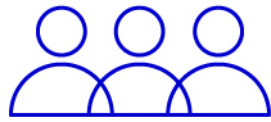# Knowledge for Network-Based Education, Cognition and Teaching

White Paper
Key competences for the 21st century

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KONECT

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Introduction

Over the past twenty to thirty years, there has been a growing concern that current education models of teaching and learning are no longer appropriate for a changing society. Since the mid-1990's, critical voices have noted that our children need improved 21st century skills. An impressive body of literature referring to this issue now exists and can be largely divided into three points of focus: the rationale underlying the need for a new model of learning, discussions regarding the specific competencies and skills needed, and the pedagogy entailed in order to stimulate those capabilities.

The project entitled Knowledge for Network-based Education, Cognition & Teaching (KONECT) aimed to explore educational needs that include and also extend beyond those that are most frequently cited as competencies for the 21st century. The most commonly cited proficiencies are often known as the '4Cs': critical thinking (often combined with problem-solving); communication, collaboration and creativity. The KONECT team recognizes these as extremely vital features for preparing children and youth for the future. These skills were implicitly and explicitly present in the first phase of the project that produced workshops, books, articles, case studies, and thematic modules created by the KONECT team and associates. These output endeavour to provide hands-on tools for educators on a wide range of 21st century educational issues, from 'Creative Inquiry' learning to critical digital media literacy and critical cosmopolitanism (all research publications, lesson plans, and other outputs are available at www.konectproject.com).

The KONECT project also had the aim of exploring beyond the more commonly accepted needs for education in the near future (there are abundant sources for ideas for these four identified characteristics). Our remit was to imagine, to the best of our abilities, what will shape society – inevitable shifts in the global social infrastructure as societies advance in knowledge – and how these changes should be mediated through effective educational perspectives and practices to ensure socially-responsible, 21st century competent citizens who can be drivers of change leading to a more equitable future society. In this second phase of the project we elicited input from a broad mix of professions and society stakeholders, resulting in trans-sectoral responses regarding future needed skills and knowledge. These data were cross-referenced thematically into the most salient issues and concepts. These were then systematically categorized to find the principal themes for this report. When writing the report we have divided the overview into two main areas: technology *and* education (Part I), and soft skills which may lead to social cohesion (Part II).

Part I. Technology and Education

In this section we have deliberately chosen the conjunction 'and' to use in our title, technology and education. Despite its unassuming simplicity, technology and education can imply many things: technology *for* education (as in specifically designed tools and resources), technology *in* education (as in the multitude of practices by both

teachers and students), technology education (as in specific courses designed to teach the use of technology for different purposes), or even technology *plus* education (as in expected and unexpected outcomes and impact therein).

There is little doubt that technology – in all of its manifestations – is a key topic in contemporary debates regarding education. It is widely accepted that students must be introduced to technology – minimally as skills to be learnt and as a means to gain knowledge – but there is also considerable talk of the need to educate children and youth about responsible use of technology, in particular social media. To be technologically 'skilled' is often perceived as a combination of actions, know-how, habits, attitudes, dispositions, and critical understandings of the roles and functions of digital media. This latter issue is sometimes referred to as 'digital literacy'. It is relevant to note that 'digital literacy' or 'media literacy' often include descriptions that encompass a wide arena of 'skills' – bringing us back full circle to a rather vague definition. Note, for example, the traits included in this definition of digital literacy.

> We define digital literacy (or, indeed, digital literacies) as a constellation of practices necessary for full participation in contemporary culture (social, political, workforce). In addition to computational skills, a digitally literate person has the capability to produce, curate, share, and critically consume and synthesize information in a variety of digital (and non-digital) forms. Moreover, digital literacy includes a person's ability to communicate ideas through multiple means of digital design and to decipher and critically reflect on mediated communication while also assessing their own ethical responsibilities in participating or sharing information. (Anderson, et al., 2017, p. 1)

Given the presumed impact of social media on children and youth, we have decided to separate the foci for this report on the role of technology in education and to refer specifically to *critical* digital literacy in this white paper (discussed in more detail in a separate section below).

Technology in education

It seems indisputable that technology transverses almost ubiquitously in everyone's lives, requiring a minimum level of skills in dealing with different devices, interfaces or apps in order to accomplish daily tasks. It is also widely accepted that education must play a role in equipping today's young citizens with the necessary knowledge required to be able to efficiently function in an increasingly technology-supported society.

Related to this is the fact that the gender gap in the technological industry is widening once more (since 2017) after a period of over ten years (since 2006), when there was a trend towards parity (World Economic Forum, 2017).

For a discussion of future competences needed for the 21st century in this white paper, we have divided the technological requisites into the following broad categories listed below. This is not an exhaustive list; the focus of this report is to introduce principal themes that have emerged as predominant concerns for education in the next two to three decades. Inevitably these categories overlap with other themes (e.g. ability to collaborate, creative thinking, problem-solving) but these competences have been widely discussed elsewhere so we focus more on the lesser mentioned ones.

> Technology and education can imply many things: technology *for* education (as in specifically designed tools and resources), technology *in* education (as in the multitude of practices by both teachers and students), technology education (as in specific courses designed to teach the use of technology for different purposes), or even technology *plus* education (as in expected and unexpected outcomes and impact therein).

Technological requisites for the 21st century:
- Basic foundational skills;
- 'Techno-collaborative' skills;
- 'Techno-creativity';
- 'Techno-social' skills;
- 'Techno-ethnic' awareness;
- 'Data literacy';
- Critical digital literacy

Basic foundational skills: the know-how needed to learn how to make use of any type of technology. This can be scaled from very basic engagement to more complex interactions with devices that are increasingly haptic – in terms of input and output, current and near future technologies will require a range of embodied, interactional skills involving touch, gesture and other psychomotor competencies, especially as 'wearable' technology becomes more easily available. Educators and policy-makers should also bear in mind that operating systems are likely to move from 'desktop' interfaces, which are more text-based and icon-based, towards more embodied interfaces.

Techno-collaborative skills: the ability to use the interconnected nature of technology (e.g. computer and digital networks) to work collaboratively with others (this may refer to both humans and machines, especially as research and use of 'big data' and 'machine intelligence' as well as 'artificial intelligence' advance and become integrated into everyday routines). Collaborating through engagement with human and non-human networks of actants will become increasingly common (Thorne, 2016).

Techno-creativity: Multitasking, re-appropriation of existing content (so-called modes of 'remixing', 'or 'mashing-up') and tenacity to continue experimenting when faced with failures (as occurs in gaming) are all key features for creative thinking and problem-solving. This category inevitably overlaps with the collaborative skills related to working creatively together with others in online contexts, and the ability to collate and make use of the collective intelligence of online groups working together (Rampton, Carlberg, Voldere & de Coen, 2017). This dovetails with general traits commonly attributed to creative thinking for the 21st century: the ability to generate and apply new ideas in specific contexts; see existing situations in a new way; identify alternative explanations; make new links that generate a positive outcome (e.g. combine existing resources and parts to form something original); reuse and/or remix existing resources to create new or more effective processes and outcomes.

Techno-social skills: 21st century civilians will need to know how to interact with many different beings and entities, some of them automated 'beings' such as 'bots', avatars, algorithms, or human assisted virtual agents (Dooly, 2016). People will need to develop new forms of 'interpersonal' skills (or perhaps we should say 'inter-being' skills) and interactional abilities in order to collaborate with (and work alongside) machines and automated systems. 'Digital citizenship' extends to include the capability of participating in online communities and belonging to a broader community that may cross many geopolitical boundaries as well as being able to build on the interconnectedness between local, national and global issues and contexts (UNESCO, 2014; UNESCO, 2015).

Techno-ethnic awareness: Children and youth need to be made aware of the fluctuating notions of intellectual property (Dooly, 2017a). They will also need to develop critical consciousness of how interaction with technology can shape their actions and identities (Helm, 2018). As technology continues to integrate with human activity across professional, educational, interpersonal, and recreational contexts, citizens will need to negotiate increasingly complex issues related to security, confidentiality and currently unforeseen ethical issues.

> 21st century civilians will need to know how to interact with many different beings, some of them automated 'beings' such as 'bots', avatars or human assisted virtual agents. People will need to develop new forms of 'interpersonal' skills to collaborate with (and work alongside) machines and automated systems.

Data literacy: There is a growing importance for individuals to know how to manage digital data,

ranging from basic concerns such as data storage and data organization to managing their 'digital identity' and 'digital legacy'. This implies understanding the consequences and permanence of data gathering, data generating and data sharing across professional and social networking sites and communities.

Critical digital literacy: Since the early 1970s, there has been a growing interest in research on the symbiosis between culture(s), individual and collective behavior(s) and the 'media environment' we live in, leading to the establishment of a niche in social sciences and humanities known as 'media studies' and perhaps more controversially 'media ecology'. As early as 1970, Postman described media ecology as a means of understanding how the different channels of communication may have a bearing on human perceptions, feelings, values and even how we 'know' things (our understanding of the ways things are). Basing his reasoning on the notion that ecology is the study of environments, Postman argued that 'media ecology' foregrounds the fact that the environment we live in includes a 'complex message system.'

Forty years after Postman's pioneering work, reports underscore how media can have an impact on our values, belief systems, behaviours and perspectives about others and ourselves. "What distinguishes recent digital technologies is their capacity to support forms of 'mass socialization'" (Broadband Commission, 2017, p. 24).

> Digital literacy is an educational expectation; it is required for all citizens, regardless of how often they communicate via digital means. Media ecologists indicate that the logic of a culture changes as its dominant media change, therefore the logic of contemporary culture is changing for everyone, regardless of media usage. (...) People act "with" technologies, and technologies act "on" people. As a result, digital literacy must be an element of all education in the same way that literacy and reasoning must be. (Anderson, et al., 2017, p. 1)

As Darvin points out in the KONECT module 1, "in 2016, the Oxford Dictionary Word of the Year was "post truth", a term that signaled how we have begun to live in an age where public opinion is shaped more by emotion and personal belief than objective facts" (2018, p. 3). As we have described above, our collective existence within a complex media ecology requires developing the ability to critically evaluate the content, point of view, and potential bias of information, a process we have termed critical digital literacy. Thus, it can be argued that critical digital literacy combines all of the previously mentioned traits: the know-how involved in interpreting and perceiving digitally generated meaning according to issue, topic, mode and context, making meaning through and with humans and technology, the ability to analyze purpose, styles, aesthetic and ethics behind digitally generation production, and, of course, appropriate and intentioned uses of technology (see Thorne, 2013a).

Recommendations for advancing technology-related expertise for 21st century skills

- Address inequality (gender, socio-economic status, etc.) related to technological careers from a very early age.
- Do not assume that children and youth are 'digital natives' who will naturally acquire foundational technology skills.
- Demonstrate and discuss with children and youth connections between their current technology skills and how they might adapt to future technological advances (e.g. shifting trends from text to touch to haptic sensors).
- Introduce multimodality for both input and production in all disciplines (see Balaman, 2018). Adding visuals to verbal (text and/or auditory) learning can result in significant gains in basic and higher-order learning (Boster, Meyer, Roberto, Inge & Strom, 2006).
- Teach students to critique and question information sources (see Darvin, 2018), including 'data-driven' answers.
- Promote telecollaborative project-based learning to assimilate negotiating skills in diverse environments (including digitally-mediated) and interaction with both machines and humans (see Dooly, 2017b).
- Introduce 'future' scenarios of technology use (presentations via webcams, interactions with avatars, etc.) in order to equip students with opportunities to predict and adapt to new environments and tools.
- Introduce more 'blended' learning opportunities, such as telecollaborative flipped classroom models (Sadler & Dooly, 2016), lectures online, project- and problem-based interaction (through face-to-face and digital interactions), telecollaboration projects that link international partners, use of technology to bring invited guest experts into the classroom, etc (see also Dooly & O'Dowd, 2018).
- Technological investment and support to ensure possibilities of connectivity of 1 to 1 devices in all classrooms, thereby promoting more interaction both inside and outside of the classroom.
- Introduce 'techno' ethics workshops to children and youth (e.g. dealing with issues such cyberbullying, data privacy, digital identities, etc).
- Embed modules for design, implementation and evaluation of telecollaborative learning projects into teacher education curriculums, including case studies of practitioner examples (see *KONECT Case Studies for Primary and Secondary Teacher Education* by Dooly & Tudini, 2018).

Part II. Education for Social Cohesion

Different from the first part of the report, this section deals with what might be seen as less obvious or 'palpable,' but nonetheless critically important competences and dispositions for the 21st century. As mentioned earlier, typically 21st century competences are considered to be related to technology and 'basic foundational skills' that afford individuals with the ability to deal with technology. These can, arguably, be quantified and measured quite easily (e.g. the student knows how to turn on a

tablet device, operate specific software, conduct basic information searches, etc). However, other competences that lead towards social cohesion, equality and a common well-being are much less tangible. Teaching and assessing attitudes towards cultural and linguistic minority populations, cultivating acceptance of the diversity of sexual identities and orientations present in all human societies, and sensitizing majority language and culture groups to the everyday challenges faced by immigrant and refugee populations are more complicated. More generally, there is a growing interrogation of current 'market-driven principles' as the only valid criteria for 'success' (individual and societal) and an emergent discourse in educational circles that promote 'intrapraneurship' (Beges, 2015) for the social sectors of society (public services, policy-administration, etc.). Parallel to this is a rising recognition that the abilities and dispositions needed to tackle life challenges must also include empathy and self-reflection. Indeed, cultivating greater empathy may be one of the greatest hurdles to moving human populations toward greater ecological awareness and openness to different cultures and belief systems, both of which influence the likelihood of the survival of our species.

"In 2016, the Oxford Dictionary Word of the Year was "post truth", a term that signaled how we have begun to live in an age where public opinion is shaped more by emotion and personal belief than objective facts" –Ron Darvin

Many studies and subsequent education policies that discuss 21st century skills mention so-called 'soft skills'. However, it is recognized that these are less 'teachable' and less measurable. Often times, soft skills are referred to as "interpersonal skills," and while these are increasingly presented as invaluable for a more socially cohesive society and more humane workplaces, defining them (and integrating them) into the curriculum remains elusive. Educators must find ways to develop children and youth's ability to recognize and acknowledge others' emotions, encourage them to value and support diversity and learn to work together with others – including individuals that they do not necessarily enjoy being with. These traits are not related simply to being 'employable' in the future. The necessity for extended interpersonal skills in all societies has been linked to not only higher employment rates but also lower percentages of crime (Heckman & Kautz, 2012).

It is also especially relevant to ensure that children and youth are able to appreciate and value diversity (for more information, see the KONECT module on gender by Vallejo and Giménez, 2018; also Helm, 2018). These values are also directly related to the discussion of the 21st century skills in part I, in particular critical digital literacy (the ability to discern fake news; understand when emotional responses are being manipulated against groups based on race, nationality, language, gender or sexuality, for instance). In turn, this 'soft skill' is directly linked to the value of integrity. Teaching children and youth *now* that valuing truth, honesty, and justice is important can help ensure that these values will form a part of the society *of tomorrow*.

Another pillar for promoting soft skills is the honing of researcher and critical inquiry skills. Soft skills such as empathy, cognitive flexibility and critical thinking are based on investigative capacities. Being able to discern fact from fiction, make in-depth

analysis of situations, evaluate problems from different angles – all of these contribute to the soft skills that are essential for getting along in the modern workplace and society in general, especially as interactions become more and more interpersonal (requiring collaboration, teamwork, interdisciplinary thinking, etc.). This is why developing children and youth into 'researchers' from an early age should be introduced into the education curriculum. There is a growing recognition that children are willful and fully capable agents in their social milieu, not merely 'partial actors' of a family or school (Christensen & Prout, 2002) and that they can be active researchers within these environs (Pinkerton, 2004; Thomas, 2017; Yamada-Rice, 2017). By engaging students in research activities, they learn how to interpret phenomenon based on data, facts and evidence; they also learn how to explain and share their experimental results. Promoting the reading of articles about new scientific discoveries in publications like *Science News for Kids* or *Science News* encourages discussion and understanding about why scientists choose particular questions to investigate, the diversity of types of studies that are carried out and the impact results from scientific studies can have on them, their families and society.

Concomitant to nurturing children and youth as 'collaborative researchers' is the need to shift towards pedagogy that champions participatory learning that engages learners as novitiates in diverse types of knowledge practices and original and innovative processes of inquiry (see Thorne, 2013b). Creativity is deeply social, with most innovative insights frequently materializing from collaborative and creative partnerships. Inevitably, soft skills are embedded in these thinking and researching processes and will be acquired in parallel.

> Teaching children and youth *now* that valuing truth, honesty, and justice is important can help ensure that these values will form a part of the society of *tomorrow*.

'Soft' skills for the 21st century:
- **Cognitive flexibility:** the ability to respond to obstacles, setbacks and challenges positively and proactively. It is also associated with the capacity to move between two different concepts, or to think about multiple concepts simultaneously (Miyake, et al., 2000; Moore & Malinowski, 2009).
- **Critical thinking:** The ability and willingness to make reliable, rational evaluations about what is reasonable to believe and disbelieve. It is also related to the ability to place emotional and intellectual distance between one's self and one's (and others') ideas (Hare, 2004).
- **Tolerance for ambiguity:** ability to exist with uncertainty, despite the discomfort of not knowing an answer, or not seeing immediately the outcome of a process. Tolerance for ambiguity requires relinquishing control to some degree.
- **Resilience:** ability to recover from a difficult or challenging situation, positively, dynamically and through a proactive response. Resilience requires a high degree of self-awareness regarding how one reacts in adverse situations.
- **Pro-activity:** ability to create or control a situation rather than simply reacting to circumstances once they have happened. Pro-activity is an action

and result-oriented behavior and involves acting in advance of a future situation.

- **Empathy:** ability to discern other people's emotions and sentiments, along with the capacity to surmise what someone else might be thinking or feeling.
- **Pro-social engagement:** Orienting a considerable portion of one's life energy toward contributing to the well-being of one's community. Increasingly, complexity models of human society illustrate that an individual's or a community's well-being is tied to the well-being of larger societal groups. Human societies do not operate on principles of a zero-sum game. Pro-social activity orients students toward helping and working with others, which ultimately creates improved social conditions for everyone.

Recommendations for advancing 'soft skills' for the 21st century

- Conduct a 'diversity' audit of the classroom, school and/or community: what identities and cultures are explicitly present? Which are missing? Why?
- Create a collaborative diversity project between teachers and students. Everyone can collaborate together to identify, critique and, if necessary, modify their own biases regarding gender, ethnicity and any other traits that can result in unequal opportunities in education.
- Ask: How can we improve the mechanics and functioning of school-based learning? Consider integrating 'gamification' into everyday teaching practices (with parental agreement and discretion in choice of gamified environments).
- Start lessons with open-ended questions. Have students write out brief responses so that they are primed to search for answers or responses throughout the instructional period.
- Allow regular, but short periods of time for 'philosophical' discussions. These do not have to end in any conclusions – thereby fortifying students' tolerance for ambiguity.
- 'Bring a question to class' day: Start each week with a special session initiated by the students themselves. These do not have to be 'deep' questions – they can be as simple as 'why are some apples green and other apples red'?
- Again, related to tolerance of ambiguity – the sessions described immediately above do not require an immediate answer. Allow plenty of time for responses to emerge; encourage diversity in the students' reasoning (to think outside the box).
- Promote 'outside' learning – encourage students to actively seek learning opportunities outside the classroom (see KONECT materials by Clark and Torretta, 2018, Sauro, 2018; see also Hellermann, Thorne, & Fodor, 2017; Thorne, Sauro, & Smith, 2015; Helm, 2018).
- Embed activities into 'content' teaching that promote critical insight into and awareness of the current responsibilities and societal roles (see KONECT materials by Moore, 2018; Zaidi, 2018; Darvin, 2018; Vallejo and Giménez, 2018).

Creativity is deeply social, with most innovative insights frequently materializing from collaborative and creative partnerships.

- Encourage students to read about current studies (e.g. *Science News for Kids*) and to brainstorm potential follow-up research for them.

Final words

Preparing today's children and youth for tomorrow's societal challenges must be a collaborative effort. Educators of today and the future must have the courage and know-how to stimulate learners' capacities to create and generate ideas, concepts and knowledge. Teachers must know how to teach self-direction, collaboration, creativity, and innovation through inquiry-based, experiential work. Policy-makers must critically evaluate current education institutions to verify whether they meet current expectations for equipping learners to live and contribute to the general well-being of a socio-political and economically connected world. And above all, there should be wide-scale collaborative sharing of notions of what a twenty-first century education at all levels –between teachers locally, administrators regionally, and governments nationally and internationally- can and should be.

Because learning involves identity formation across time, learning is dispositional and enmeshed with self-perception, attitudes, and ambitions that are informed by recent and more distant historical conditions. In this sense, and to a significant degree, we acknowledge that traditional approaches to school and life activity continue to be relevant. However, increasingly in the 21st century, highly mediatized cognitive and social practices emphasize new capacities. These do not necessarily replace older skills, rather they join them as high frequency and high stakes abilities and even in some domains have become dominant and essential. Educationally enhanced critical digital literacy instruction can be used to recognize and better understand the nuances and complexities of mediated communication and learning that will help to enable full participation in existing and future communities of practice across the lifespan.

We live in a complex and changing world in which academic, professional, and everyday life activity increasingly illustrates the need for adaptive problem solving and communicative abilities in intercultural and plurilingual contexts. These late modern conditions articulate closely with what KONECT project members see as the primary goal of robust approaches to 21st century education – to cultivate learning conditions under which individuals and communities build the capacity to contribute to processes of problem solving, meaning making, and collaboration for mutual benefit within and across world regions and diverse cultural and linguistic practices.

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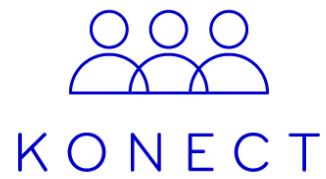
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Knowledge for network-based education, cognition & teaching: Key competences for the 21st century. KONECT white paper
by Melinda Dooly & Steven L. Thorne