely Reading, wRiting, and aRithmetic. The labels of the subjects vary across different continents of the world, but the knowledge covered by them are similar in essence, encompassing knowledge in languages, aesthetics, science, mathematics, humanities, and civics.

In addition to subject knowledge, certain learning skills are deemed particularly imperative in the twenty-first century. These include critical thinking and problem solving skills, communication, and collaboration skills, and creativity and innovation. These soft skills are pivotal for learners to cope with the rapidly changing society in which human connection around the globe and the amount and availability of information are maximized by technological advancement.

2.3.2 Skill Set 2: Digital Literacies

Digital literacies are made up of three key components: information literacy (IL), information and communication technology (ICT) skills, and media literacy (ML). IL is the ability to effectively and ethically select, evaluate, and use information to gain, apply, and share their knowledge (American Association of School Librarians [AASL] 2007). ICT skills, as defined by the International ICT Literacy Panel (2002), refer to the ability to use digital technology, communication tools, and/or networks to access, manage, integrate, evaluate and create bodies of information. The third component, ML, which is interdisciplinary in nature, is associated with the ability to access, analyze, evaluate, and communicate messages in a variety of forms (NAMLE 2012).

In the twenty-first century, online information is readily available. Human life has become more closely connected by the Internet and heavily dependent on digital technologies. More and more classroom activities are now computer-based and capitalize upon the convenience brought about by the World Wide Web. It has therefore become vital for learners to acquire knowledge and skills to harness the power of digital technologies in widening their opportunities for learning, communication, collaboration and knowledge creation (Trilling and Fadel 2009).

In particular, when learners are provided with inquiry learning opportunities, it is important for them to have the IL proficiency needed to gather the information they require for further research actions, which in turn contributes to their successful mastery and construction of knowledge (Todd 2008). Moreover, ICT skills enable learners to utilize technological tools in their learning process. For example, students (especially younger ones) may need skills in using MS Excel and PowerPoint to present their project outcomes. Equally salient is ML, which allows learners to

Table 2.3 Operational definition of the components of digital literacies

Component	Definition	Example
Information literacy (IL)	Ability to recognize when information is needed, and ability to locate, evaluate and use the information effectively and ethically	Searching for information via the Internet or other sources (e.g., books, newspapers, television, YouTube)
Information and communication technology (ICT) skills	Ability to use digital technology, communication tools and/or networks, to access, manage, integrate, evaluate and create information	Using MS Excel to produce charts or histograms from a set of data
Media literacy (ML)	Ability to decode, evaluate, analyze, and produce print and electronic media	Recording and editing a music file

acquire and share information in different media forms (e.g., videos, music, podcasts). The definitions of these components of digital literacies, along with examples, are put together in Table 2.3.

2.3.3 Skill Set 3: Life and Career Skills

Life and career skills help learners cope with complex life and work environments in a knowledge-based and globalized economy. On top of content knowledge and thinking skills, learners are also expected to develop adequate soft skills that equip them with the readiness to adapt to more challenging working environments, manage heavy workload, meet stringent deadlines, as well as interact and work with their counterparts in achieving a mutually agreed goal.

2.4 A Formula of Twenty-First Century Learning

To make the core components of the P21 framework easier to retrieve, Trilling and Fadel (2009) have rearranged and condensed them into seven skills, all beginning with the letter “C” representing Critical Thinking and Problem-solving, Creativity and Innovation, Collaboration, Teamwork and Leadership, Cross-cultural Understanding, Communication and Media Fluency, Computing and ICT Fluency, Career and Learning Self-reliance, and three “R” skills referring to Reading, wRiting and aRithmetic. They have thus summed up twenty-first century learning in the following handy formula:

3Rs × 7Cs = Twenty-First Century Learning	
Reading wRiting aRithmetic	Critical Thinking and Problem-solving Creativity and Innovation Collaboration, Teamwork, and Leadership Cross-cultural Understanding Communication and Media Fluency Computing and ICT Fluency Career and Learning Self-reliance

Now that we have a common ground on what twenty-first century skills embody, we will examine the education roadmaps of various parts of the world in the next chapter, trying to align the education policies and reforms with the mentioned demands of the twenty-first century. Education systems around the world have been undergoing substantial reforms to ensure the younger generations receive training that enables them to meet the challenges brought about by technological advancements and changes in the global economic structure, and therefore play a more central part in sustaining the development of their society. In the following sections, the education roadmaps in Hong Kong, Switzerland, the U.S., and some other regions are presented to unveil some of the research-supported best practices from different education systems and to highlight lessons we can learn from current education policies worldwide.

2.5

Twenty-First Century Skills and the Education Roadmap in Hong Kong, Switzerland, and the U.S.

Table 2.4 captures the goals of the mentioned education frameworks in Hong Kong, Switzerland, and the U.S., using the P21 framework as a reference point in outlining their differences and similarities. These three places have taken different approaches to twenty-first century skills education. In the subsections that follow, we will discuss the education system of each country/region in greater detail.

2.5.1

Hong Kong

Among all the renowned education systems in Asia, we have chosen to zoom into Hong Kong for a close investigation partly due to its multicultural environment and availability of state-of-the-art technology, and also because the authors of this book have conducted extensive research in the area in relation to the key concepts explored in the chapter. Owing to its century-long colonial history, Hong Kong is one of the most international cities in Asia that combines Western and Eastern cultures in the most harmonious way. As “Asia’s World City,” the education system of Hong Kong attracts local, Mainland Chinese and overseas students with its

Table 2.4 A summary of the comparison of education roadmaps and P21 standards

P21 twenty-first century skill sets	Components	Hong Kong	Switzerland	The United States		
		EDB seven learning goals	EDK commission report	ISTE standards	AASL standards	Common Core State Standards
Core subjects and twenty-first century themes	English, reading or language arts	✓	✓			✓
	World languages	✓	✓			✓
	Arts	✓	✓			✓
	Mathematics	✓	✓			✓
	Economics	✓				✓
	Science	✓	✓			✓
	Geography	✓	✓			✓
	History	✓	✓			✓
	Government and civics	✓	✓			✓
Learning and innovation skills	Creativity and innovation	✓		✓	✓	
	Critical thinking and problem solving	✓		✓	✓	✓
	Communication and collaboration	✓	✓	✓	✓	✓
Information, media and technology skills	IT literacy	✓	✓	✓	✓	✓
	Information literacy		✓	✓	✓	✓
	Media literacy		✓	✓	✓	✓
Life and career skills	Flexibility and adaptability	✓	✓	✓	✓	✓
	Initiative and self-direction	✓	✓	✓	✓	
	Leadership and responsibility	✓		✓	✓	
	Social and cross-cultural skills		✓		✓	✓
	Productivity and accountability		✓	✓	✓	

world-class institutions, internationally recognized curricula, expertise and quality assurance mechanisms, and rigorous intellectual property protection regime (Education Bureau [EDB] 2011b).

It is stated that the aim of education in Hong Kong is “to promote students’ whole-person development and life-long learning capabilities” (EDB 2011a), which essentially aligns with the competencies denoted by twenty-first century skills (P21 2009; Voogt and Pareja Roblin 2010). Tracing back to the beginning of the

twenty-first century, the EDB (2011b) made recommendations to the Hong Kong Government for reforms to be staged in the curricula, assessment mechanisms, and admission systems at different stages of education. These proposed reforms emerged from the foreseeable needs in the changing world of the twenty-first century, with the objective of empowering the younger generation of Hong Kong with “a broad based knowledge, high adaptability, independent thinking and the ability for life-long learning” (EDB 2006, p. 3). Inquiry-based learning was, for the first time, officially introduced in the city’s education policies in 2008 (EDB 2008).

Four areas in education have been identified by the Education Commission to be essential skills that students should be able to develop and strengthen during their education, namely moral and civic education, reading to learn, project learning, and information technology for interactive learning. Seven learning goals, which are complementary to these four aspects, have been recognized as ‘the overall aim of the curriculum’ (EDB 2008) to facilitate the holistic development of students in primary and secondary education. The goals have been set on the basis of a comprehensive approach that focuses on whole-person development and include not only learning skills but personal interest and value enhancement as well. EDB goals may appear on the surface to be distinct from twenty-first century skills. However, the *expectations* of each learning goal are largely coherent with the capabilities associated with the twenty-first century skill sets.

2.5.2 *Switzerland*

In Switzerland, educational sovereignty resides with the cantons (member states), not with the federal government, so the educational landscape in Switzerland is characterized by the sovereignty of the 26 Cantons and the 4 national languages. Each Canton has its own school curriculum. Back in 2003, a project called harmoS (Harmonisierung der obligatorischen Schule: “harmonization of compulsory school”) was launched by the Conference of the Cantonal Directors of Education (EDK). The goal of the project was to establish educational standards and one national curriculum for K12 in Switzerland. The national curriculum is called “Lehrplan 21.” At the present moment 15 cantons¹ are willing to harmonize their curriculum. “Lehrplan 21” integrates the national educational objectives (educational standards), thus ensuring compatibility among the cantonal educational systems and responding to the mobility of families within the country, which is becoming an increasing reality (Amsler 2013).

One prominent benefit of the new curriculum is its skills (competence) orientation. “Lehrplan 21” describes the competencies to be attained by the end of compulsory education at the age of 16. The structure is conceptualized in three

¹A canton is a member state of the federal state of Switzerland. There are a total of 26 Cantons of Switzerland.

cycles, and for each cycle a minimal standard is defined. The rigorous formulation of competencies clearly indicates that the curricular requirements are not likely to be met simply by “covering” the syllabus in a particular subject; students should be competent in the subject matters. Being competent means having the necessary knowledge and being able to apply this knowledge in a particular situation (Amsler 2013). “ICT and Media” has its own place in the curriculum and is integrated into individual subject syllabuses. In “Lehrplan 21,” the purpose of “ICT and Media” is to be sure that learners can participate in the media society of today and tomorrow as self-determined, creative, and mature individuals, as well as behave in an appropriate and socially responsible manner. In this area, however, various issues beyond the actual curriculum still need to be resolved, such as framework conditions, jurisdiction, and (basic and further) teacher training (Amsler 2013).

Another initiative led by the Swiss Academy of Engineering Sciences targets new technologies and educational trendspotting (SATW) (Jobin and Morel 2012). SATW is recognized as the principal organization for the communication of independent, objective, and comprehensive information about technology—as a basis for the forming of well-founded opinions—and as an effective institution for the promotion of engineering sciences and new technologies in Switzerland.

Based on the key competences for lifelong learning proposed by the Recommendation 2006/992/EC of European Parliament (Europa 2006), SATW proposed a matrix of transversal competencies such as collaboration, communication, learning strategies, creative thinking, and self-reflexive methods to be applied in general education consisting of the media and ICT, health, learning in projects, democracy, society and environment, and a specific subject-based education in the following school subjects: Languages, mathematics and science, social sciences, arts, and sports.

2.5.3 *The U.S.*

The U.S. Bureau of Labor Statistics forecasts that the number of jobs in professional computing and information sciences is expected to grow at more than twice the rate of that of all positions in engineering, life sciences, natural sciences, and physical sciences by 2018 (Lacey and Wright 2009). More broadly, technology has become commonplace in U.S. workplaces and the professional sphere. Survey data from Pew Research in late 2013 shows that among a randomized sample of U.S. jobholders, 94 % use the Internet at work, representing all kinds of enterprises from technology companies to non-technology firms, from big corporations to small proprietor operations, and from those in urban areas, farms, and places in between (Purcell and Rainie 2014). Furthermore, many jobs require specialized uses of computing software, productivity tools and web services, and more and more computers are deployed to control and operate technical equipment, tools and machinery. Government officials, policy makers, education leaders, and scholars alike agree that in the midst of this global transition to a knowledge-driven

economy, there is a need for young people to be more adequately prepared during their public schooling for the use of technology. The authors of this book all share the same view. Education must extend students' learning in schools beyond reading to include inquiry, discovery, critical thinking, productivity, and innovative creation with technology, to support students' information-to-knowledge journey, and their personal, social and cultural growth as well as livelihood (AASL 2007; International Society for Technology in Education [ISTE] 2007; National Education Technology Plan [NETP] 2010).

Like many other nations, the education system of the U.S. is in many ways driven by testing requirements. Under the "No Child Left Behind" (NCLB) Act in the U.S., public education is universally available, with control and funding coming from the state, local, and federal government. Public school curricula, funding, teaching, employment, and other policies are set through locally elected school boards, who have jurisdiction over individual school districts. State governments set educational standards and mandate standardized tests for public school systems. NCLB places an emphasis on test-based assessment and school/teacher accountability within the traditional U.S. core curricular domains of math, science, English/language arts, and social studies. These testing imperatives underscore school improvement efforts, and increasingly, curriculum and day-to-day classroom pedagogy. As of late Fall 2015, NCLB was replaced by the Every Student Succeeds Act (ESSA), a new law the U.S. president Barack Obama is expected to sign into legislation. This Act shifts the fight for the survival of public education and the teaching profession to the U.S. states. States will now have wide discretion in goals and objectives, accountability, performance measurement, and handling intervention in low-performing schools. Tests will play a central role, but states will be charged with identifying other factors prioritized for learning, tailored to the localized population.

The Common Core State Standards initiative has invigorated the national discussion around curriculum reforms, and 47 states and the District of Columbia have signed on. These new national level standards include anchors for digital and information skills. To go further, the National Education Technology Plan of 2010 offers a siren call for advances in student-centered, personalized learning experiences leveraging technology affordances for teaching, learning, and administration. The Plan also calls for greater research, development, and commercialization of effective innovations to maximize learning experiences for youth (in the traditional subject domains, and, in domains not currently prioritized by the traditional canon, such as computer science/computational thinking). The Plan is worthy of investigation as it offers a roadmap for quite sweeping reforms, and was drafted by a number of innovators in education research, including several whose work is situated in the more newly emergent research discipline of the "learning sciences."

There are several notable standards frameworks that address twenty-first century skills in the U.S. The Common Core State Standards (CCSS) framework reflects the national level core curriculum in the U.S. in the subject domains of English

Language Arts/Literacy (ELAL) and mathematics. The CCSS standards attach considerable importance to the application of higher order thinking skills integrated with a range of technology tools for the development of rigorous knowledge and its application to solving world problems (CCSS 2010). Its Reading, Writing, and Research standards require that students comprehend, evaluate, and present increasingly complex information, ideas, and evidence through reading, listening, and speaking as well as through engagement with information technology and media in all its forms (CCSS 2010). Two other associations, the International Society for Technology in Education (ISTE) and American Association of School Librarians (AASL), issued standards in 2007 for digital and information literacies, which include outcomes specifically related to creative technology uses and dispositions for productivity with technology tools (ISTE 2007; AASL 2007).

2.6 The Need for an Inquiry-Based Pedagogical Approach

In the beginning of the chapter, a comparison of various twenty-first skills frameworks indicated that they vary across international contexts but, on the whole, present commonalities that can be cross-referenced. We then highlighted a prominent model for twenty-first century skills developed in the U.S. (namely, P21 etc.) and used this framework as an anchor to juxtapose skill dimensions that have been developed and disseminated as learning goals in other international contexts. In 2.4, we discussed educational reforms in Hong Kong, Switzerland, and the U.S. Reforms in all three places make reference to twenty-first century skills, although under different models or frameworks. It would thus be appropriate to say that policy makers generally recognize the importance of such skills in one's learning process and in the workplace.

One limitation of the twenty-first century skills models is that while they specify prioritized learning objectives, they do not offer educators the “means” by which to achieve those articulated “ends.” School leaders, teachers, and decision-makers need to better understand “what works.” UNESCO is undertaking regional projects to assess transversal skills (UNESCO 2015). This shows the relevancy of supporting schools. Education research and scholarly publications in each of the countries and regions discussed as well as internationally support these efforts, but often lack coordination and dissemination of findings from one region to the next, across disciplines, hinders progress. This book aims to synthesize some of the literature on technology-based inquiry pedagogical approaches, with a pragmatic focus on implementation studies. Students acquire twenty-first century skills throughout the inquiry process, guided by teachers along the way (Kuhlthau et al. 2007, 2015). In Chaps. 3–5, we present empirical results from several implementation studies, and showcase the best practices for twenty-first century skills education that emerge, examining the results and limitations of each case.

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