● Introduction: More pro-human than anti-machine ●

Since the late 90s progressive politicians and activists have been placing their faith in the utopian promise of the Internet as a democratizing force. But the erosion of privacy caused the age of innocence to be left behind. Even the most enthusiastic were dismayed to discover the expansion of the "State of Mass Surveillance" and the role played by a limited group of large corporations engaged in the business of digital communication. The irony reportedly lies in the fact that the information and communication technologies (ICTs) that enabled individuals to organize demonstrations against the state could also enable governments to spy on their citizens.

Today's technological scenario is very different from that in the '90s. At present, techno-scepticism coexists with techno-enthusiasm. Brynjolfsson & McAfee (2014) tell us about a different stage of technological transformations that they call the "new machine age," alluding to the rapid expansion of artificial intelligence with an increased ability to recognize and interpret languages and understand patterns and symbols.

The authors predict that the next technological breakthrough will leave some people – perhaps many people – behind. They state that there has never been a better time to be a worker with special skills or the right education, because these people can use technology to create and capture value. However, there has never been a worse time to be a worker with "regular" skills because computers, robots and other digital technologies are acquiring these skills and abilities at an extraordinary rate.

Artificial intelligence brings closer the possibility that machines could learn and also teach themselves. The more data and processing time used, the better the results.

All of this happens at a time when citizens use social networks with unbridled enthusiasm to (over) expose large volumes of information about their habits, interests, interactions and relationships to acquaintances – or strangers. This phenomenon is occurring at an increasingly fast pace in a growing sector of the population in both developed countries and the rest of the world (Howard, 2014).

Today, Levy & Murnane´s (2004) question is more than justified: How does computerization affect the tasks performed by people and machines? If machines now learn, it seems appropriate to ask oneself the following questions at the education level: What should we teach those who are not machines? Do the meaning of learning and the value of knowledge change?

Morozov (2014) coined the term "solutionism" to refer sarcastically to those who see technology almost as a religion. The idea is that every social problem has a technological solution and therefore, according to this view, it would be enough to use new technologies to address the shortcomings and problems existing in the world, and education would not be the exception to the

rule. Among the techno-sceptics are those who stress the need to recover the value of what is human and argue for the need to stop and reflect on today's technological frenzy. One of the major criticisms levelled is the fact that many of the fashionable innovations are primarily designed to solve problems in the most economically developed countries. One of the big concerns is that machines could soon know more about us than we know about ourselves (Youyou, Kosinski, & Stillwell, 2015).

Where does the human aspect fit in this digital avalanche? The most critical voices (Keen, 2015, Lanier, 2011, Turkle, 2015) suggest that as individuals we have now become mere content, rather than true creators of value. We are simply a set of data, they suggest. Carr (2014) points out that a new form of "digital paternalism" is gaining ground, which suggests that people are no longer able to think for themselves or behave themselves. Today it seems that wisdom lies in algorithms. If we keep up this techno-utopian vision - the author warns - some will soon think that the best way to put an end to human error is by avoiding the mediation of people. The irony is that learning involves processes that are not necessarily efficient; they are often slow or simply contemplative.

Today it is necessary to reinvent the Internet and the way we use it. But this discussion cannot be restricted solely to the hands of computer scientists and related communities. The world of education and many other sectors linked to the intensive use of knowledge are also expected to reflect on these challenges and questions posed by this changing landscape (Achenbach, 2015).

Along these lines, Siemens (2015) criticizes the fact that educational technology is not becoming more human; but it is making humans more technological.

He states that it is time to say goodbye to techno-solutionism, which represents people as agents within a scheduled infrastructure. To do this, he argues that it is necessary to focus on technology that contributes to humanization, not just the reduction of people to algorithms and behavioural patterns.

Current societies are what they are, largely, as a result of today´s increasing technological boom. However, the challenge today involves avoiding both fanaticisms and reductionism. No solutionism, no radicalism of any kind, but also no platitudes. The challenge is about moving cunningly across the various perspectives, never suggesting that the technologies themselves are the solution to every problem, and staying away from apocalyptic approaches that frown upon any device that requires electricity to process information. However, just saying that technologies are not the answer to everything is hardly a contribution. The challenge lies in changing the questions and exploring possible routes.

There are some scaremongering views that suggest that the future of IT threatens to render half the population unemployed. A survey by the University of Oxford which analyzed over 700 occupations in the American market found that 47% of them are at risk of becoming computerized and automated in the next two decades (Frey & Osborne, 2013). The book you are holding in your hands – or reading on your screen – proposes a different perspective. Instead of amplifying the warning voices – which often ignore reconversion and the new employability opportunities that arise with each technological revolution – the focus here is on thinking about these challenges through education. In other words, this is about thinking of the skills and abilities that are not likely to become computerized (e.g., creativity or social intelligence).

This work does not offer a cure-all. Without resorting to facile formulae, this text presents a more thorough analysis of the challenges posed by technologies in education, and conceptual redefinitions of what knowing about and having knowledge of something means today. This analysis is not restricted to the classroom as it cuts through social life (as does our use of technology). This paper will discuss issues related to: digital citizenship; hyper-connection and self-regulation; content abundance and curation; a critical and at the same time proactive approach to understanding technologies; an emphasis on the significance of both creating content and using entrepreneurial skills in digital environments; lessons that can be extrapolated in the light of a collaborative economy, and the need to create new instruments to assess and recognize knowledge.

One of the elements that is hardest to understand, given its intangibility, is the fact that the current revolution is not a revolution of devices, infrastructure, platforms or channels of trade. Rather, it embraces a redefinition of meaning. Although what attracts much of the attention in this kind of discussion is devices, the most substantive changes are invisible. In other words, the most structural change is not related only to thinking of educators from a new perspective. It also involves thinking of trainers that are much more than technology facilitators. That is, redefining the role of teachers in a different relationship with knowledge. A different relationship from that which they were used to – and which shaped many of us. This means that the core value no longer lies in accessing or mastering some particular knowledge, but in the ability to defragment and rebuild knowledge by means of new combinations, formats and channels; a redefinition of what it means to provide and receive education. The change of value lies

in knowledge as such on account of its accelerated renewal, the abundance of existing possibilities and channels to access it, as well as the possibility of hybridizing contexts, disciplines and approaches. All these possibilities are in some way reflected in a change in the role of both the individuals and institutions that have traditionally managed knowledge.

The new knowledge is not only cumulative but it also grows exponentially. This inevitably causes us to experience rapid obsolescence processes. In this context Perkins (2014) asks the question, What is it really worth learning? How do you educate in learning to decode the unknown? To address these questions, this author suggests that it is necessary to move forward in different fields:

• Going beyond the basic skills: developing 21st century skills with special openness to collaboration, critical thinking and entrepreneurship.
• Going beyond the traditional disciplines: Stimulating and opening up to hybrid issues such as bioethics, ecology, and other challenges of our time.
• Going beyond discrete disciplines: Encouraging interdisciplinary topics and issues.
• Going beyond regional issues: Expanding the prospects and challenges of global citizenship.
• Going beyond the content domain: Developing the ability to connect content with different life situations.
• Going beyond prescribed content: Providing students with options to learn beyond what is being studied.

The current relationship between the boom in digital technology and the expansion of knowledge is not without its complex and – sometimes – counterintuitive factors. In the world of education, for instance, expectations of revolutionizing capacity-

building by incorporating technology platforms have not always gone hand in hand with better results on tests traditionally used to measure formal learning. A clear example was observed in the survey by the Organization for Economic Co-operation and Development (OECD, 2015) that analyzed technology programmes in primary schools in more than thirty countries. The report concluded that students who frequently use computers score poorly at most school learning levels.

What is to be understood by meaningful learning? What can be read between the lines of this survey? Taking into account the comments made by Perkins (2014) and in the light of the 2015 OECD report, moving towards a redefinition of knowledge must be taken as an opportunity to redesign instruments for knowledge definition (curriculum, syllabus), recognition of skills and abilities (degrees, diplomas, certificates, etc.). This involves devising new rubrics that will move from assessing the ability to memorize to an assessment of the ability to manage massive amounts of data. But it will also require much deeper changes, namely the construction of instruments to recognize different categories of knowledge, as well as traditional and non-traditional skills in order to better understand people's ability to reconfigure and renegotiate knowledge together with others - in person or online. Here, contextual or multi contextually meaningful knowledge is enriched (but not determined) by the use of ICTs.

The construction of new ways of validating knowledge must diversify (diplomas, nanodegrees, digital badges, rubrics, etc.), but it must also make us reflect on the validity and relevance of assessment and knowledge recognition tools that are traditionally used to monitor the knowledge domain.

The present seems to be the best time to rethink those traditional assessment tools currently used to assess, compare and rank education systems. Building a digital identity, the exercise of digital citizenship, the ability to generate value in the exchange of goods and online services are only some examples of the need to creatively adopt new channels, tools and devices to assess and recognize expanded knowledge and make it visible. However widespread the use of technology has become, it is still too early to understand and exploit all the information generated while individuals learn and teach online.

The incorporation of technologies by itself will not suffice to broaden the outlook. In order to move towards new ways of recognizing learning it will be necessary to develop new skills both in the educational community and the educational institutions – for example, the skilful use of data generated in education, considering its collection, analysis and interpretation. Enriched data use for decision making in the teaching process is one further layer that is added to this discussion, if well implemented it could also help advance progress towards higher levels of individualization. This would help to overcome the most conservative paradigms that impose homogeneous, static content and one single way of teaching and assessing for all. If properly implemented, it could allow us to assess the process of creating and applying knowledge in real environments and time (e.g. online communities of practice) and not just monitor whether the student memorized what they studied for the test. This means going beyond the skill of using the information.

• Book Overview•

Below is a guide to this text which outlines some of the main ideas and explorations that will be discussed. It is organized into four sections:

Chapter One: Artificial Intelligence and Technological Disobedience. It is necessary to rethink our relationship with information. The challenge today is not just about developing the ability to curate and process large volumes of data but also about laying more stress on the creation of new knowledge. The chapter describes and discusses the boom of artificial intelligence and its possible implications for the training of future generations. It raises the issue of what skills it will not be possible to replace with automated systems. It also discusses the implications of learning to programme and promote computational thinking from the perspective of both an economy of creativity and the need to dismantle the current levels of technological dependence. The section concludes by considering the significance of broadening the current discussion on digital skills and lay more stress on a meta-cognitive development of learning.

Chapter Two: Triangulation between content-container and context. This chapter discusses the premise that suggests that the more the technology the better the educational outcomes. A partial reading of the pro-technologies approach makes it seem that digital tools alone make us more creative or disruptive, apart from improving our learning. Under this assumption, investment in technologies should result in better marks. From a critical but evidence-based perspective, this chapter discusses to what extent this has been the case and what can be done about it. It analyzes the need to broaden the outlook in order to move towards recognizing alternative ways of gaining knowledge. For this purpose, the side-effects and invisible lessons generated in this pro-technology age are discussed. A presentation of the content-container-context triangulation is then followed by an analysis of why exposure to technology may not be enough to develop complex skills. Finally, the chapter discusses the need to rethink and discuss the term digital citizenship and the significance of understanding the responsibilities and opportunities behind this concept.

Chapter Three: Multiliteracies for new ecosystems of creation and collaboration. This chapter presents an analysis of the asymmetries of the pro-globalization discourse and discusses the need to move towards more inclusive ways of thinking about diversity. From a scenario of cultural openness, the concept of "Knowmad" is brought back by the need to be adaptable subjects able to operate in changing, hyper-connected environments. The chapter also stresses the importance of shaping citizens with a global conscience who are willing to learn from others and with others. Content curation guidelines are proposed for manoeuvring in spaces with an overabundance of information. The concept of "anti-

disciplinarity" is the next highlight, given the reconceptualization of the school curriculum proposed by the Ministry of Education of Finland. The chapter also explores the idea of a wiki-curriculum that recognizes those meta-cognitive skills (e.g. knowledge building) which are of particular significance for interaction in ecosystems exposed to accelerated exchanges of knowledge. It also discusses the case of a collaborative economy as a metaphor that suggests that knowledge is a matter of multiple interconnections and an option related to an education that recognizes the value of collaborative learning.

Chapter Four: **New assessment methods: pending innovation**. In keeping with the foregoing paragraphs, this chapter analyzes why the most important change is not a technological one but a change in meaning. New infrastructure not only requires new responsibilities; it also defines new scenarios to think about knowledge. This chapter illustrates, with background information, the increasing global adoption of the Internet in its first 8000 days of existence and the tensions in education resulting from the changing paradigm that suggests a sort of digitalness. After explaining the rapid obsolescence of knowledge, the chapter illustrates some of the changes in the rules regarding what we understand as learning to know. It describes the ways in which these transitions can be dealt with, both at the more institutionalized (OECD PISA[1]) and the more cutting-edge levels (connectivity). All the above are key aspects for the understanding and development of new (multi) literacies. This transition scenario requires new instruments, logics and assessment approaches that can offer a more complete, high-resolution picture of the learning that is occurring in different ways and

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[1] Programme for International Student Assessment (PISA).

contexts. The chapter finally offers seven key vectors to think of pending challenges resulting from the current transition that knowledge is undergoing in the digital age. Far from offering a cure-all, the chapter proposes critical hubs accompanied by overwhelming evidence and perspectives that enrich this analysis and offer new routes of exploration in this field.

This discussion is expected to contribute to the debate and enrich the educational processes with new questions and opportunities for both research and evidence systematization. The early enthusiasm that was aroused by the Internet and digital technologies in the classroom has evolved substantially. Yesterday's frenzy is not the same as today's. However, today we have more and newer tools and evidence to help us understand where the opportunities are. All this new scenario stands us in good stead to face the siren song that sometimes enchants those who expect radical changes merely because of an improvement in the layer of technological infrastructure.

The Internet is no longer the answer to all our questions. Now it is time to turn it into a source of new questions and reflexions on the future of knowledge.